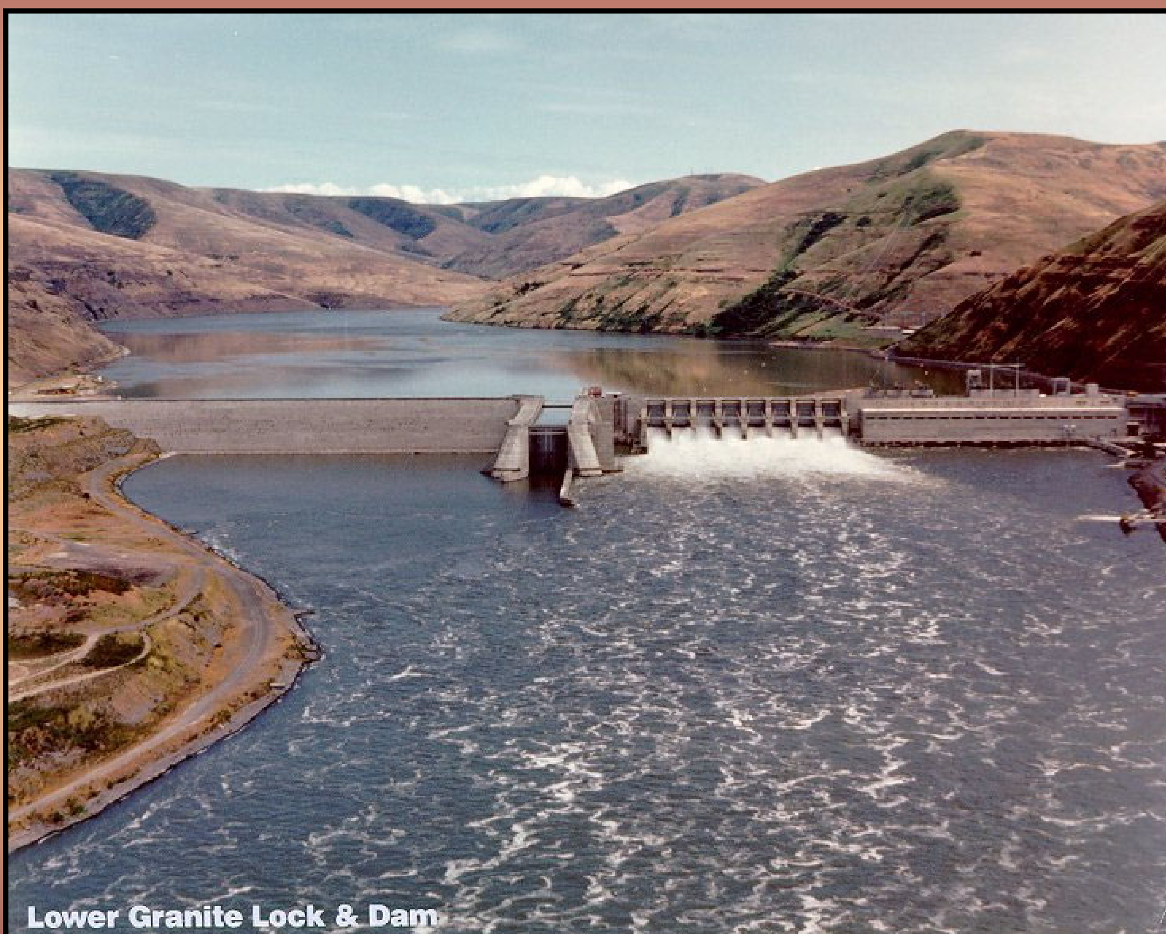
US Army Corps
of Engineers®
Walla Walla District

United States
Environmental Protection Agency
Region 10

DREDGED MATERIAL MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT

McNary Reservoir and Lower Snake River Reservoirs



FINAL
July 2002

EXECUTIVE SUMMARY

INTRODUCTION

The U.S. Army Corps of Engineers' Walla Walla District (Corps) is responsible for maintenance of the portion of the Columbia-Snake River inland navigation waterway that includes the Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs on the Snake River, and McNary reservoir on the Columbia River. The Corps maintains a 14-foot- [4.3-meter (m)-] deep and 250-foot- (76.2-m) wide navigation channel through these reservoirs, which have historically required some level of dredging. These reservoirs are part of an inland navigation system that provides slackwater navigation from the mouth of the Columbia River near Astoria, Oregon, to port facilities on the Snake and Clearwater Rivers in Lewiston, Idaho, and Clarkston, Washington.

The Corps, in cooperation with the U.S. Environmental Protection Agency (EPA), is developing a long-range plan for the maintenance of the navigation channel from Lower Granite through McNary reservoirs (see plate 1). The Corps has completed a Draft Dredged Material Management Plan and Environmental Impact Statement (DMMP/EIS) for McNary reservoir and the lower Snake River reservoirs. The DMMP/EIS evaluates the likely environmental effects of the plan alternatives on a long-term, programmatic basis. Public comments on the plan and EIS will be considered by the Corps prior to the selection and implementation of a final plan. In addition, as specific proposals to implement the plan are developed and evaluated by the Corps over the 20-year term of the DMMP, the Corps will solicit public comments on these specific proposals. This Executive Summary presents the key components of the Corps' programmatic plan for:

- Maintenance of the authorized navigation channel in the lower Snake River reservoirs between Lewiston, Idaho, and Columbia River in the McNary reservoir for 20 years after the Record of Decision (ROD) is signed.
- Maintenance of limited public facilities within the reservoirs, such as recreational boat basins and irrigation intakes for the wildlife habitat management units (HMUs).
- Management of dredged material from these reservoirs.
- Maintenance of flow conveyance capacity at the most upstream extent of the Lower Granite reservoir for the remaining economic life of the project (to year 2074).

Plates 2 through 17 provide further information on area features and likely dredging and disposal areas. Based on current information, the plates depict the sites most likely to be dredged. Not every location shown will be dredged and not every location to be dredged is necessarily shown on the plates. The size and shape of the areas are approximate and will be further defined when the need to dredge is identified.

This Executive Summary presents a description of the DMMP planning process, including: the purpose and need; the plan alternatives; the anticipated environmental effects of the plan alternatives; and the Corps' preferred alternative.

AUTHORITY

The portion of the Columbia-Snake Rivers navigation system addressed in the DMMP was authorized by Section 2 of the River and Harbor Act of 1945 (Public Law 79-14, 79th Congress, 1st Session) and approved March 2, 1945, in accordance with House Document 704, 75th Congress, 3rd Session. The projects include:

- McNary Lock and Dam (McNary) - Lake Wallula, Columbia and Snake Rivers, Oregon and Washington
- Ice Harbor Lock and Dam (Ice Harbor) - Lake Sacajawea, Snake River, Washington
- Lower Monumental Lock and Dam (Lower Monumental) - Lake Herbert G. West, Snake River, Washington
- Little Goose Lock and Dam (Little Goose) - Lake Bryan, Snake River, Washington
- Lower Granite Lock and Dam (Lower Granite) - Lower Granite Lake, Snake River, Washington and Idaho

Each of these projects is authorized to provide slackwater navigation, including locks and a 14-foot- (4.3-m-) deep channel. Additionally, although not part of the DMMP/EIS, each project is authorized to provide hydroelectric power generation, irrigation, recreation, and wildlife habitat.

The Corps study was initiated under guidance provided in Engineer Circular (EC) 1165-2-200, *Policy - Dredged Material Management Plans*, which directed the development of DMMP's for Federal navigation projects. It is the Corps' policy to manage dredged material associated with the construction or maintenance dredging of navigation projects in a manner that is the least costly, is consistent with sound engineering practice, and meets Federal environmental standards. Guidance for developing DMMP's has now been incorporated into the current revision of Engineer Regulation (ER) 1105-2-100, *Planning Guidance Notebook*. The ER 1105-2-100 also provides the requirements, as well as principles and guidelines, for conducting planning studies within the Corps' Civil Works program and ensuring environmental compliance through the planning process. Section 3-2 of ER 1105-2-100 provides specific guidance on the maintenance of navigation projects and the preparation of DMMP's. A least-cost alternative that is compliant with environmental laws forms the "base plan," against which other plan alternatives can be compared. Through the DMMP planning process, the Corps has considered a range of management strategies (including approaches to reduce the need for dredging and to beneficially use dredged materials) and has incorporated these strategies into its alternatives development and evaluation process.

In addition, on May 4, 1995, the Corps Director of Civil Works provided guidance to the Commander, North Pacific Division, by memorandum entitled "Lower Granite Lock and Dam, Washington, Sedimentation Studies Related to the Level of Protection Provided to the City of Lewiston, Idaho." This memorandum discussed a study to evaluate restoring the performance of project levees constructed to protect Lewiston, Idaho, from inundation caused by the Lower

Granite project. It states, "The study should evaluate a range of alternative risk management plans, including modifications in the operation of the project and increased dredging." In compliance with this memorandum, consideration of reestablishing the flow conveyance capacity at Lewiston, Idaho is included in the DMMP.

PURPOSE AND NEED

The purpose of the DMMP is threefold:

1) To develop and evaluate alternative programs to maintain the authorized navigation channel and certain publicly owned facilities in the lower Snake River and McNary reservoirs for the next 20 years;

2) To develop and evaluate alternative measures to maintain the flow conveyance of the Lower Granite reservoir for the remaining economic life of the project (through 2074);

3) To develop and evaluate alternative programs of managing dredged material in a cost-effective, environmentally acceptable, and, wherever possible, beneficial manner.

The Corps is authorized to maintain a navigation system on the lower Snake and Columbia Rivers and to manage the lock and dam/navigation projects (generally referred to as "projects" or "reservoirs" in this document) on the lower Snake River from Lewiston, Idaho, to the McNary Lock and Dam project at Umatilla, Oregon, on the Columbia River (which includes the confluence of the Columbia and Snake Rivers). The Corps also maintains publicly owned recreational areas (such as marinas and swimming beaches), irrigation intake facilities for wildlife HMUs and recreation areas, and port access channels within the lower Snake River and McNary reservoirs. Historically, the Corps has dredged accumulated sediments from the navigation channel and the other facilities noted above on these reservoirs in order to maintain their operational capacities. Maintenance dredging actions are in response to a variety of conditions including, but not limited to: emergency situations which would result in an unacceptable hazard to navigation; program periodic dredge maintenance of known persistent shoal areas which impede navigation; and removal of sediment that presents a hydraulic flow impediment.

In addition, sediment accumulation in the upstream reach of Lower Granite reservoir at the confluence of the Clearwater and Snake Rivers has reduced the flow conveyance capacity of the river channel. If allowed to continue, this sedimentation would reduce the flow capacity to a point that the Standard Project Flood [(SPF) an estimated or hypothetical flood that might be expected from the most severe combination of weather and flow conditions that are considered reasonably characteristic of the geographical area] could potentially overtop the levees in Lewiston, Idaho, before the end of the economic life of the project is reached in 2074. To date, dredging has been the method of choice for the removal of this sediment and restoration of the flow capacity.

LOCAL SEDIMENT MANAGEMENT GROUP

A Local Sediment Management Group (LSMG) has been formed, and has met on three occasions (July 2000, February 2001, and December 2001) to provide input and discussion in the development of the DMMP, as well as during the plan's implementation (i.e., the dredging and dredged material management activities). This group has been formed consistent with the inter-agency National Dredging Team's guidance. Roles within the LSMG will continue to develop in accordance with policies and procedures currently evolving for the Regional Dredging Team (RDT), as referred in the April 26, 2002 policy letter jointly signed by Brigadier General David A. Fastabend (Corps of Engineers Northwest Division Commander) and L. John Iani (EPA Region 10 Administrator).

The LSMG would assist in the development and adoption of appropriate method(s) for management of dredging and use and/or disposal of dredged material from Federal navigation and maintenance projects and dredging activities regulated under Section 404 of the Clean Water Act. In the formulation of these management policies, the LSMG would be asked to consider key environmental laws and regulations involved in this process; consider the responsibilities of other Federal, state, and local resource agencies; and help develop a coordination process for dredging and beneficial use of dredged material. In addition, the LSMG would assist the Corps in evaluating dredging and dredged material management activities and options consistent with an adaptive management approach.

The general objectives of the LSMG are to:

- Provide an interagency approach to dredged material management.
- Promote consistency in dredging and sediment management activities.
- Assist in development of monitoring plans and a sediment sampling and testing framework.
- Facilitate adaptive management and beneficial use of dredged materials.
- Promote consideration of all environmental laws and regulations.
- Consider necessary cultural resource protection.
- Discuss and evaluate possible strategies to reduce sediments entering the lower Snake River system.
- Involve other stakeholder groups and pursue consistency with their plans.

The Corps anticipates that the LSMG will convene regularly, either annually or semi-annually, depending on dredged material management activities. It is envisioned that the LSMG will consider proposed dredging within a given timeframe, suggest strategies to reduce dredging requirements, provide suggestions for promising beneficial uses of dredged materials, and comment on proposals for in-water habitat creation using dredged materials. The LSMG would also serve as a forum for providing suggestions to the Corps on improving the implementation of the DMMP.

As situations develop which call for maintenance dredging, the LSMG would be informed. The situations expected to cause maintenance dredging could include, but would not be limited to:

- Emergencies involving shoaled areas that pose a serious risk to navigation of commercial vessels as indicated by records of groundings, complaints by shippers, and/or condition surveys of the navigation channel.
- Programmed/periodic dredge maintenance activities based on well-established historical records of persistent shoaling in a navigation channel that could pose a serious risk to navigation of commercial vessels.
- Shoaled areas that pose a serious risk to navigation and moorage of recreational craft as indicated by comments of operators of recreational boat facilities and/or condition surveys.
- Sedimentation to irrigation intakes associated with Lower Snake River Habitat Management Units (HMU) which restricts the ability to deliver irrigation water to the HMU.
- Advanced maintenance, of a commercial navigation channel or berth which historically requires dredging to remove shoals that pose a serious risk to navigation, when an opportunity to meet a specific environmental restoration need for beach nourishment exists and/or when the dredging can be combined with other maintenance dredging to lower the cost and minimize the dredge related disturbance to transportation and local business activities.

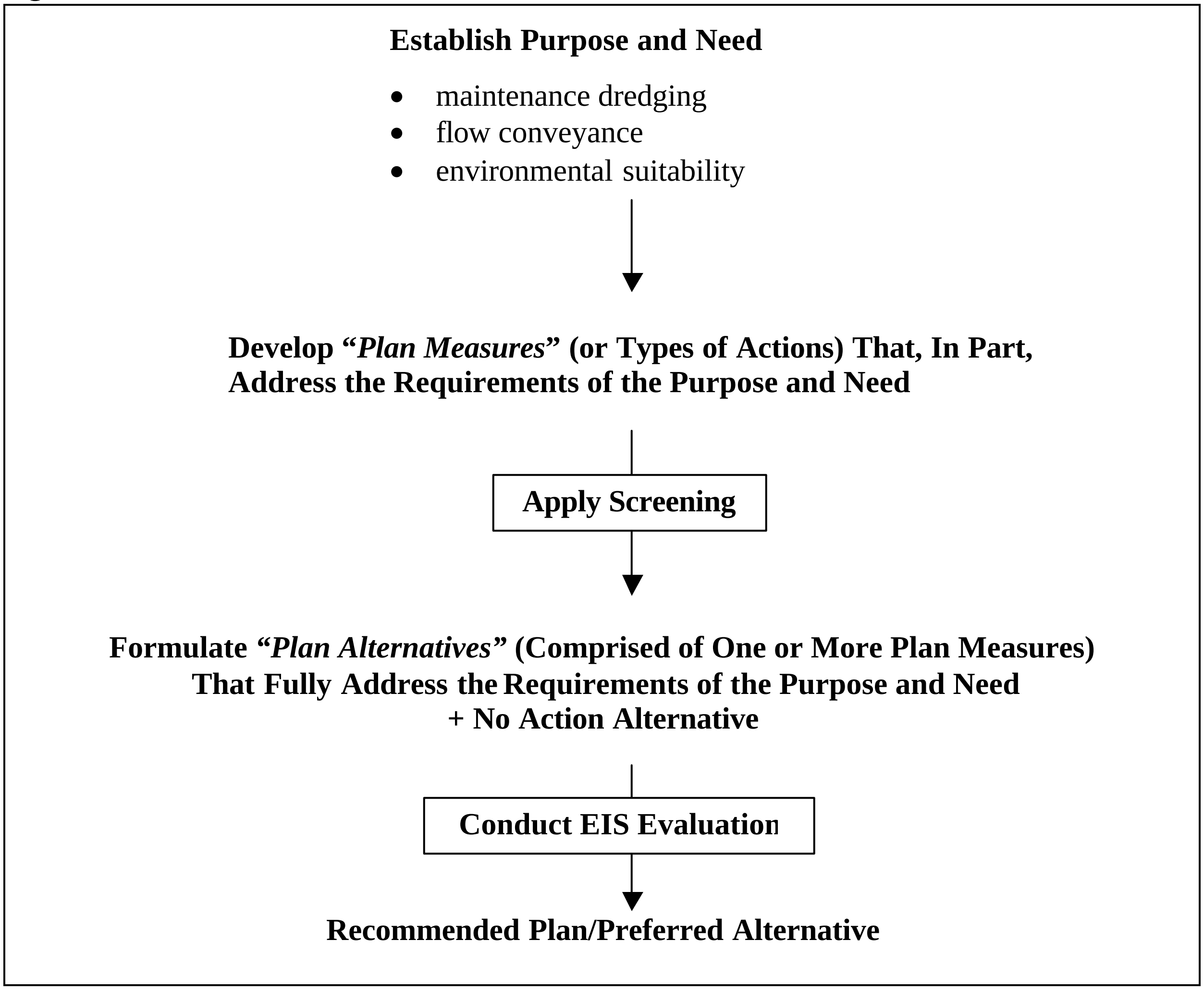
Federal and state agencies with resource management and regulatory responsibilities applicable to the development and implementation of the DMMP, and affected Native American Tribes, have been asked to participate in the LSMG. Additionally, public ports within the study area have been invited to participate in the LSMG. Other local entities (e.g., counties, municipalities, environmental groups, and transportation and industrial interests) with an interest in management of the resources involved in dredging and disposal activities have been invited to participate.

The LSMG has been identified as a forum for discussion of possible measures to reduce sedimentation in the lower Snake River system and, as such, land management and conservation agencies like the U.S. Forest Service, the Natural Resources Conservation Service, and others that may have a role in sediment reduction strategies, will be asked to participated in the LSMG.

ALTERNATIVES

The Corps of Engineers' planning guidelines and the National Environmental Policy Act require the consideration and analysis of a broad range of alternatives in the development of the DMMP/EIS. A summary of the process the Corps employed to develop and evaluate plan alternatives is illustrated in figure ES-1.

Figure ES-1. DMMP/EIS Plan Formulation Process.



Plan Measures Development and Evaluation

Initially, a broad range of measures that either partially or completely fulfilled the purpose and need were considered in the development of plan alternatives. These measures included:

- Sediment deposition reduction.
- Dredging.
- Management of dredged materials.
- Raising levees in the Lewiston, Idaho, area.

In accordance with the requirements of the NEPA, a broad range of alternatives that could potentially meet the stated purpose and need was developed. The Corps conducted public scoping meetings, consulted with state and Federal environmental and resource agencies, and conducted technical studies to develop a range of conceptual alternatives that addressed the plan's purpose and need. Multiple scenarios which included sediment deposition reduction, dredging, dredged material management, and/or levee raises were considered in the development of plan measures. A range of alternative strategies within each of the plan measures was developed and evaluated.

Sediment deposition reduction strategies that were considered included: changes in upstream land uses to control sediments entering the system; pool draw-down; in-water sedimentation controls that would prevent sediments from being deposited within the navigation channel, including Bendway weirs and "bubble curtains" around the navigation channel; and construction of upstream sediment traps.

Dredging scenarios included maintenance dredging only on an as-needed basis, dredging 300,000 cubic yards (cy) [229 366.5 cubic meters (m^3)] per year, dredging 1,000,000 cy (764 555 m^3) per year, and dredging 2,000,000 cy (1 529 110 m^3) per year. The three scenarios that included dredging beyond navigation maintenance requirements were intended to provide flow conveyance capacity in Lower Granite reservoir.

Similarly, several levee raise alternatives in the Lewiston, Idaho, area were considered. These included: 3-foot, 4-foot, 8-foot, and 12-foot (0.9-m, 1.2-m, 2.4-m, and 3.7-m) levee raise options.

Finally, a range of dredged material management options were developed and evaluated. These options included upland disposal of dredged material, in-water disposal of dredged material, and beneficial uses of dredged material. Several in-water disposal options were considered, such as beneficially using dredged sand and gravel to create shallow-water fish habitat.

The Corps may need to perform dredging on an emergency basis. Potential situations that could require emergency dredging include high flows depositing sediment that block the navigation channel or rock could be swept into the navigation lock approach posing an unacceptable navigation hazard. For an emergency dredging situation, the Corps would perform environmental coordination on an expedited basis as much as possible before initiating the emergency dredging.

An iterative screening process was developed that consisted of formulating alternatives from the most viable program measures above, evaluating each alternative and selecting alternatives for further detailed consideration. Preliminary evaluation criteria were then developed to determine the alternatives that were feasible, reasonable, and should be considered in detail. These criteria considered whether:

- The alternatives were cost-effective, while either providing environmental benefits or causing the least environmental damage.

- The alternatives provided a way to regain and/or maintain channel capacity to provide an acceptable level of flow conveyance capacity resulting in flood protection (based on the results of a risk-based analysis) in the Lewiston-Clarkston area.

- The alternatives have acceptable impacts on other project uses (such as shippers and recreational users).

Based on these preliminary screening criteria, measures that were incorporated into plan alternatives included combinations of dredging and levee raises, with consideration of upland disposal/beneficial use and in-water disposal/beneficial use of dredged materials.

A set of more detailed screening criteria were then developed to evaluate the relative impacts, costs, and/or benefits of a set of dredging and levee alternative combinations. Application of these criteria facilitated the identification of alternatives that were considered feasible, reasonable, and would be evaluated in detail. The identified alternatives are summarized in table ES-1 and presented in detail below:

Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Alternative 1 represents the continuation of historic maintenance of the authorized navigation channel in the study area. As such, this alternative includes those activities (specifically, mechanical dredging and in-water disposal) that have been performed in the recent past to maintain the authorized depths in the navigation channels of the lower Snake River and McNary reservoirs. The areas covered include Lake Wallula behind McNary Lock and Dam on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River (see plates 2 through 17). This navigation project provides for a 14-foot by 250-foot (4.3-m by 76.2-m) channel within each reservoir with at least a 15-foot (4.6-m) depth over the sills at each of the locks. This alternative would provide the authorized navigation clearance and provide some flow conveyance capacity in Lower Granite reservoir, based on maintenance dredging. Maintenance dredging would be done on an as-needed basis (possibly as often as every 2 to 3 years) and would generate up to 340,000 cy (259 948.7 m^3) per dredging activity. Additionally, dredging could only occur during an in-water work "window" approved by the National Marine Fisheries Service (NMFS). This window represents the time of year when dredging and disposal activities would have minimal effects on salmonid species. The current in-water work window is December 15 through March 1 for the lower Snake River reservoirs and December 1 to March 31 for the Columbia River. The Corps also periodically conducts maintenance dredging around public recreation areas (such as swimming beaches and boat basins) and irrigation intakes for wildlife HMU's managed by the Corps (see plates 2 through 17).

Disposal of dredged materials under alternative 1 would be consistent with disposal methods utilized during recent dredging cycles: dredged materials would be loaded onto bottom-dump barges and transported to the disposal site. Dredged materials would be sampled for particle size and sediment quality prior to dredging. Historic testing for sediment quality has indicated that dredged sediments are suitable for in-water disposal. As such, fine-grained materials (i.e., silts) would be disposed in deep-water areas and sand, gravel, and cobbles would be used to create shallow-water fish habitat within the study area reservoirs (using techniques similar to those in alternative 2, described below).

Table ES-1. Comparison of Alternatives.

Alternative	Dredged Material Disposal	Levee Modification	Relocation/Acquisition Requirements
1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal	In-water; silt in deep water; sand, gravel, and cobbles to create shallow water fish habitat	None	None
2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise	Create shallow water fish habitat. Material unsuitable for in-water disposal to Joso or other upland site.	Raise levees up 3 feet (0.9 m) to maintain flow conveyance capacity.	Raising of two roadways.
3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise	Upland at Joso site in Lower Monumental reservoir.	Raise levees up 3 feet (0.9 m) to maintain flow conveyance capacity.	Raising of two roadways.
4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise	Beneficial use, either upland or in water. Material unsuitable for in-water disposal to Joso or other upland site.	Raise levees up 3 feet (0.9 m) to maintain flow conveyance capacity.	Raising of two roadways.

Note:
(1) Includes maintenance of the authorized navigation channels of the lower Snake River reservoirs and McNary reservoir; maintenance dredging of access channels to port and moorages on an as-needed basis, public recreation areas (swimming beaches and boat basins), irrigation intakes for wildlife HMU's managed by the Corps; and flow conveyance capacity of the Lower Granite reservoir.

Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities with the same quantities and frequencies as alternative 1, but with changes in dredging methods, work window, and disposal location for silt. Mechanical dredging would still be the primary dredging method used, but hydraulic dredging would also be considered for off-channel areas on a case-by-case basis. The majority of the dredging would be done during the winter in-water work windows used in alternative 1, but a summer work window would be considered for off-channel areas on a case-by-case basis. Silt would no longer be disposed of in deep-water sites. Instead, all dredged materials would be placed in water to create shallow-water fish habitat that would be beneficial to salmonid species.

Disposal and creation of shallow-water habitat would be accomplished using bottom-dump barges to transport and deposit the dredged material. Finer sands and silts would be used in a base for creation of habitat and may be dumped in mid-depth water areas as part of this process. Coarser sands, gravels, and cobbles would be placed over the base or within shallow water. These materials provide a favorable substrate for juvenile salmonid rearing and resting. Finally, a drag beam or some other similar device would be used to re-contour the surface of the material dumped from the bottom-dump barges in order to provide a relatively smooth surface. Placement and contouring of sand and gravel would occur with each dredging cycle in order to maximize the amount of habitat created. Figures ES-2 and ES-3 illustrate this dredged material management process.

An upland containment area would be constructed for disposal of dredged materials that sediment testing indicates would be unsuitable for in-water disposal but suitable for upland disposal. These dredged materials would be transported by barge to the upland disposal site. Currently, the preferred site is the Joso HMU, located on land adjacent to the Lower Monumental reservoir at Snake River Mile 56.5 (see plate 11). Only material that meets all applicable environmental health and safety regulations and requirements would be disposed of at the upland site. Material that is not appropriate for disposal at the upland site would be transported to a licensed landfill facility.

Alternative 2 would employ an "adaptive management" approach to the overall implementation of the DMMP. The Local Sediment Management Group (LSMG) would provide input and feedback to the Corps with respect to dredging and dredged material management that would be implemented under this alternative, as well as Alternatives 3 and 4. The adaptive management approach would allow the Corps and the LSMG to regularly evaluate dredging and dredged material management activities and monitoring results, and make needed adjustments to the overall course of action.

This alternative includes raising the levee at Lewiston up to 3 feet (0.9-m) at critical locations to maintain flow conveyance. Plate 18 shows the location of proposed levee raises. Proposed levee raises would require modification of portions of two adjacent roadways. Three existing buildings would experience an increased risk of flooding.

Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities in terms of locations, quantities, frequencies, and methods as alternatives 1 and 2, but with upland disposal of dredged material. The 3-foot (0.9-m) levee raise described as a part of alternative 2 would be included with this alternative.

Under this alternative, dredged materials would be transported by barge to the Joso upland disposal site (see plate 11). This site was selected through a process that identified and screened multiple candidate sites and selected the Joso site based on environmental and economic considerations. A large portion of the Joso site is a disturbed area that was previously used for gravel mining. An existing barge slip is located at the downstream end of the site, and this area would be used to establish an off-loading and staging area for the disposal facility. A containment berm would be constructed around the disposal area and a 600-foot (182.9-m) setback from the river would provide a buffer zone to minimize environmental impacts of disposal operations.

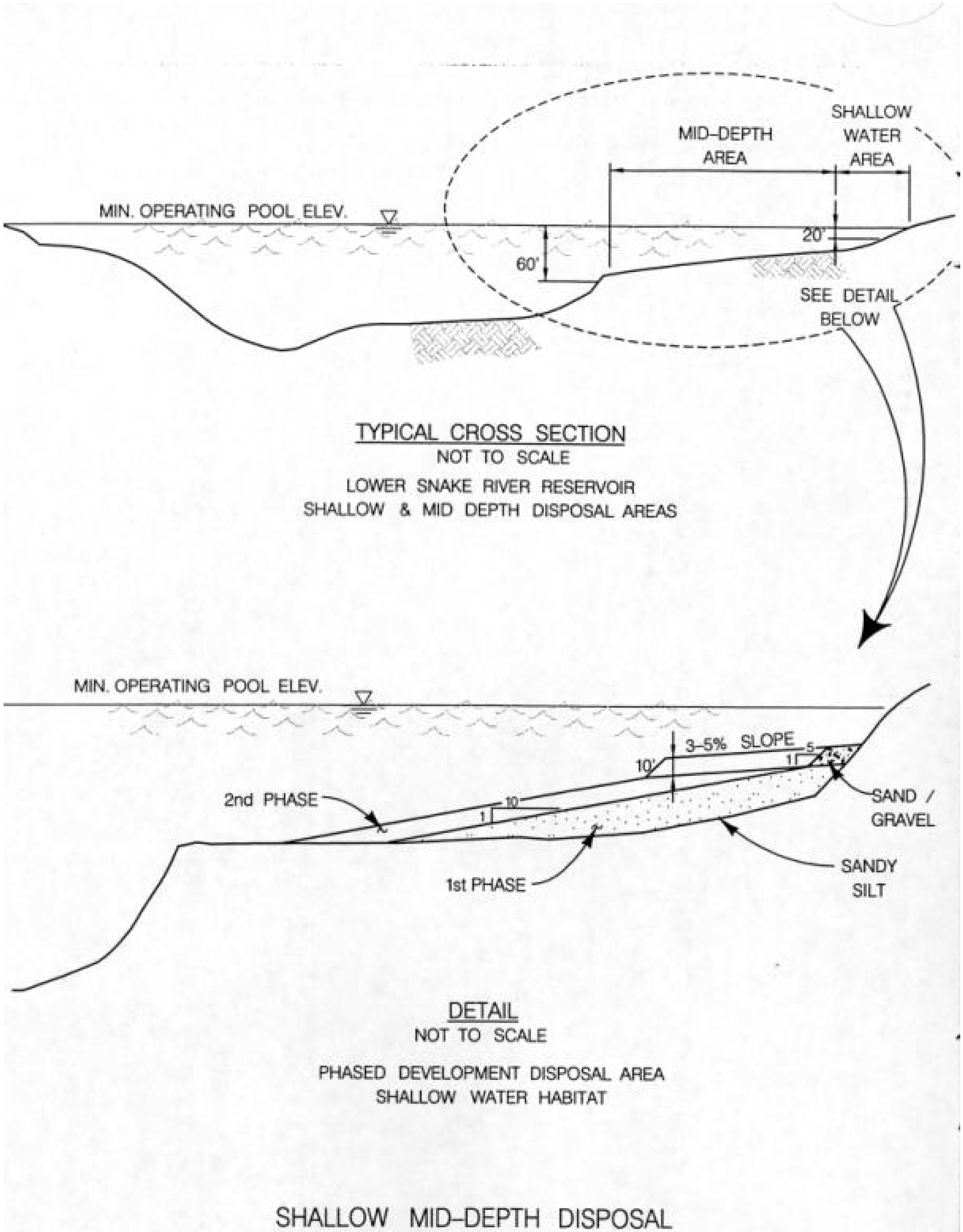


Figure ES-2. Cross Section of the Phased Development Disposal Technique for Creating Shallow Water Habitat.

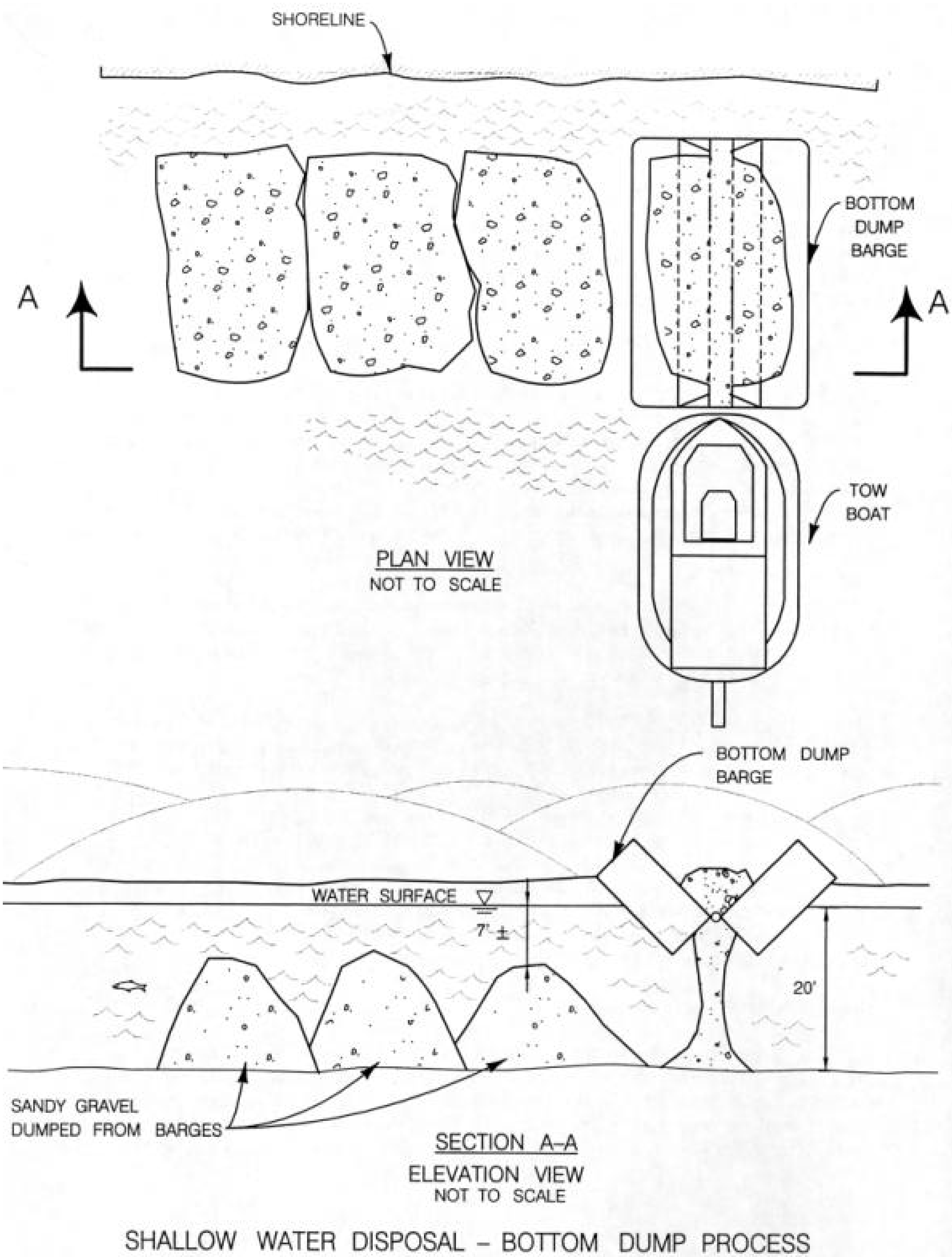


Figure ES-3. Shallow Water Sediment Placement Technique Using a Bottom Dump Barge.

Alternative 4 -Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities in terms of locations, quantities, frequencies, and methods as alternatives 1, 2, and 3. As with alternatives 2 and 3, this alternative includes raising the levee at Lewiston up to 3 feet (0.9 m) at critical locations to maintain the flow conveyance capacity of the upper reservoir behind Lower Granite Dam at the confluence of the Snake and Clearwater Rivers.

The distinguishing characteristic of alternative 4 is that the primary focus of the management strategy for dredged material under this alternative would be to incorporate beneficial uses. For each dredging activity, the Corps would identify potential beneficial uses and coordinate the uses with the Local Sediment Management Group prior to selecting a use. Beneficial uses, as defined by this process, may be achieved when a local sponsor is willing to contribute a share of the cost if the use would require cost sharing.

Potential beneficial uses that could be initially considered include:

- Fish habitat creation as described in alternative 2.
- Woody riparian habitat program.
- Hanford remediation and closure activities capping material.
- Potting soil.
- Riparian habitat restoration.
- Fill at Port of Wilma.
- Fill on non-Federal lands.
- Fill for roadway projects.

The Corps proposes to use dredged material to develop woody riparian area at Chief Timothy Habitat Management Unit in Lower Granite Reservoir as a beneficial use of dredged material that would result from the planned dredging in winter 2002-2003. This beneficial use would create shoreline habitat in line with the goals of the Lower Snake River Fish and Wildlife Compensation Plan.

Because opportunities to use dredged material beneficially become available over time and cannot always be anticipated, a process would be established whereby a notice would be sent to parties known to have an interest in the use of the dredged material and a public notice published prior to the proposed dredging/beneficial use activity. Impacts would be assessed on a case-by-case basis through this process. The Corps may prepare Biological Assessments (BA's) for each dredging activity or for up to 5 years of dredging activities, depending upon the outcome of the Endangered Species Act (ESA) consultation processes with the NMFS and U.S. Fish and

Wildlife Service (USFWS). The Corps may also prepare a Clean Water Act Section 404(b)(1) evaluation for each dredging activity or for 5 to 10 years of dredging, depending upon the outcome of coordination with the state water quality agencies and EPA.

ENVIRONMENTAL EFFECTS OF ALTERNATIVES

The following sections provide brief summaries of the anticipated environmental effects of the plan alternatives considered in the DMMP/EIS for each element and table ES-2 presents a summary of those effects. The anticipated effects are generally characterized with respect to their intensity and duration as:

- Direct, indirect, or cumulative;
- Minor, moderate, or major, and
- Short- or long-term.

Aquatic Resources

The dredging activity associated with all four alternatives would have the same indirect, minor, short-term effects on aquatic ecosystems by disturbing sediments and removing macroinvertebrate species (which are prey species for resident and migratory fish) from the dredging area. However, re-colonization of macroinvertebrates would occur relatively rapidly within both the dredging area and at the in-water shallow and mid-depth disposal areas. Long-term impacts would not occur. Fish could use the areas upstream and downstream of dredging and disposal activities, and dredging would not be a continuous activity confined to a single location. Fish could return to the area following completion of dredging and disposal activities.

Alternatives 1, 2, and 4 could have potential benefits by creation of in-water fish habitat, whereas alternative 3 (upland disposal) would provide no benefit to fish habitat. In addition to benefiting salmonid species, creation of in-water habitat could benefit white sturgeon and macroinvertebrate species. Initially, the proposed beneficial use would be creation of woody riparian habitat in shoreline areas of Chief Timothy HMU. The 3-foot (0.9-m) levee raise proposed in alternatives 2, 3, and 4 would have no impacts on aquatic resources.

Terrestrial Resources

The dredging and disposal actions within and adjacent to the river included in alternatives 1 through 4 would not prevent wildlife (primarily waterfowl and raptors) from obtaining food from, or otherwise using the areas adjacent to, dredging and disposal activities. Dredging and disposal activities would occur only within the approved in-water work window and, following dredging and disposal, wildlife would return to areas affected by these activities.

TABLE ES-2. Environmental Effects Summary Matrix.

Discipline	Alternative 1 No Action (No Change) - Maintenance Dredging with In-Water Disposal	Alternative 2 Maintenance Dredging with In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise	Alternative 3 Maintenance Dredging with Upland Disposal and a 3-Foot (0.9-m) Levee Raise	Alternative 4 Maintenance Dredging with Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise
Aquatic Resources	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term effects anticipated. Potential beneficial effects from creation of some in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. Potential beneficial effects (greater than Alternative 1) from creation of shallow water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. No creation of in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species; no long-term effects anticipated. Potential beneficial effects from creation of shallow water fish habitat, woody riparian habitat and/or beneficial use that may restore habitat.
Terrestrial Resources	Indirect, short-term minor effects on terrestrial wildlife and habitat	Similar effect as Alternative 1; Minor, short-term, indirect impacts on terrestrial species through disruption of habitat from levee raise and displacement during dredging.	Direct, moderate effects to terrestrial species from loss of habitat at upland disposal site and disruption of habitat from levee raise. Positive effects from habitat creation in old borrow area at disposal site.	Indirect, minor, short-term, negative effects through disruption of habitat from levee raise; potential long-term positive effects from beneficial use of dredged material to create upland habitat and woody riparian habitat.
Endangered Species	• *Fish* – "May affect and would likely adversely affect" salmonids but no jeopardy to listed species; "may affect, not likely to adversely affect" bull trout. • *Terrestrial Wildlife* – "May affect, not likely to adversely affect" bald eagle. • *Plants* – "May affect, not likely to adversely affect" Ute ladies' tresses and water howelia; "no effect" on Spalding's silene.	Same effects as Alternative 1.	• Same effects as Alternative 1.	• Same effects as Alternative 1.
Recreation	Minor, short-term impact on access to portions of the river for recreational boats near proposed dredging and disposal activities. Maintains ability to use recreational facilities.	Minor, short-term, direct impact due to disruption of recreational facilities in Lewiston area due to levee raise, and minor short-term impact to recreational boating near dredging and disposal. Maintains ability to use recreational facilities.	Same effects as Alternative 2 except for dredged material disposal. Minor indirect effects to recreational users in the vicinity of the upland disposal site. Maintains ability to use recreational facilities.	Same effects as Alternative 2. Potential long-term, beneficial effect from beneficial use of dredged material if used to enhance recreation sites. Maintains ability to use recreational facilities.
Cultural Resources	Known submerged cultural properties would be avoided to the maximum extent practicable during dredged material disposal and management activities.	Same effects as Alternative 1.	Same effects as Alternative 1. Cultural properties in vicinity of upland disposal site would be avoided.	Same effects as Alternative 1. Potential effects of beneficial uses would be evaluated as proposals are developed.
Socioeconomics	Long-term, positive effect from maintaining navigation. Indirect, long-term, moderate negative effect from greater potential flood risk (no levee raise). Minor effects could occur. Low-income and minority populations not disproportionately affected.	Long-term, positive effect from maintaining navigation. Direct, short-term and long-term positive effect from levee raise due to added jobs and materials required by levee construction. Reduction of flood risk from levee raise. Low-income and minority populations not disproportionately affected.	Same effects as Alternative 2.	Same effects as Alternative 2.
Transportation	Maintains existing transportation systems.	Direct, short-term, minor effect on roadways and railroads from proposed levee/road raise construction activities.	Same effects as Alternative 2.	Same effects as Alternative 2. Potential positive effect if dredged material is used for transportation projects.
Geology and Soils	Local displacement of soils and alluvial material.	Potential short-term effect to soils in the vicinity of levee raise due to construction activities.	Potential short-term effect to soils in the vicinity of the levee raise. Long-term effect on soils at upland disposal site due to construction and disposal activities.	Potential short-term effect to soils from implementation of beneficial use due to construction activities.
Water Quality/ Water Resources	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No effect. • *Flood Plains* – No impacts	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise. • *Flood Plains* – Minor, short-term impact at proposed upland containment site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise and upland disposal. • *Flood Plains* – Minor, short-term impact at upland disposal site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity and placement of fill in shoreline areas for woody riparian habitat creation. • *Wetlands* - Minor direct effect from woody riparian habitat creation adjacent to wetland. Minor indirect effects associated with levee raise. • *Flood Plains* – No impact to floodplain from woody riparian development. Future beneficial uses may require assessment of floodplain impacts.
Hazardous, Toxic, and Radioactive Waste	No effects anticipated; sediments will be tested for contamination.	Same effects as Alternative 1.	Same effects as Alternative 1.	Same effects as Alternative 1.
Air Quality	Direct, minor, short-term effects to local air quality due to dredging and disposal equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation and upland disposal activities.	Direct, minor, short-term effects to local air quality due to dredging disposal, and construction equipment operation, including implementation of beneficial use(s).
Noise	Direct, minor, short-term effects due to noise from dredging and disposal equipment operation.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.
Aesthetics	Direct, minor, short-term effect on aesthetics from dredging and disposal activities.	Direct, minor, short-term effects on aesthetics from dredging and disposal activities; long-term, minor impacts from levee raise.	Direct, minor, short-term effects from dredging. Long-term, minor impacts from levee raise. Direct, minor, long-term effects from upland disposal.	Direct, minor, short-term effects from dredging and disposal; long-term, minor impacts from levee raise; and long-term beneficial effect to shoreline area for woody riparian habitat creation.
Native American Tribal Communities	Potential positive effects on salmon fishing from creation of salmon rearing habitat and cultural resources to be avoided.	Potential positive effects (greater than Alternative 1) on salmon fishing from creation of salmon rearing habitat.	No effects anticipated.	Same effects on salmon fishing as for Alternative 2.
Cumulative Effects	Potential positive effects on salmonid fish from creation of shallow-water fish habitat. Other resources were evaluated regarding cumulative effects and nothing was determined to preclude the selection of this alternative.	Potential positive effects on salmonid fish (greater than Alternative 1) from creation of shallow-water fish habitat. Same effects on other resources as Alternative 1.	Potential positive effects to terrestrial species from filling old borrow area at disposal site and establishing vegetation. Same effects on other resources as Alternative 1.	Same effects as Alternative 2. Positive effects from proposed beneficial use of dredged material (e.g., woody riparian habitat development). Same effects on other resources as Alternative 1.

[1] "Impacts" and "effects" are used interchangeably. Unless otherwise noted as beneficial or positive, impacts described are negative.

There would be displacement of wildlife habitat for alternative 3, where the disposal of all dredged material would occur at the Joso upland site. Most disposal activities would occur on the disturbed portion of the site that was formerly used as a gravel pit. The area would be stabilized following each disposal cycle and would be re-contoured and restored with native plantings following completion of all dredging over the next 20 years. With completion of the disposal and revegetation, the site would provide wildlife habitat similar to the surrounding area, which would be a long-term benefit to wildlife habitat. Upland disposal at Joso is expected to have a direct, long-term, moderate impact on terrestrial wildlife. Material that is unsuitable for in-water disposal under alternatives 2 and 4 would be taken to an upland site (currently identified as the Joso site), which would have a minor, direct effect on terrestrial resources at the site.

The proposed 3-foot (0.9-m) levee raise for alternatives 2, 3, and 4 would similarly have minor, indirect, temporary impacts on terrestrial species. Construction could disturb wildlife; however, the areas proposed for the levee raise are in an urban setting and only those species accustomed to human activity would be present. The levee raise would be placed atop the existing levee. Revegetation would result in habitat similar to existing conditions.

Endangered Species

The Corps prepared a Biological Assessment for the proposed dredging and dredged material management activities and consulted with NMFS and USFWS. See Appendix F and G for further details. NMFS determined that the proposed actions would not cause jeopardy to anadromous fish species listed under the Endangered Species Act (ESA) and set forth Reasonable and Prudent Measures. USFWS provided concurrence with the findings of the Corps' Biological Assessment.

Anadromous salmon and steelhead stock from all of the Evolutionary Significant Units (ESU's) listed as Threatened or Endangered under the ESA pass through the McNary reservoir and lower Snake River. These species include Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*), listed as Threatened in 1991; Snake River fall chinook salmon (*O. tshawytscha*), listed as Threatened in 1991; Snake River sockeye salmon (*O. nerka*), listed as Endangered in 1992; Snake River Basin steelhead (*O. mykiss*), listed as Threatened in 1998; Upper Columbia River spring run chinook salmon (*O. tshawytscha*), listed as Endangered in 1999; Middle Columbia River steelhead (*O. mykiss*), listed as Threatened in 1999; and Upper Columbia River steelhead, listed as Endangered in 1997. In addition, the resident Columbia Basin bull trout (*Salvelinus confluentus*) is listed as Threatened under the ESA.

Of the alternatives that involve in-water disposal, alternative 1 would provide the least benefit to increasing habitat for fall chinook salmon rearing in the McNary and lower Snake River reservoirs. The dredged material disposal methods of alternative 2 would provide the greater opportunity to develop shallow water salmonid habitat throughout the McNary and lower Snake River reservoirs. Upland disposal of dredged material proposed in alternative 3 would not provide for creation of salmonid habitat. Some of the beneficial uses proposed in alternative 4 could also create salmonid habitat.

Because dredging and disposal activities would only occur during authorized in-water work windows, impacts to salmonids would be minimized. For alternative 1, the work windows would be winter only. For alternatives 2, 3, and 4, these work windows would include winter main stem dredging and both winter and summer dredging of off-channel areas.

The likelihood of bull trout being in the project areas is remote, and they are not expected to be affected by the dredging and disposal activities. However, if bull trout were present in dredging and disposal areas, there would be short-term, indirect effects due to turbidity and disturbance from dredging activities, which would cause them to leave the area.

Beneficial use of dredged material proposed in alternative 4 is anticipated to have minor effects or potential benefits to endangered fish species.

The bald eagle (*Haliaetus leucocephalus*) inhabits the project area and is listed as Threatened under the ESA. The dredging activities proposed for all four alternatives would not be a continuous activity confined to a single location. If impacts to bald eagles were to occur, they would be minor, short-term, and localized. Adjacent areas would be available for foraging, feeding, and perching.

The levee raise proposed in alternatives 2, 3, and 4 would not result in the loss of any trees or shoreline perch areas. Eagles' prey species would not be impacted. Thus, if any impacts were to occur, they would be related to disturbance during construction and would be minor, short-term, and localized.

Two plant species that may be found within the project area [Ute ladies' tresses (*Spiranthes diluvialis*) and water howelia (*Howellia aquatilus)*] are listed as Threatened under the ESA. Another plant, Spalding's silene, is proposed for listing under the ESA.

The proposed activity would not likely impact these plant species. There are no recorded observations of Ute ladies' tresses in the project vicinity, and they are not likely to occur due to lack of suitable habitat and the elevation of the project area. Therefore, no impacts to Ute ladies' tresses are expected to occur. Similarly, water howelia and Spalding's silene are not likely to occur at this low elevation or in this habitat.

As with endangered fish species, alternative 4 is not anticipated to impact endangered terrestrial species. However, because opportunities to use dredged material beneficially become available over time and cannot always be anticipated, a process has been established whereby a notice would be sent to parties known to have an interest in the use of the dredged material and a public notice published prior to the dredging activity. Impacts would be assessed on a case-by-case basis through this process. Plant surveys would be required to determine the presence of Ute ladies' tresses. Any sites found to support these plants would need to be avoided to preclude impacts to these plants. A BA may be prepared for each dredging activity, or for 5 years of dredging activities, depending upon the outcome of the ESA consultation with USFWS.

Recreation

Dredging activities proposed as part of all of the alternatives are expected to have a minor, short-term effect on those recreation activities and facilities located near proposed dredging and disposal locations. Dredging scenarios proposed may temporarily close boat ramps and boat basins and affect public recreation areas (e.g., swimming beaches) on a short-term basis during maintenance dredging. There would be short-term, minor impacts due to low levels of activities that occur during the winter months. Summer dredging of recreation sites would also have short-term impacts since the small areas would not take long to dredge. Construction of the levee raises proposed under alternatives 2, 3, and 4 are anticipated to have short-term, direct effects on the Lewiston levees park and the recreational activities that occur there. These effects would be minor because they impose a temporary disruption of activities at the Lewiston levees park, specifically multi-use paths and day-use facilities such as picnic tables on and adjacent to the levees could not be used during construction of the levee raise. Recreational facilities and activities would be restored following the interruption caused by the construction of the levee raise.

Upland disposal activities (barging and material handling) at the Joso site would have long-term, minor, indirect effects on river users, hunters, and the nearby Lyon's Ferry State Park and Lyon's Ferry Marina facilities. These effects are anticipated to be minor since the disposal area is set back at least 600 feet (182.9 m) from the river shoreline and is not directly visible from Lyon's Ferry State Park and Lyon's Ferry Marina, which are located on the opposite side of the Snake River.

To the extent that beneficial uses of dredged material would reduce the need to dispose of the material either upland or in-water, these uses are expected to have minor, direct impacts to recreational facilities and activities, depending on where the material is placed. Beneficial uses that would create or enhance wildlife habitat would have indirect beneficial effects on recreation if they enhanced hunting, fishing, or wildlife viewing opportunities.

Cultural Resources

Proposed dredging, disposal, and levee modification activities could affect cultural resources located within the project's area of potential effect as defined under the National Historic Preservation Act (NHPA). Dredging actions for all four alternatives would be limited to the removal of accumulated sediments and would not affect original riverbed or shoreline material, or cultural resources contained within that material. In-water disposal proposed in alternatives 1, 2, and 4 could affect identified underwater cultural resources in the lower Snake River and McNary reservoirs; however, known submerged cultural resource sites would be avoided to the maximum extent practicable during the placement of dredged material. Levee modification proposed in alternatives 2, 3, and 4 would not affect any cultural resources sites that have been identified.

Alternatives 2, 3, and 4 would use the Joso area for the upland disposal of some or all of the dredged material. Any cultural resources identified in the vicinity of the Joso upland disposal site would be avoided during construction and operation of the disposal site.

Beneficial uses of dredged material, as proposed in alternative 4, could potentially affect cultural resources, depending on the use. Prior to implementation of any beneficial use, the Corps would need to conduct research and field investigations to determine if cultural resources would potentially be affected.

The development, implementation, and monitoring of project actions would be conducted in conformance with the NHPA and the National Environmental Policy Act. Prior to the finalization and implementation of any plan, the Corps would complete the required cultural resource consultation. The Corps would continue to consult with appropriate State and Tribal Historic Preservation Officer(s) as well as other affected consulting parties throughout the life of the 20-year plan.

If human remains were inadvertently discovered during dredging or dredged material handling operations, all work in the immediate area would stop and the Corps archaeologist will take the appropriate steps to address the discovery. The Corps will notify all appropriate tribes, agencies, and local coroner's offices depending on the status of the human remains.

Socioeconomics

Dredging to maintain the navigation channel, access channels to ports and moorages, public recreation areas, irrigation intakes for HMUs, and flow conveyance capacity of the Lower Granite reservoir proposed under all four alternatives, and disposal of dredged material in-water proposed in alternatives 1, 2, and 4 represent no change in the management of the navigation projects and associated facilities. Therefore, with respect to navigation and economic use of waterways, these alternatives would have no effects on regional population, employment, or income. All alternatives considered would have minor, short-term, positive economic effects due to added employment for dredging-related activities.

Since alternative 1 does not include a levee raise in Lewiston, allowing continued loss of levee freeboard and increased risk associated with flooding, it would be expected (in comparison to the other alternatives being considered) to have an indirect, long-term, moderate negative effect on the local economy of the Lewiston area since reduction in annualized flood damages would not be realized. Proposed levee modifications for alternatives 2, 3, and 4 are anticipated to have a direct, short-term, positive effect on the local economy of the Lewiston area due to the added jobs and materials required for construction of the levee modifications.

Upland disposal proposed under alternative 3 would be expected to have a direct, minor, short-term positive impact due to jobs created for construction and initial operation of the disposal facility at the Joso site. The economic effects would remain positive, but lessen over time, for the continued use of the upland disposal facility.

Beneficial use of dredged material would be expected to have a direct, minor, short-term positive economic effect due to construction activities associated with implementation of the beneficial use. Also, beneficial uses that create or enhance wildlife habitat or recreational resources would potentially have minor, indirect, long-term beneficial effects attributable to enhancement of recreational resources and opportunities.

The Corps reviewed demographic data to identify areas where there are potential environmental justice populations, and considered the alternatives' environmental effects with respect to these areas.

Transportation

River Navigation

Maintenance dredging for all four alternatives would have a long-term beneficial impact on river navigation by ensuring adequate depths in the navigation channels, access channels to ports and moorages, and public recreation areas. In-water disposal activities would be away from areas of commercial navigation. Dredging in the navigation channels would occur on a 2-year cycle on average, causing some disruption during the authorized in-water work period from December 15 to March 1 in the Snake River and December 1 and March 31 in the Columbia River. No disruption to recreational boating would be expected in the main river channels; only short-term disruption may occur during maintenance dredging of boat basins.

Upland disposal of all material proposed in alternative 3 would increase the number of lockages (barges passing through lock and dam facilities) during the dredging period by as much as 150 lockages every 2 years (up to 113 barges with an average of four lockages of three barge tows). These lockages would occur during a time of year when they would cause very little impact to other commercial or recreational traffic.

Alternative 4 could have different effects in the disposal area depending on the disposal location and method employed to develop the beneficial use. For the beneficial uses being considered, the adverse impacts to other river navigation would be short-term and minor. In some cases beneficial uses could have positive impacts to river navigation by providing added terminal and port areas.

Railroads

Continued maintenance of the navigation channels, access channels to ports and moorages, public recreation areas, irrigation intakes, and flow conveyance capacity proposed in all four alternatives would have no adverse effect on the railroads in the area and would continue to support the multi-modal flow of commerce to and from the study area.

The nominal 3-foot (0.9-m) levee raise, proposed in alternatives 2, 3, and 4 includes construction to the west levee below the south abutment of the Camas Prairie Railroad Bridge over the Clearwater River at Lewiston and would have minor, short-term impacts during construction.

Disposal of all dredged material at Joso proposed in alternative 3 would cause minor, long-term, direct impacts to the Union Pacific Railroad resulting from the developments of the Joso disposal site and increases in crossings of the Union Pacific Railroad right-of-way during construction.

The beneficial use of the dredged material proposed in alternative 4 would be determined on a case-by-case basis and may affect the railroads due to minor disruptions that could potentially involve the railroad to transport dredged material to a final destination point. The potential impacts to railroads from this alternative are expected to be minor.

Highways/Roadways

Modification of roads (associated with the levee raise) proposed in alternatives 2, 3, and 4 would create short-term, direct impacts to Highway 129 and the Snake River Road. The roadways would be raised to avoid inundation with water during high-flow events. Effects would occur during reconstruction of the affected portions of roadway.

One concept for beneficial use of dredged material, proposed in alternative 4, would use the material to form a roadway connection on the north shore of the Lower Granite pool linking State Route (SR) 193 at Wawawai to SR 194, a distance of 3 miles [4.8 kilometers (km)]. This would create a potential positive effect with respect to roadway construction.

Geology and Soils

Maintenance dredging proposed in all four alternatives is not anticipated to significantly affect the geology and soils in areas surrounding the lower Snake River and McNary reservoirs. Dredging would cause local soil and rock disturbance and relocation of some alluvial material.

Modifications to the levee system in Lewiston proposed in alternatives 2, 3, and 4 are expected to result in direct effects on the geology and soils of the levees and surrounding areas. Minor, short-term effects to soils and topography, resulting from earthmoving and construction activities, are expected during construction of the levee modifications.

Upland disposal as proposed under alternative 3 is anticipated to have a direct, long-term effect on the soils and topography of the Joso site. Erosion and compaction would occur from construction and dredged material disposal activities. Site restoration would include stabilizing and seeding of the dredged material after it has been disposed of on site. Disposal material would be contained within a bermed area and drainage would be controlled to minimize erosion. In addition, a 600-foot (182.9-m) setback from the river would help minimize shoreline erosion.

Alternative 4 would use some or all of the dredged material for beneficial uses. Beneficial uses, such as woody riparian habitat creation, other habitat creation/enhancement, landfill cover, or other activities, would be expected to have direct, short-term impacts to the soils in the areas where the uses would be implemented.

Water Quality/Water Resources

All alternatives considered in the DMMP/EIS are expected to have a temporary, direct negative effect on water quality in the Columbia, Snake, and Clearwater Rivers, mostly because of turbidity plumes caused by the dredging and, where proposed, in-water disposal. However, it is anticipated that elevated turbidity levels would be confined and will stay within the "mixing zones" (established under Clean Water Act Section 401 water quality certification) allowed for this activity, and allowable turbidity downstream of the mixing zone would not be exceeded.

Historically, the Corps has sampled and tested dredged materials for sediment size and quality, including contaminants, to determine suitability for in-water disposal. To date, sediment contaminant levels have been at low levels that allow in-water disposal. Based on historic sediment testing data, contaminant levels that would preclude in-water disposal in the future are not anticipated. Nonetheless, the Corps will continue its sediment sampling protocols to ensure sediment quality is adequately assessed.

Construction of the levees at Lewiston proposed in alternatives 2, 3, and 4 could result in short-term, minor water quality impacts due to runoff and erosion. These concerns would be minimized with the implementation of a site-specific Erosion/Sedimentation Control (ESC) Plan and construction best management practices (BMP's). The levees would be stabilized by hydroseeding immediately after construction.

Direct, temporary, minor impacts due to erosion may occur as a result of construction and disposal operations at the Joso site as proposed in alternative 3. A containment berm would be constructed on the perimeter of the permanent disposal area and would minimize water quality impacts associated with runoff and erosion. An ESC plan would be developed and BMP's used during site development. The site would also be regularly stabilized in a phased manner during disposal, and measures will be taken to minimize sedimentation from dredged material transfer activities.

Impacts from beneficial use of the dredged material proposed in alternative 4 could vary depending on the use and would be the responsibility of the local sponsor. As with other dredged material management methods, beneficial uses involving placement of dredged materials would be subject to ESC measures and BMP's.

Wetlands

Minor, short-term, indirect impact to wetlands adjacent to the levees or roadway could occur during construction of the nominal 3-foot (0.9-m) levees as proposed in alternatives 2, 3, and 4. Long-term impacts are not expected as a result of the levee raise.

Two small wetland areas have been identified in the vicinity of the Joso upland disposal site proposed in alternative 3. The proposed disposal facility has been sited to avoid directly or indirectly affecting these wetland areas.

Beneficial uses proposed in alternative 4 would be expected to generally affect wetland resources positively if dredged material were used for enhancement or creation of aquatic and wildlife habitat. Beneficial uses could potentially improve wetland size, function, and quality. Specific wetlands in the vicinity of a proposed beneficial use would require identification prior to commitment for the beneficial use project. A wetland area approximately one acre (0.4 hectare) in area is adjacent to the area where woody riparian habitat development is proposed. This wetland area would be minimally impacted by the proposed habitat development. The wetland is a low area where ponding occurs; it holds water only at extremely high pool elevations, and dries out during most years. Under the proposed beneficial use, an inlet channel to the pond would be constructed, which should increase flows into the pond at lower reservoir elevations. It will also have an exit (outlet) constructed so there will be some flow through, thus improving the water quality.

Floodplains

There would be no foreseeable significant negative floodplain impacts as a result of the maintenance dredging proposed in all four alternatives or the levee raise at Lewiston proposed in alternatives 2, 3, and 4.

The permanent upland disposal site at Joso would not be located in the 100-year floodplain and would not affect the floodplain. Approximately 360,000 square feet (33 445.1 square meters) of the unloading and temporary storage area for dredged material would encroach on the 100-year floodplain, causing minor short-term impacts to the floodplain during the time that the material is stored. However, the fill is not expected to change the water surface elevation and would not pose long-term effects on the 100-year floodplain.

Beneficial uses are not anticipated to present significant impacts to floodplain areas. The proposed woody riparian habitat creation would involve placement of fill in shoreline areas at Chief Timothy HMU, including some areas within the 100-year floodplain. This fill would not change the water surface elevation, nor have impact on the 100-year floodplain. Specific areas considered for placement of dredged material under beneficial use would require analysis of floodplain issues.

Hazardous, Toxic, and Radioactive Waste

Based on Phase I environmental site assessments conducted for the Joso site, there is a very low potential for land-based hazardous, toxic, and/or radioactive waste concerns to be associated with the Joso upland disposal site.

Based upon existing sediment quality data, it is not anticipated that the handling and disposal of dredged materials as hazardous or solid waste (as defined by applicable environmental health and safety regulations and requirements) would be required.

The proposed woody riparian habitat creation area at Chief Timothy HMU does not pose any known HTRW concerns. Beneficial use of dredged materials could have minor positive effects on hazardous waste if dredged material was used for cover or fill at the Hanford Reservation, which is a beneficial use option considered in alternative 4. In general, beneficial uses that involve upland handling of dredged materials would not be expected to have hazardous waste effects, given the quality of the sediments. See the Water Quality/Water Resources section for information on sediment contaminant levels.

Because of the location of the Hanford Nuclear Reservation at the upstream end of McNary reservoir, there is speculation of radioactive materials being present in the reservoir sediments. Dredging activities under any of the four alternatives should not extend deep enough into the sediment layer to reach existing (if any) radioactive material. However, the Corps plans to evaluate each dredging activity in the McNary reservoir and determine if and what type of further pre-dredging sediment testing and analysis may be necessary.

Air Quality

All alternatives would cause direct, minor, short-term effects to local air quality due to dredging equipment operation. Dredged material would be wet, and is not anticipated to be subject to dust generation. Construction activities associated with raising the Lewiston levee could generate dust, as could the upland disposal at Joso proposed in alternative 3 and the upland contingency disposal at Joso in alternatives 2 and 4. The BMP's would be used to prevent material from becoming airborne during transport, offloading, and upland placement.

No additional impacts associated with implementation of alternative 4 are anticipated.

Noise

Minor, direct, short-term noise impacts are anticipated to result from dredging, transport, and disposal activities of all alternatives considered. Levee construction would occur primarily during daytime hours and would cause minor, short-term impacts from construction activities. Upland disposal of dredged material would occur primarily during daytime hours and would have minor, direct, short-term effects during site work and disposal activities.

Aesthetics

It is anticipated that all four alternatives will have a direct impact on aesthetics in the area where dredging activities are taking place and, for alternatives 1, 2, and 4, where in-water disposal is anticipated. Impacts due to levee modification as proposed in alternatives 2, 3, and 4 are expected to be both short-term (due to construction activities) and long-term (due to raising of the levees). Levee modifications would affect the riverfront park facilities and would present moderate impacts to both visual quality and viewing patterns.

Under alternative 3, dredged material from all reservoirs disposed of at the Joso site in the Lower Monumental reservoir would have a direct, long-term effect on the aesthetics of the disposal site and the areas immediately surrounding the site from which the site can be viewed. While the proposed disposal operations would directly impact the aesthetic quality of the Joso site, the effects would be minor due to the fact that the site is not highly visible to viewers and would be restored upon completion of disposal operations. Beneficial use of dredged material, proposed in alternative 4, would potentially have a long-term positive effect on aesthetic resources if used for wetlands or habitat restoration. Proposed woody riparian habitat creation at Chief Timothy HMU in Lower Granite Reservoir would have a long term, beneficial effect on the aesthetics of the shoreline area.

Native American Tribes and Communities

Impacts from DMMP activities that are of concern to tribes would involve potential effects to aquatic species and their habitats, water quality, and cultural resources. Although DMMP actions would occur in the five study area reservoirs over its 20-year life, most dredging activities and the majority of any in-water disposal would occur in the Lower Granite reservoir.

Dredging as proposed for alternatives 1, 2, 3, and 4, and in-water disposal of dredged materials as proposed for alternatives 1, 2, and 4, could result in habitat changes that are beneficial, neutral, or even detrimental to different aquatic species depending on given species responses and needs. Constructing more shallow-water habitat could change water quality factors. Shallow-water temperatures, currently below optimum for the growing season of resident game fish, would be increased and possibly enhance resident game fish habitat conditions and population numbers.

Water quality impacts from DMMP activities under any of the alternatives are expected to be temporary, but would result in direct negative effects due to turbidity plumes caused by dredging and in-water disposal. Greater sediment plumes are expected from dredging operations.

Concerns over potential impacts to cultural resources would be focused on damage to cultural sites from dredging actions or covering sites with too much sediment as a result of disposal activities. As now planned, dredging under all four alternatives would be limited to existing navigation channels and/or would not go below accumulated sediments into original riverbed. Likewise, disposal activities either upland or in-water would avoid known sites. (However, sediment drift from in-water disposal could result in the eventual covering of sites with additional material.) Such actions would help to reduce the chances of impacting cultural sites.

Cumulative Effects

The National Environmental Policy Act and the Council on Environmental Quality's regulations require Federal agencies to consider the cumulative impacts of their actions on the natural and human environment. Cumulative effects are those environmental consequences that result from the incremental impact of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of the agencies or individuals that may undertake them.

Other past, present, and reasonably foreseeable projects or actions that could, when added to the proposed plan alternatives, result in cumulative impacts include:

- Construction of the five Corps dams.
- Land uses in the study area.
- Past and present dredging and disposal activities undertaken by the Corps for navigation maintenance or flow conveyance, as well as dredging for ports and/or boat basins within the study area.
- Levee construction and modification.
- Re-licensing of dams within the Columbia/Snake River system.
- The Lower Snake River Juvenile Salmon Migration Feasibility Study.
- Columbia River Channel Improvement Project.

The Corps has conducted a series of studies to evaluate appropriate in-water and upland disposal sites for dredged material and the effectiveness of habitat creation with dredged material deposited in water in shallow and mid-depth areas. In addition, the Corps reviewed and considered major projects and plans from throughout the study area, both within and outside of their jurisdiction.

Plan alternatives considered in combination with past and present dredging and disposal activities and other reasonably foreseeable plans and projects are not anticipated to cumulatively adversely affect the resources analyzed in the DMMP/EIS. The in-water disposal to create juvenile salmonid rearing habitat, when coupled with other measures being taken by the region to improve fish passage, may have a positive effect on juvenile salmonid survival.

RECOMMENDED PLAN/PREFERRED ALTERNATIVE

The Corps' preferred alternative, or Recommended Plan, for long-term management of dredging is "Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise." Alternative 4 most completely and efficiently meets the project purpose and need at the least cost, while presenting potential environmental impacts that are no greater, and often less, than other alternatives considered.

The recommended plan also represents the greatest beneficial use of dredged material that can be implemented on a programmatic basis at this time. Furthermore, the plan incorporates an adaptive management approach that provides for on-going evaluation of proposed dredging and dredged material management activities and opportunities to adapt and adjust actions based on these evaluations. Alternative 4 provides the most flexibility for identifying, evaluating, and potentially implementing beneficial uses of dredged material. The plan becomes the basis for cost sharing of other beneficial uses of dredged material that may be identified in the future as each separate dredging activity is planned and executed. Beneficial uses of dredged material may be adopted on a case-by-case basis under this plan as opportunities become available and, if necessary, when local sponsors agree to fulfill sponsorship requirements. To continue to optimize the use of dredged material, the Corps will coordinate potential beneficial uses for each dredging activity with the LSMG prior to the start of dredging. Figure ES-4 displays the decision tree that the Corps would use to determine the type of dredging and the disposal plan for each activity.

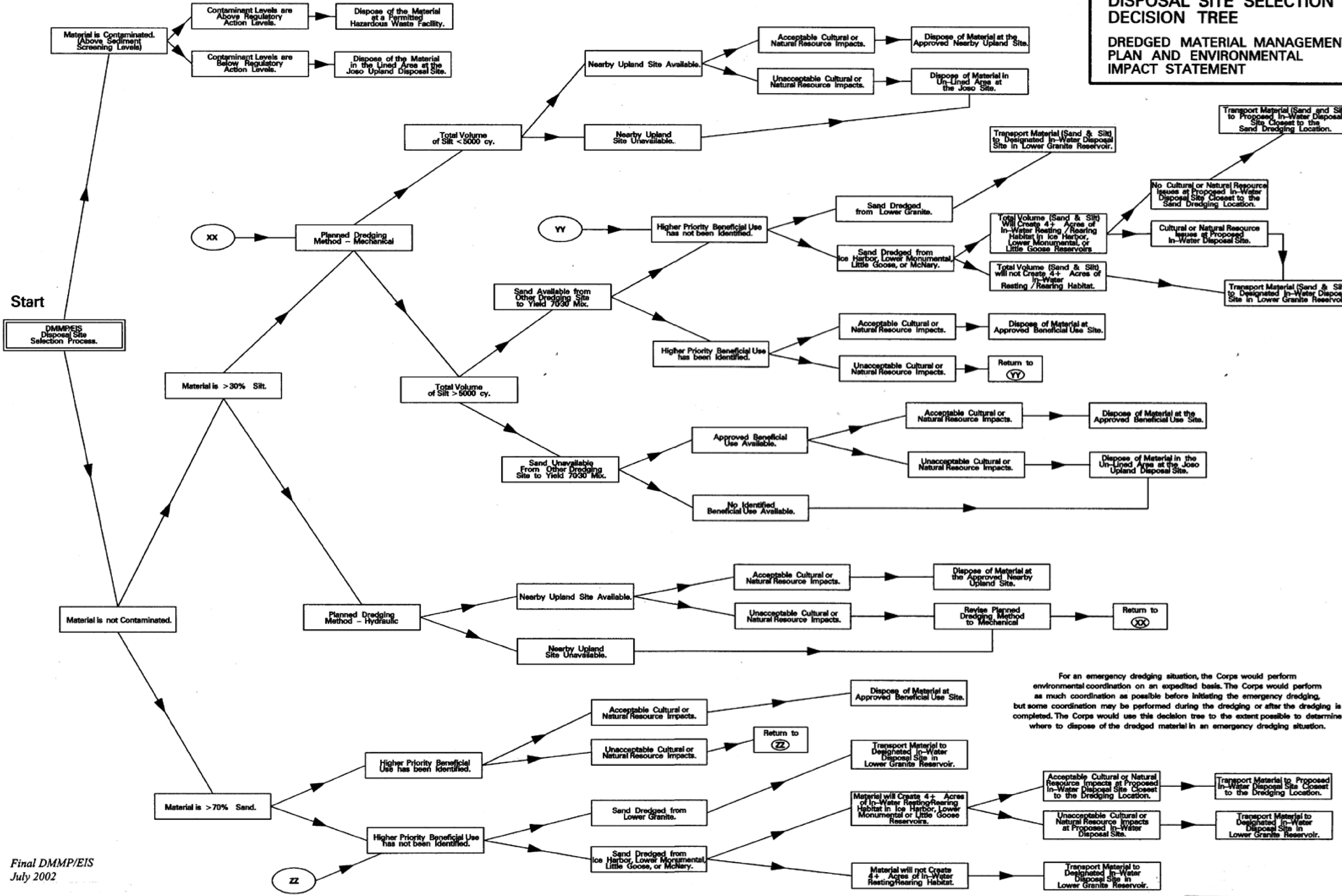
The 3-foot (0.9-m) levee raise feature is the preferred plan for maintaining the flow conveyance capacity in the Snake and Clearwater Rivers confluence area of Lower Granite reservoir because it meets the purpose and need and produces maximum net benefits in excess of costs. Raising the levee was found to reduce the need for dredging in the confluence area of Lower Granite reservoir and, therefore, is considered as a part of this DMMP. Selection of the levee raise as the preferred flow conveyance restoration method was based on the maximization of net benefits determined from a risk-based flood damage assessment and annual costs amortized over the remaining 74 years of the project life. Levee construction would not start until after 2005 and after any necessary appropriation and authorization is obtained.

Dredging projects implemented under this DMMP can be initiated in response to a variety of conditions described in the discussion of the Local Sediment Management Group above.

The Corps has identified the first dredging activity that would be conducted under the DMMP. This dredging is currently proposed for winter 2002-2003 and includes dredging the navigation channel at the confluence of the Snake and Clearwater rivers, several port facilities in the Lewiston-Clarkston area, several recreation facilities in Lower Granite and Little Goose reservoirs, navigation lock approaches to Lower Granite and Lower Monumental Dams, and several other potential areas. The Corps is currently proposing using dredged material to develop woody riparian habitat at the Chief Timothy Habitat Management Unit and/or using in-water disposal to create fish habitat in Lower Granite reservoir as the beneficial use of the dredged material. Appendix N provides a detailed description of the proposed dredging areas, the disposal plan, the sediment contaminant analysis, and the environmental impacts specific to this dredging activity.

DISPOSAL SITE SELECTION DECISION TREE

DREDGED MATERIAL MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT



For an emergency dredging situation, the Corps would perform environmental coordination on an expedited basis. The Corps would perform as much coordination as possible before initiating the emergency dredging, but some coordination may be performed during the dredging or after the dredging is completed. The Corps would use this decision tree to the extent possible to determine where to dispose of the dredged material in an emergency dredging situation.

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SECTION 1
INTRODUCTION

This Dredged Material Management Plan/Environmental Impact Statement (DMMP/EIS) presents the U.S. Army Corps of Engineers' Walla Walla District (Corps') programmatic plan for:

- Maintenance of the authorized navigation channel in the lower Snake River reservoirs between Lewiston, Idaho, and the Columbia River, and McNary Lock and Dam (McNary) reservoir on the Columbia River for 20 years after the Record of Decision (ROD) is signed.
- Maintenance of limited public facilities within the reservoirs, such as recreational boat basins and irrigation intakes for the wildlife habitat management units (HMUs).
- Management of dredged material from these reservoirs.
- Maintenance of flow conveyance capacity at the most upstream extent of the Lower Granite Lock and Dam (Lower Granite) reservoir for the remaining economic life of the project (to year 2074).

This section presents background and introductory information on the formulation of this DMMP/EIS, including the purpose and need, authorities for this study, and the Corps' operation of the lower Snake River and McNary reservoirs, historic maintenance and dredging activities, and related activities.

1.1 STUDY AUTHORITY

The Corps' Dredged Material Management Study (DMMS) was initiated under the guidance provided in Engineer Circular (EC) 1165-2-200, Dredged Material Management Plans, which directs the development of DMMP's for Federal navigation projects, groups of inter-related harbor projects, and systems of inland waterway projects. It is Corps policy to dispose of dredged material associated with the construction or maintenance dredging of navigation projects in a manner that is the least costly, is consistent with sound engineering practice, and that meets Federal environmental standards. Guidance for developing DMMPs is now incorporated in Engineer Regulation (ER) 1105-2-100, *Planning Guidance Notebook*. The ER 1105-2-100 also provides the requirements, as well as principles and guidelines, for conducting planning studies within the Corps' Civil Works program and ensuring environmental compliance through the planning process. Section 3-2 of ER 1105-2-100 provides specific guidance on the maintenance of navigation projects and the preparation of dredged material management plans. A least-cost alternative, which is compliant with environmental laws, forms the "base plan" against which other plan alternatives can be compared. Through the DMMP planning process, the Corps has considered a range of management strategies, including approaches to reduce the need for dredging and to beneficially use dredged materials, and has incorporated these strategies into its alternatives development and evaluation process.

On May 4, 1995, the Corps Director of Civil Works provided guidance to the Commander, North Pacific Division, by memorandum entitled "Lower Granite Lock and Dam, Washington, Sedimentation Studies Related to the Level of Protection Provided to the City of Lewiston, Idaho." This memorandum discussed a study to evaluate restoring the performance of project levees constructed to protect Lewiston, Idaho, from inundation caused by the Lower Granite project. It states, "The study should evaluate a range of alternative risk management plans, including modifications in the operation of the project and increased dredging." In compliance with this memorandum, consideration of reestablishing the flow conveyance capacity at Lewiston, Idaho, is included in the DMMS.

1.2 PURPOSE AND NEED

The purpose of this DMMP/EIS is threefold:

1) To develop and evaluate alternative programs to maintain the authorized navigation channel and certain publicly owned facilities in the lower Snake River and McNary reservoirs for the next 20 years;
2) To develop and evaluate alternative measures to maintain the flow conveyance of the Lower Granite reservoir for the remaining economic life of the project (through 2074); and
3) To develop and evaluate alternative programs of managing dredged material removed from these five reservoirs in a cost-effective, environmentally acceptable, and, wherever possible, beneficial manner.

The Corps is authorized by Congress to maintain a navigation system on the lower Snake and Columbia Rivers and to manage the lock and dam/navigation projects (generally referred to as "projects" or "reservoirs" in this document) on the lower Snake River from Lewiston, Idaho, to the McNary project at Umatilla, Oregon, on the Columbia River (which includes the confluence of the Columbia and Snake Rivers). The Corps also maintains publicly owned recreational areas (such as marinas and swimming beaches), irrigation intake facilities for wildlife Habitat Management Units (HMUs) and recreation sites, and port access channels within the lower Snake River and McNary reservoirs. Historically, the Corps has dredged accumulated sediments from the navigation channel and the other facilities noted above on these reservoirs in order to maintain their operational capacities. Maintenance dredging actions are in response to a variety of conditions including, but not limited to: emergency situations which would result in an unacceptable hazard to navigation; programmed periodic dredge maintenance of known persistent shoal areas which impede navigation; and removal of sediment that presents a hydraulic flow impediment.

In addition, sediment accumulation in the upstream reach of Lower Granite reservoir at the confluence of the Clearwater and Snake Rivers has reduced the flow conveyance capacity of the river channel. If allowed to continue, this sedimentation would reduce the flow capacity to a point that the Standard Project Flood [(SPF) an estimated or hypothetical flood that might be expected from the most severe combination of weather and flow conditions that are considered reasonably characteristic of the geographical area] would be expected to overtop the levees in Lewiston, Idaho, long before the end of the economic life of the project is reached in 2074 (Corps, 1993). To date, dredging has been the method of choice for the removal of this sediment and restoration of the flow capacity.

The Corps policy stated in EC 1165-2-200 relates to development of a DMMP to address the dredged material management requirements of the navigation projects within its jurisdiction. This policy encourages the development of a range of feasible management alternatives that are cost effective and environmentally acceptable, and to seek to optimize beneficial uses of dredged materials that may be generated. In preparing the DMMP, the Corps will assess opportunities to minimize dredging requirements and maximize beneficial uses of dredged materials.

The Corps, Walla Walla District, is preparing this DMMP/EIS to address the maintenance of the authorized navigation channel and specific public facilities for 20 years after the ROD is signed. This DMMP/EIS presents and analyzes management alternatives and addresses management of dredged materials that are likely to result from these activities.

In addition, since dredging for flow capacity represents a significant quantity of historically dredged material volumes, this DMMP/EIS evaluates future maintenance of flow conveyance through the remaining economic life of Lower Granite. Various methods to maintain flow conveyance in Lower Granite are considered, including dredging and raising the existing levees in Lewiston as a means of reducing dredged material volumes.

The development of the DMMP/EIS is consistent with the requirements of EC 1165-2-200 and has been integrated with the requirements of the National Environmental Policy Act (NEPA).

1.3 DESCRIPTION OF THE STUDY AREA

Navigation on the Columbia and Snake Rivers has historically provided an important route of access into and from the interior Columbia and Snake River basins (plate 1). As a part of its Congressional mandate, the Corps continues to maintain, enhance, and operate the navigational improvements on the Columbia and Snake Rivers waterway. The Columbia and Snake Rivers projects include channels, locks, and dams providing access to the ports, moorage, and recreational areas along the rivers.

The Corps typically maintains authorized channels on an as-needed basis by dredging to maintain the authorized channel depth. Maintenance dredging of access channels to port and moorages occurs infrequently, on an as-needed basis. The Corps also periodically conducts maintenance dredging around public recreation areas, such as swimming beaches, boat basins, and irrigation intakes for wildlife HMUs and recreation sites managed by the Corps.

The Columbia and Snake Rivers navigation project begins at the mouth of the Columbia River near Astoria, Oregon, and extends to Lewiston, Idaho, on the Snake River, a distance of approximately 460 miles [740.3 kilometers (km)]. A 40-foot- [12.2-meter (m)-] deep, 600-foot- (182.9-m-) wide ship channel is authorized from the Columbia River Bar to Vancouver, Washington, and a 27-foot- (8.2-m-) deep, 300-foot- (91.4-m-) wide ship channel is authorized from Vancouver to The Dalles Lock and Dam (The Dalles) on the Columbia River. The 27-foot- (8.2-m-) deep channel is typically only maintained to a 17-foot (5.2-m) depth, reflecting the needs of vessels using this reach. A 14-foot- (4.3-m-) deep, 250-foot- (76.2-m-) wide channel is maintained from The Dalles through McNary on the Columbia River and through the four lower Snake River projects to Lewiston, Idaho.

Sill depths at the navigation locks limit the passage of vessels, commercial or recreational, on the Columbia and Snake Rivers. At most of the projects, upstream sills are 15 feet (4.6 m) below the Minimum Operational Pool (MOP). The MOP provides the clearance needed for a barge drafting between 13 and 14 feet (4 and 4.3 m), the typical draft of loaded barges operating in the Columbia and Snake River fleet.

This document covers five locks and dams for the upper portion of the Columbia and Snake Rivers navigation project: McNary, Ice Harbor Lock and Dam (Ice Harbor), Lower Monumental Lock and Dam (Lower Monumental), Little Goose Lock and Dam (Little Goose), and Lower Granite. Each of these projects is authorized to provide navigation facilities including locks with dimensions of 86 feet (26.2 m) in width and over 665 feet (202.7 m) in length to allow passage of a tug with a four-barge tow commonly used in river navigation. McNary lock provides a lift of approximately 75 feet (22.9 m), while each of the four Snake River locks and dams provide between 98- and 100-foot (29.9- and 30.5-m) lifts, raising navigation from elevation 265 feet mean sea level (msl) below McNary to elevation 738 feet msl in the Lower Granite reservoir. This portion of the waterway extends approximately 179 miles (288.1 km) from McNary to Lewiston, Idaho. The initial McNary project, including construction of the locks, was completed in 1954 and provided slackwater navigation to the Tri-Cities, Washington, area.

Ice Harbor, which began operation in December 1961, is approximately 8 miles (12.9 km) east of Pasco, Washington, and was the first dam constructed on the Snake River in Washington. Three more dams were built on the Snake River in Washington over the next 13 years: Lower Monumental (1969), Little Goose (1970), and Lower Granite (1975). Construction of these dams has created a series of slackwater reservoirs on the Snake River, adding an additional 140 miles (225.3 km) to the Columbia and Snake Rivers shallow draft inland navigation system. This navigation system has resulted in a significant shift in the economy of eastern Washington as new inland ports have become established to handle the needs of barge shippers. Wheat, barley, wood chips, and other wood products are the primary commerce downbound from this region, with petroleum and fertilizer the principal commerce upbound. These shipments depend on the availability of a navigation system that provides a 14-foot (4.3 m) draft channel for barge tows.

1.4 EXISTING FEDERAL PROJECT AUTHORITY

The portion of the Columbia and Snake Rivers navigation system addressed in this DMMP/EIS was authorized by Section 2 of the River and Harbor Act of 1945 (Public Law 79-14, 79th Congress, 1st Session) and approved March 2, 1945, in accordance with House Document 704, 75th Congress, 3rd Session. The projects include:

- McNary Lock and Dam - Lake Wallula, Columbia and Snake Rivers, Oregon and Washington.
- Ice Harbor Lock and Dam - Lake Sacajawea, Snake River, Washington.
- Lower Monumental Lock and Dam - Lake Herbert G. West, Snake River, Washington.
- Little Goose Lock and Dam - Lake Bryan, Snake River, Washington.
- Lower Granite Lock and Dam - Lower Granite Lake, Snake River, Washington.

Each of these projects is authorized to provide for slackwater navigation, irrigation, hydroelectric power generation, recreation, and fish and wildlife.

Public Law 87-874, Title II - Flood Control Act of 1962, October 23, 1962, states:

"COLUMBIA RIVER BASIN

> The projects and plans for the Columbia River Basin, including the Willamette River Basin, authorized by the Flood Control Act of June 28, 1938, and subsequent Acts of Congress, including the Flood Control Acts of May 17, 1950, September 3, 1954, July 3, 1958, and July 14, 1960, are hereby modified to include the projects listed below for flood control and other purposes in the Columbia River Basin (including the Willamette River Basin) substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 403, Eighty-seventh Congress: *Provided*, That the depth and width of the authorized channel in the Columbia-Snake River barge navigation project shall be established as fourteen feet and two hundred and fifty feet, respectively, at minimum regulated flow."

Public Law 102-580, Water Resources Development Act of 1992, Section 109, authorizes the Secretary of the Army to maintain navigation access to, and berthing areas at, all currently operating public and private commercial dock facilities associated with or having access to the Federal navigation project on the Columbia, Snake, and Clearwater Rivers from Bonneville Lock and Dam (Bonneville) to, and including, Lewiston, Idaho, at a depth commensurate with the Federal navigation project. A one-time appropriation, to carry out the provisions of this section, was made in fiscal year 1992. Future Federal maintenance of non-Federal commercial channels authorized under this Act would require special appropriation legislation. The Corps is also authorized to maintain associated publicly owned recreation areas and wildlife HMUs.

Lower Granite includes levees as appurtenant facilities of the authorized project to allow normal operating water surface elevations of 733 to 738 feet msl in the Lewiston, Idaho, and Clarkston, Washington, areas. These backwater levees constructed around Lewiston were designed to protect the city from inundation during the occurrence of the SPF and to maintain flow conveyance capacity.

1.5 HISTORY AND BACKGROUND

Several locations along the Snake and Columbia Rivers have required periodic dredging to maintain the authorized channel depth, and several ports have experienced frequent sediment-related problems in accessing their loading or docking facilities. In the 8-year period from 1991 through 1998, there were navigation-related dredging activities in all of the reservoirs in the study reach. Some of these dredging projects were directed toward cleaning out berthing areas, turning basins, and access channels for individual ports, and some were directed toward restoring the authorized depth in the main navigation channel. The Corps has also performed periodic maintenance dredging of relatively small amounts of sediments around public recreation areas and irrigation intakes for wildlife management areas. Table 1-1 presents the history of dredging of this system.

Table 1-1. History of Dredging in Lower Snake River and McNary Reservoirs.

Dredging Location	Year	Purpose	Amount Dredged Cubic Yards (cy) (m^3)	Disposal
Excavation of Navigation Channel Ice Harbor Lock & Dam Part I & II, Channel Construction	1961	Navigation	3,309,500 (2 530 294)	Unavailable
Navigation Channel Ice Harbor Lock and Dam Part III, Channel Construction	1962	Navigation	120,000 (91 746.6)	Unavailable
Downstream Navigation Channel Ice Harbor Lock and Dam	1972	Navigation	80,000 (61 164.4)	Unavailable
Downstream Approach Navigation Channel Lower Monumental Lock and Dam	1972	Navigation	25,000 (19 113.9)	Unavailable
Navigation Channel Downstream of Ice Harbor Lock and Dam	1973	Navigation	185,000 (141 442.6)	Unavailable
Downstream Approach Channel Construction Lower Monumental Lock	1977	Navigation	10,000 (7 645.5)	Unavailable
Downstream Approach Channel Construction Ice Harbor Lock	1978	Navigation	110,000 (84 101)	Unavailable
Downstream Approach Channel Construction Ice Harbor Lock	1978/ 81/82	Navigation	816,814 (624 499.1)	Unavailable
Recreation Areas (Corps)	1975 - Present	Recreation	20,000 (15 291.1)	Upland Sites
Port of Lewiston – Lower Granite Reservoir (Corps)	1982	Navigation/ Maintain Flow Conveyance Capacity	256,175 (195 859.8)	

Table 1-1. History of Dredging in Lower Snake River and McNary Reservoirs (continued).

Dredging Location	Year	Purpose	Amount Dredged Cubic Yards (cy) (m^3)	Disposal
Port of Clarkston – Lower Granite Reservoir(Port)	1982	Navigation	5,000 (3 822.8)	Upland Site
Downstream Approach Channel Construction Ice Harbor Lock	1985	Navigation	98,826 (75 557.9)	In-Water
Confluence of Clearwater and Snake Rivers (Corps)	1985	Maintain Flow Conveyance Capacity	771,002 (589 473.3)	Wilma HMU
Port of Lewiston – Lower Granite Reservoir (Corps)	1986	Navigation/ Maintain Flow Conveyance Capacity	378,000 (289 001.7)	Upland Sites
Confluence of Clearwater and Snake Rivers (Corps)	1988	Maintain Flow Conveyance Capacity	915,970 (700 309.3)	In-Water
Confluence of Clearwater and Snake Rivers (Corps)	1989	Maintain Flow Conveyance Capacity	993,445 (759 543.2)	In-Water
Schultz Bar – Little Goose Reservoir (Corps)	1990	Navigation	27,335 (20 899.1)	Not Applicable
Confluence of Clearwater and Snake Rivers (Corps)	1992	Maintain Flow Conveyance Capacity	520,695 (398 099.9)	In-Water
Ports of Lewiston (Lower Granite Reservoir), Almota, and Walla Walla	1991/92	Navigation	90,741 (69 376.5)	Unavailable
Boise Cascade – McNary Reservoir near Wallula, WA	1992	Navigation	120,742 (92 313.9)	In-Water
Port of Kennewick – McNary Reservoir	1993	Navigation	6,130 (4 686.7)	Not Applicable
Schultz Bar – Little Goose Reservoir (Corps)	1995	Navigation	14,100 (10 780.2)	In-Water
Confluence of Clearwater and Snake Rivers (Corps)	1996/97	Navigation	68,701 (52 525.7)	In-Water
Confluence of Clearwater and Snake Rivers (Corps)	1997/98	Navigation	215,205 (164 536)	In-Water
Greenbelt Boat Basin Clarkston – Lower Granite Reservoir	1997/98	Navigation	5,601 (4 282.3)	In-Water
Port of Lewiston – Lower Granite Reservoir (Port)	1997/98	Navigation	3,687 (2 818.9)	In-Water
Port of Clarkston – Lower Granite Reservoir(Port)	1997/98	Navigation	12,154 (9 292.4)	In-Water
Lower Granite Navigation Lock Approach	1997/98	Navigation	2,805 (2 144.6)	In-Water
Lower Monumental Navigation Lock Approach	1998/99	Navigation	5,483 (4 192.1)	In-Water

Source: U.S. Fish and Wildlife Service (USFWS), August 1998/Corps, July 19, 1995, and September 2, 1999.

Several major tributaries enter the Snake or Columbia Rivers within the study area, and most are heavy sediment contributors in high runoff years. Projections of sediment inflow and deposition indicate more sediment buildup at the tributary mouths that may, over time, affect the navigation channel, requiring more frequent dredging at these locations.

Lower Granite, the most upstream of the four lower Snake River dams, is the final link in the inland waterway system that provides slackwater navigation to the cities of Lewiston, Idaho, and Clarkston, Washington. Because this reservoir is the most upstream in the lower Snake River system, it is the predominant sediment collection area for a large sediment-contributing drainage area that includes the Salmon, Grande Ronde, and Imnaha Rivers; the main stem of the Clearwater River; and the local drainage of the Snake River between the Hells Canyon complex and Lower Granite. The upper reach of the Lower Granite reservoir serves as a sediment trap for most of the material carried in suspension in the free-flowing reaches of the contributing rivers. The quantity of sediment that collects in the Lower Granite reservoir exceeds the quantities observed in each of the other lower Snake River reservoirs and in the McNary reservoir.

The deposition of sediments at the upstream end of the Lower Granite reservoir impacts backwater levee systems constructed at the cities of Lewiston and Clarkston. The Lower Granite project included a backwater levee system in lieu of relocating the business district of Lewiston. This levee system was not designed primarily to provide flood control to Lewiston; rather, it was designed and constructed to be an upstream extension of the dam. This project element was designed to allow the Lower Granite reservoir to pass an SPF event while protecting Lewiston from inundation.

The levee system was designed to provide a minimum freeboard of 5 feet (1.5 m) during the SPF event of 420,000 cubic feet per second (cfs) [11 893.1 cubic meters per second (m^3/s)] on the Snake River below the confluence of the Clearwater River. Since the reservoir was filled in 1975, sediment deposition has reduced the channel capacity, causing the computed water surface elevations associated with a particular discharge to rise. The sedimentation deposition has restricted the channel so that the SPF event cannot pass without seriously encroaching into the levee freeboard. Subsequent studies conducted by the Corps indicate that overtopping of the levees could occur in the future.

Sediment accumulation in Lower Granite reservoir continues to reduce the level of protection provided by the levees. Less than 3 feet (0.9 m) of the originally designed 5 feet (1.5 m) of levee freeboard remain for the SPF. Approximately 2.2 million tons (2.0 metric tons) or 3.2 million cy (2.4 million m^3) of sediment collects in the reservoir annually. During the first 12 years of operation, the average annual reduction in levee freeboard was 3 inches [7.6 centimeters (cm)] per year. Projections indicate that, without corrective action, the SPF could overtop the existing levees.

A dredging and experimental in-water disposal test program was conducted over the period between 1985 and 1993 to determine acceptable solutions to the sedimentation problems in Lower Granite reservoir. Disposal of dredged material was a problem due to limited availability of upland disposal sites combined with the need to dredge for navigation and flow conveyance. Dredged material from the upper reservoir was considered to be potentially beneficial in creating shallow water habitat. Shallow water habitat provides foraging opportunities and short-term rearing for downstream migrating salmonid fishes and spawning and rearing habitat for resident game fishes. This experimental in-water disposal test was implemented in 1985 with an exhaustive monitoring program to assess the value of using dredged material for fish habitat enhancement. As a part of this test, an underwater bench and island (Centennial Island) were constructed at mid-depth (20 to 60 feet) (6.1 to 18.3 m) with additional disposal at a deep-water (greater than 60 feet) (greater than 18.3 m) site between river mile (RM) 120 and Lower Granite. Fish assemblages were sampled before the test began in 1985 and after construction of the dredged disposal island in 1993 to assess local changes in community structure. The results of this test suggest that construction of shallow water habitat using dredged material has a potential for increasing habitat complexity in Lower Granite reservoir.

1.6 RELATED ACTION PROGRAMS

In February 2002, the Corps issued the Final Environmental Impact Statement (FEIS) for the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study), which analyzed measures that may increase the survival of juvenile anadromous fish through the lower Snake River project [which includes the four lowermost dams operated by the Corps on the Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite)] and assist in the recovery of listed salmon and steelhead stocks. Several key aspects of the Feasibility Study and this DMMP/EIS are interrelated. The history of the development of the Feasibility Study and its relationship to this DMMP/EIS are discussed below. The Final Feasibility Study EIS and supporting documentation are incorporated by reference in the DMMP process.

On November 20, 1991, the National Marine Fisheries Service (NMFS) declared the Snake River sockeye salmon as Endangered effective December 20, 1991 (56 FR 58619). Snake River spring/summer chinook and Snake River fall chinook salmon were listed as Threatened on April 22, 1992 (57 FR 14653). Critical habitat was designated for Snake River sockeye, spring/summer chinook, and fall chinook salmon on December 28, 1993 (58 FR 68543). Snake River basin steelhead were formally listed as Threatened on August 18, 1997 (62 FR 43937).

On March 2, 1995, NMFS issued a Biological Opinion for the Reinitiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years. The 1995 Biological Opinion established measures necessary for the survival and recovery of Snake River salmon listed under the Endangered Species Act (ESA).

The Corps' primary responsibility in implementing the measures prescribed in the 1995 Biological Opinion is to study those measures that are associated with dams and reservoirs and that influence fish migration through the hydro system. Thus, the purpose of the Feasibility Study is to evaluate and screen alternative measures that may increase the survival of juvenile anadromous fish through the lower Snake River project and, therefore, assist in the recovery of listed salmon and steelhead stocks.

The Feasibility Study considered four alternatives; three of the alternatives would keep the dams in place, while one alternative includes breaching of the earthen portion of the four dams. Breaching the dams would allow the lower Snake River to return to a more free-flowing condition, while eliminating hydropower production and the ability to use river navigation for the shipments of goods between the Lewiston-Clarkston area and the Tri-Cities area. The Corps considered public input on the Feasibility Study received through extensive outreach and public comments on the Draft FR/EIS. The recommended plan documented in the Feasibility Study Final EIS is "major system improvements (adaptive migration)," and features structural and operational measures that are considered to be technically feasible, and which the Corps has the capability to design, construct, and operate.

The Feasibility Study process and its ultimate recommendations may affect the management of the lower Snake River and McNary reservoirs. This DMMP/EIS addresses long-term (20 years) management of dredged material by providing a programmatic "framework" or "road map." As such, this DMMP/EIS incorporates a number of assumptions about the future operations of the lower Snake River projects, including the assumption of continued navigation on the lower Snake River (i.e., that the four lower Snake River dams would not be breached). However, by incorporating this assumption, the DMMP/EIS does not pre-determine the outcome of the Feasibility Study process, nor whether the lower Snake River dams would be kept in place or breached. In fact, the DMMP is based upon an adaptive management approach that would allow the Corps a degree of flexibility to accommodate certain regulatory, policy, or environmental changes over the 20-year timeframe of the plan.

As a programmatic plan, this DMMP/EIS accounts for the fact that the Feasibility Study process may determine that the lower Snake River dams are to stay in place, be modified in place, or breached. If the dams stay in place, this DMMP/EIS would continue to set the management objectives for the lower Snake River and McNary reservoirs. On the other hand, if the Feasibility Study process concludes that the dams should be modified or removed, this DMMP/EIS would be necessary for the interim management of the lower Snake River projects. Also, if the lower Snake River dams are breached, this DMMP/EIS would need to be revised to address the changed navigation and sedimentation conditions in McNary reservoir. On the other hand, data from the NMFS 2000 BiOp check-in points in 2003, 2005, and 2008 and other new information could result in a decision to modify or breach these four dams, this DMMP would still be necessary for interim management and to address conditions in the McNary Reservoir.

After publication of the Draft FR/EIS, NMFS issued a Biological Opinion (December 21, 2000) to the Bonneville Power Administration (BPA), the Corps, and the Bureau of Reclamation. In this Biological Opinion, NMFS calls for various Habitat Actions. One of the stated goals of these Habitat Actions as they apply to main stem habitat is to "improve main stem habitat on an experimental basis and evaluate the results." The specific Action Item, Action #155, states that, "BPA, working with the BOR, Corps, the Environmental Protection Agency (EPA), and the U.S.

Geological Survey, shall develop a program to: (1) identify mainstem habitat sampling reaches, survey conditions, describe cause-and-effect relationships, and identify research needs; (2) develop improvement plans for all mainstem reaches; and (3) initiate improvements in three mainstem reaches. Results shall be reported annually." As one means of achieving this, the Biological Opinion states that, "BPA, working with the Corps, will take immediate steps to begin to address these uncertainties by . . . improving mainstem reaches in ways that mimic the range and diversity of the historic habitat conditions as much as possible, and monitoring and evaluating the results." The beneficial use of dredged materials, including development of mid-depth and shallow water rearing habitat as proposed in this DMMP/EIS would contribute toward these actions proposed by NMFS.

Whatever the outcome of the Feasibility Study process, this DMMP/EIS would provide management guidance over the short term. The adaptive management approach of the DMMP's recommended plan would also allow it to be modified or amended to account for changes that may occur to the system over the next 20 years.

1.7 ECONOMIC JUSTIFICATION

The recommended DMMP is economically justified by confirming that transportation savings over the next 20 years resulting from the dredging program exceed the cost of maintenance of the navigation project. Benefits in transportation costs to barge shippers of commodities on the lower Snake River system were compared with the cost of providing the authorized channel depths and maintaining the navigation features of the system.

Justification for the restoration of flow conveyance capacity in the Lower Granite reservoir is determined by comparing costs of alternatives to increase conveyance with the expected reduction in flood damages based on the results of a risk-based flood damage assessment. Economic feasibility of an acceptable alternative to restore flow conveyance capacity is based on maximization of net benefits computed over the remaining economic life of the project to year 2074 at a 6.875 percent interest rate.

1.7.1 Navigation

Barge navigation on the lower Snake River system accommodates the downbound transport of wheat, barley, wood chips, other wood products, and miscellaneous agricultural products and the upbound transport of petroleum, fertilizer, and other consumer goods. The authorized navigation project on the lower Snake River provides 14 feet (4.3 m) of depth at normal operating pool levels. Impacts to shallow draft commercial navigation from sedimentation and shallowing of the authorized channels above McNary are estimated from information presented in the Columbia River System Operation Review, Final Environmental Impact Statement, dated November 1995, Appendix O, Economic and Social Impact, page 453. Transportation costs for commerce moving to and from the Snake River projects on the Columbia and Snake Rivers system were estimated at $414.43 million in 1992 under present authorized channel depths. The cost of transporting the same commerce over alternative landforms of transportation was estimated to be $458.33 million. The difference of $43.90 million (that is, $458.33 minus $414.43) can be considered the annual benefits attributable to barge navigation on the Snake River system. A similar evaluation was presented in the February 2002 FR/EIS. The FR/EIS estimated the increased average annual transportation costs resulting from the elimination of barge transportation at $43.191 million in 2002 dollars [Snake River Juvenile Salmon Migration Feasibility Report/EIS, appendix I, February 2002, Table ES-15]. Wheat and barley shipments represented more than 60 percent of the tonnage and more than 90 percent of the transportation savings. Barge commerce above McNary is expected to continue to grow over the next 20 years and transportation benefits are expected to grow similarly. Forecasts of barge transportation in the 20-year period of this DMMP/EIS show tonnage to increase to between 7.9 and 10 million tons (7.1 and 9.0 metric tons) by the year 2020 from nearly 7 million tons (6.3 metric tons) in the mid-1990's.

Average annual costs to provide the dredging maintenance of channels and operate the navigation features in the five dams and reservoirs were estimated and compared with estimates of transportation savings described above to determine the economic justification of continued maintenance of the system. Channel maintenance average annual costs are estimated at $560,000 computed over the 20-year period at a 6.875 percent interest rate. This cost estimate is based on maintaining the authorized navigation channel dimensions over the next 20 years using clamshell dredging, bottom-dump barges, and in-water disposal of the dredged material. Use of hydraulic equipment was not considered acceptable because of the anticipated adverse impact on endangered fish resources. Disposal at upland sites instead of in-water sites was considered, but found to be more costly and provide less environmental benefit than in-water disposal. In addition to channel maintenance costs, annual costs include $2.14 million (expended in fiscal year 1998) for the operation and maintenance of navigation locks at each of the five reservoir projects. Comparing the annual $43.191 million in transport savings estimated for just the Snake River portion with the combined channel average annual maintenance and 1998 navigation lock operation and maintenance costs of $2.70 million ($0.56 + $2.14) results in a benefit-to-cost ratio of 16.0 to 1.0. This portion of the Columbia and Snake River navigation system provides a very strong economic justification for the continued maintenance of this system. The study described in section 1.6 considers various levels of navigation clearances and evaluates the resultant effects. All alternatives described in this DMMP/EIS provide 14-foot (4.3-m) navigation clearances over the Federal navigation system. Appendix A, Hydrologic Analysis, contains a summary description of the dredging operations and appendix B, Cost Estimates, presents the cost estimate of each dredging and disposal alternative.

Consideration can also be given to reduced maintenance that would result in a change in depth to the authorized Federal channel causing transportation companies to light load their equipment to accommodate a shallower channel. Navigation benefits and dredging costs can be compared on an incremental basis for different channel conditions to determine if channel maintenance is more cost effective than light-loading barges. Commodity transportation and barge cost data prepared for the Lower Snake River Feasibility Study were used to determine the feasibility of the maintenance dredging proposed and evaluated in the DMMP/EIS. For this analysis two shallower Federal navigation channels, with controlling depths of 13 feet and 12 feet, were assumed to result from termination of maintenance dredging. Grain shipments, representing 78.8% of the commerce on the Snake River for the period of 1987 to 1996, were selected to represent the impacted commerce. Grain barge costs for shipments from the various ports on the Snake River system were developed to reflect light-loading to accommodate the shallower channels. Reduced cargo capacity of the standard 3,600-ton grain barge (274 feet long, 42 feet wide, and 13.5 feet draft) with drafts of 12.5 feet and 11.5 feet were determined to be 3,270 tons and 2,950 tons, respectively. The impact of this reduced capacity would be to raise per ton barge costs by 10% and 22%, respectively. The resultant increase in transportation costs for moving the forecast grain shipments from the Snake River in the 20-year period was compared to the avoided annual cost of maintenance dredging. The result of this analysis, based on 1999 costs, indicated that dredging costs were equal to the estimated increase in barge costs when the channel capacity was reduced by only one foot. However, where channel depths were reduced by two feet, the cost of dredging was about half of the increased cost to barge transportation. In essence, shoaling that reduces the channel depth by one foot represents the " break even" point where maintenance dredging is feasible and cost effective when only grain shipments are considered. While this study was not an exhaustive analysis of the feasibility of reduced channel maintenance dredging, it indicates that dredging was more cost effective than light loading the present barge equipment. If all the waterborne commerce on the Snake River is considered the maintenance dredging of the channel would be clearly more feasible and cost affective than light loading barges.

1.7.2 Conveyance Capacity

Existing levees, protecting the city of Lewiston, Idaho, from reservoir backwaters, were built as a part of the construction of Lower Granite. Sediment deposition in the Lower Granite reservoir threatens to reduce the channel capacity and cause flows to overtop levees and flood developed areas. Correction of this condition has been the subject of memoranda between the Walla Walla District and Corps Headquarters. In a memorandum dated May 4, 1995, the Director of Civil Works, Corps of Engineers, stated that a study was needed to evaluate restoring the performance of the project levees constructed to protect Lewiston, Idaho. It further stated, "The study should evaluate a range of alternative risk management plans, including modifications in operation of the project and increased dredging." Flow conveyance could be provided by dredging and, therefore, it was considered appropriate to formulate the plan as part of this DMMP/EIS. This DMMP/EIS includes the results of the risked-based analysis conducted to determine the appropriate means of restoring the flow conveyance capacity in the confluence area of Lower Granite reservoir.

Risk-based analysis is an approach to evaluation and decision making that explicitly incorporates considerations of risk and uncertainty. This approach combines the underlying risk and uncertainty information so that the engineering and economic performance of a project can be expressed in terms of probability distributions. The objective is to identify and recommend a flood damage reduction alternative that reasonably maximizes expected net benefits (expected annual damages reduced minus the average annual cost of the alternative). No longer is protection against the SPF with 5 feet (1.5 m) of freeboard the criteria for the levees protecting the Lewiston-Clarkston area. As of 1977, the base year for the analysis, the project provided protection against a flow condition having a recurrence interval of 500 years. Sedimentation in the confluence area would reduce the protection by the year 2021 to a 167-year recurrence interval and by 2074 to a 83 year recurrence interval without any upgrade to the levee system.

A number of measures were considered to restore the flow conveyance capacity including making operational changes, dredging additional material to provide adequate channel capacity below elevation 738 feet msl, and raising the height of the existing levees to allow for water surface increases. Operational changes were found not to be an effective method of restoring flow conveyance capacity, as discussed in section 2, and this study concentrated on dredging and levee raise alternatives. All flow restoration options were considered to provide the flow conveyance needed after the navigation maintenance dredging program (considered the baseline in this study) had been implemented. Various dredging options including removing 300,000 cy (229 366.5 m^3) per year, 1 million cy (764 555 m^3) per year, and 2 million cy (1 529 110 m^3) per year were considered. Levee modifications providing nominal raises of 3 feet (0.9 m), 4 feet (1.2 m), 8 feet (2.4 m), and 12 feet (3.7 m) were also considered. These levee raise alternatives are identified nominally by their largest levee height increase expressed to the nearest foot (meter). This identification is nominal since the actual levee raise varies along the length of the existing levee. Where necessary to protect against design water surface profiles for nominal levee raises exceeding 3 feet (0.9 m), the levee footprint was extended upstream as described in appendix E, Lewiston Levee Modification Extension Analysis. Cost estimates were developed for each of the dredging and levee raise alternatives and converted to annual costs based on 6.875 percent interest over the remaining life of the project to year 2074. Only those dredging costs above the base navigation maintenance plan were accepted as costs relating to flow conveyance capacity. Flood damage reduction estimates were obtained using the Corps Hydrologic Engineering Center Flood Damage Assessment (HEC-FDA) model. This model is consistent with the Corps' Engineering Manual 1110-2-1619, *Risk-Based Analysis for Flood Damage Reduction Studies*. Results from the risk-based model were converted to average annual damages reduced for each alternative and compared to their annual cost.

The risk-based flood damage assessment and economic analysis, presented in appendix C, Economic Analysis, indicates that a nominal levee raise of 3 feet (0.9 m) provides maximum net flood damage reduction benefits. Information presented on page 48 of appendix C was converted to average annual costs and benefits. This economic analysis shows that a nominal 3-foot (0.9-m) levee raise would have annual costs of $152,000 and annual flood damage reduction benefits of $689,000 with a net benefit of $537,000. A levee alternative providing a nominal 4-foot (1.2-m) raise would have average annual costs of $938,000 and annual flood damage reduction benefits of $793,000, producing net benefits of -$145,000. A dredging alternative providing somewhat higher flood damage reduction benefits to the 3-foot (0.9 m) levee raise would have annual costs of $1,233,000, approximately eight times greater than the levee alternative. The value of average annual flood damages that could occur without a modification was computed to be $941,000 over the life of the project discounted by 6.875 percent. None of the flow conveyance alternatives with annual costs that exceeded $941,000 could be considered economically feasible and, therefore, were not considered further. Accordingly, dredging alternatives to provide flow conveyance with average annual costs ranging from $1,233,000 to $4,706,000 are not considered feasible. Table 1-2 presents the results of these economic investigations. Appendix C and the remainder of this DMMP/EIS provide the details of the economic studies, with the incremental analysis results and discussion of impacts and mitigation requirements.

Table 1-2. Comparison of Alternatives.

Alternative	Annual Alternative Costs(1)	Annual Damages Reduced(2)	Net Annual Benefits
No Action (No Change) Maintenance Dredging	$0.0	$0.0	$0.0
3-Foot (0.9-m) Levee Raise	$152.0	$689.0	$537.0
4-Foot (1.2-m) Levee Raise	$938.0	$793.0	-$145.0
8-Foot (2.4-m) Levee Raise	$2,595.0	(3)	(3)
12-Foot (3.7-m) Levee Raise	$4,259.0	(3)	(3)
300,000 cy (229 366.5 m^3) Dredge	$1,233.0	(3)	(3)
1 million cy (764 555 m^3) Dredge	$1,911.0	(3)	(3)
2 million cy (1 529 110 m^3) Dredge	$4,706.0	(3)	(3)

Notes:
(1) Costs presented in this table are in $1,000 computed as average annual values computed at 6.875 percent interest for the period 2001 to 2074 from table 10, page 51 of appendix C.
(2) Benefits presented are in $1,000 computed as average annual values at 6.875 percent interest for the period 2001 to 2074 based on values presented in table 11, page 52 of appendix C.
(3) All of these alternatives have annual costs that exceed the total annual damages computed at 6.875 percent interest for the period 2001 to 2074 from values presented on page 48 of appendix C.

1.8 LOCAL SEDIMENT MANAGEMENT GROUP

A Local Sediment Management Group (LSMG) has been formed, and has met on three occasions (July 2000, February 2001, and December 2001), to provide input in the development of this DMMP/EIS, as well as coordination of the plan's implementation (i.e., the dredging and dredged material management activities). This group has been formed consistent with the inter-agency National Dredging Team's guidance (EPA, 1998a). Roles within the LSMG will continue to develop in accordance with policies and procedures currently evolving for the RDT, as referenced in the April 26, 2002 policy letter jointly signed by Brigadier General David A. Fastabend (Corps of Engineers Northwest Division Commander) and L. John Iani (EPA Region 10 Administrator).

The LSMG would assist in the development and adoption of appropriate method(s) for management of dredging and use and/or disposal of dredged material from Federal navigation and maintenance projects and dredging activities regulated under Section 404 of the Clean Water Act. In the formulation of these management policies, the LSMG would be asked to consider key environmental laws and regulations involved in this process; consider the responsibilities of other Federal, state, and local resource agencies; and help develop a coordination process for dredging and beneficial use of dredged material. In addition the LSMG would assist the Corps in evaluating dredging and dredged material management activities and options consistent with an adaptive management approach.

The general objectives of the LSMG are:

- Provide an interagency approach to dredged material management.
- Promote consistency in dredging and sediment management activities.
- Assist in development of monitoring plans and sediment sampling and testing framework.
- Facilitate adaptive management and beneficial use of dredged materials.
- Promote consideration of all environmental laws and regulations.
- Consider necessary cultural resource protection.
- Discuss and evaluate possible strategies to reduce sediments entering the lower Snake River system.
- Involve other stakeholder groups and pursue consistency with their plans.

The Corps anticipates that the LSMG will convene regularly, either annually or semi-annually, depending on the Corps' anticipated dredged material management activities. The LSMG will consider all dredging and dredged material management activities for the ensuing time period. Specifically, it is envisioned that the LSMG will consider proposed dredging, suggest ways of potentially reducing dredging requirements, explore promising beneficial uses of dredged materials, and comment on proposals for in-water habitat creation using dredged materials.

As situations develop which call for maintenance dredging, the LSMG would be informed. The situations expected to require maintenance dredging could include, but would not be limited to:

- Emergencies involving shoaled areas that pose a serious risk to navigation of commercial vessels as indicated by records of groundings, complaints by shippers, and/or condition surveys of the navigation channel.
- Programmed/periodic dredge maintenance activities based on well-established historical records of persistent shoaling in a navigation channel that could pose a serious risk to navigation of commercial vessels.
- Shoaled areas that pose a serious risk to navigation and moorage of recreational craft as indicated by comments of operators of recreational boat facilities and/or condition surveys.
- Sedimentation to irrigation intakes associated with Lower Snake River Habitat Management Units (HMU) which restricts the ability to deliver irrigation water to the HMU.
- Sedimentation to irrigation intakes associated with Corps-managed recreation areas.
- Advanced maintenance of a commercial navigation channel or berth which historically requires dredging to remove shoals that pose a serious risk to navigation, when an

opportunity to meet a specific environmental restoration need for beach nourishment exists and/or when the dredging can be combined with other maintenance dredging to lower the cost and minimize the dredge related disturbance to transportation and local business activities.

Further, it is anticipated that the LSMG would provide a forum to address historic inconsistencies in dredging and disposal methods and in-water work windows, and discuss ways of bringing consistency to dredging-related activities within the study area. The LSMG would also serve as a forum for providing suggestions to the Corps on improving the implementation of the DMMP/EIS.
The following Federal and state agencies and tribes with responsibilities applicable to the DMMP/EIS have been asked to participate in the LSMG to facilitate the accomplishment of the general objectives:

Bonneville Power Administration
Confederated Tribes and Bands of the Yakama Indian Nation
Confederated Tribes of the Colville Reservation
Confederated Tribes of the Umatilla Indian Reservation
Idaho Department of Fish and Game
Idaho Department of Water Resources
Idaho Division of Environmental Quality
Idaho State Historical Society (State Historic Preservation Officer)
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Division of State Lands
Oregon State Historic Preservation Office
Oregon Water Resources Department
National Marine Fisheries Service
Nez Perce Tribe
U.S. Army Corps of Engineers, Northwest Division
U.S. Army Corps of Engineers, Portland District
U.S. Army Corps of Engineers, Seattle District
U.S. Army Corps of Engineers, Walla Walla District
U.S. Department of Energy
U.S. Environmental Protection Agency, Region 10
U.S. Fish and Wildlife Service
Wanapum Band
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington Department of Natural Resources
Washington State Historic Preservation Officer

Additionally, public ports within the study area have been invited to participate in the LSMG. Other local entities with an interest in management of the resources involved in dredging and disposal activities (e.g., counties, municipalities, environmental groups, and transportation and industrial interests) would be asked to participate on a regular basis.

The LSMG has been identified as a forum for discussion of possible measures to reduce sedimentation in the lower Snake River system and McNary reservoir. To facilitate these discussions, land management and conservation agencies such as the U.S. Forest Service, the Natural Resources Conservation Service, and others that may have a role in sediment reduction strategies, will be asked to participate in the LSMG.

1.9 LOCAL SPONSORS

Beneficial uses of the dredged material may be undertaken solely by the Corps, without non-Federal cost sharing, where it is consistent with the authorized project purpose (such as woody riparian habitat or shallow water habitat development). The Corps' project authorization requires maintenance of the navigation channel in the lower Snake River and in the Columbia River upstream of McNary. Historically, the ports and other users located on the rivers that benefit from and rely on maintenance of navigation on this inland waterway system have requested that the Corps provide dredging to maintain their facilities. The dredging of ports and other non-Federal facilities is a reimbursable cost paid to the Federal Government.

Potential local sponsors for navigation maintenance activities on the lower Snake River and McNary reservoirs include the public port authorities listed on the following page. In addition, there are numerous private port and dock facilities on the lower Snake and Columbia Rivers within the study area. Periodic dredging of port facilities may be required. For example, in the 1997-1998 confluence dredging, the Corps dredging contractor removed 3,687 cy (2 818.9 m^3) of material from the Port of Lewiston and 12,154 cy (9 292.4 m^3) from the Port of Clarkston.

<u>Public Port Authorities</u>
- Port of Benton County
- Port of Clarkston
- Port of Garfield
- Port of Kennewick
- Port of Lewiston
- Port of Pasco
- Port of Umatilla
- Port of Walla Walla
- Port of Whitman County

Other potential local sponsors of dredged material management activities include agencies or individuals who are willing to share in the cost of beneficial use of dredged material. Beneficial uses of dredged material to protect, create, or restore aquatic and wildlife habitat are authorized under Section 204 of the Water Resources Development Act of 1992. Implementation of beneficial use projects is conditioned on local sponsors agreeing to pay 25 percent of the cost of implementing the project and 100 percent of maintenance costs. Similarly, use of dredged material for other purposes not related to ecological restoration (e.g., use as fill or cover material) may be undertaken provided additional costs to Federal agencies are not incurred. Local sponsors who identify such a beneficial use are responsible for financing all the costs associated with implementing and maintaining the use. The LSMG would serve as a forum for identifying sponsors and planning beneficial uses of dredged materials.

Potential local sponsors for beneficial use of dredged material include:

- Port of Whitman County to fill additional dredged material disposal cells at Port of Wilma.
- Port of Whitman County as a raw material source for production of potting soil.
- State wildlife agencies and wildlife organizations for habitat creation by shoreline terracing and covering exposed riprap.
- The U.S. Department of Energy for capping contaminated material in environmental restoration projects at the Hanford Reservation.
- Public landowners.

Potential beneficial uses of dredged material are discussed in detail in section 2.5.4.

SECTION 2
ALTERNATIVES

The Corps' planning guidelines and NEPA require the consideration and analysis of a broad range of alternative approaches in the development of this DMMP/EIS. Section 2 presents the process to formulate the plan alternatives that were considered by the Corps in developing this DMMP/EIS (figure 2-1). This process includes:

- The development of *plan measures* (or types of actions) that, of themselves, address one or more of the requirements of the purpose and need discussed in section 1.2.
- Screening the plan measures to determine their effectiveness and suitability to include in plan alternatives.
- Formulating *plan alternatives* (or packages of one or more plan measures) that fully address the requirements of section 1.2, Purpose and Need.

Those alternatives that reasonably and efficiently meet the Corps' planning objectives are further evaluated and compared in detail in sections 3 and 4. From these alternatives, a preferred alternative (or "recommended plan") would be selected. In addition, the "No Action (No Change)" alternative is presented and evaluated.

2.1 INITIAL OPTIONS

The Corps' DMMS examined methods for maintaining the existing 14-foot (4.3-m) draft navigation channel and other related features in the five reservoirs on the Columbia and lower Snake Rivers:

- Lake Wallula (McNary).
- Lake Sacajawea (Ice Harbor).
- Lake Herbert G. West (Lower Monumental).
- Lake Bryan (Little Goose).
- Lower Granite Lake (Lower Granite).

This DMMP and programmatic EIS are built on studies that have been ongoing since the mid-1980s and address management of dredged material for the next 20 years.

Establish Purpose and Need

- maintenance dredging
- flow conveyance
- environmental suitability

↓

Develop “*Plan Measures*” (or Types of Actions) That, In Part, Address the Requirements of the Purpose and Need

- upstream land changes
- reservoir drawdown
- in-water sediment control
- dredging and disposal of dredged materials
- upstream sediment construction
- levee modification

↓ **Screening**

Formulate *“Plan Alternatives”* (Comprised of One or More Plan Measures) That Fully Address the Requirements of the Purpose and Need + No Action Alternative

- Alternative 1 - No Action (No Change)
- Alternative 2 - Maintenance Dredging with In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise
- Alternative 3 - Maintenance Dredging with Upland Disposal and a 3-Foot (0.9-m) Levee Raise
- Alternative 4 - Maintenance Dredging with Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

↓ **Evaluation**

Recommended Plan

Figure 2-1. DMMP/EIS Plan Formulation Process.

In addition to addressing the navigation maintenance needs, this study examines methods to maintain flow conveyance capacity in the upper reach of Lower Granite reservoir through the remainder of its economic life to year 2074 (Corps, 1993). Flow conveyance capacity is achieved currently through dredging. The continued need for flow conveyance capacity maintenance was based on the results of a risk-based flood damage assessment that considered the conditions with the 14-foot (4.3-m) navigation channel maintained. Dredging alternatives that both maintain navigation and meet the feasible flow conveyance needs were developed and compared to a full array of alternatives including levee raise alternatives. Levee raise alternatives were found to be a cost-effective substitute for dredging to achieve flow conveyance. The objective was to select an alternative that maximized flow conveyance capacity and net flood damage reduction benefits, based on engineering, environmental, and social criteria, and present it in this DMMP/EIS.

In accordance with the requirements of the NEPA, a broad range of alternatives that could potentially meet the stated purpose and need was developed. The Corps conducted public scoping meetings, consulted with state and Federal environmental and resource agencies, and conducted technical studies to develop a range of conceptual alternatives that addressed the plan's purpose and need. Alternatives were developed from a combination of possible measures, as described in section 2.2. See Sec. 6.1 for further discussion in scoping process. The process and criteria for screening the alternatives to determine whether they were environmentally, economically, technically, and administratively feasible are described in section 2.3. The measures removed from further consideration are discussed in section 2.4. Finally, sections 2.5, 2.6, and 2.7 present the alternatives that are evaluated in the EIS, mitigation, and the Corps' recommended plan, respectively. The Corps also considered public comments submitted in response to the Draft DMMP/EIS.

2.2 MEASURES CONSIDERED

Various measures or types of actions that addressed the program purposes were developed; often measures were combined. Initially, non-structural measures were considered to meet the needs of maintenance of the navigation channel and related facilities in all five reservoirs and to maintain the flow conveyance capacity of Lower Granite reservoir. These measures include land use changes that would restrict the inflow of sediment and the possible use of in-water systems for control of sediment (such as bubble curtains). Reservoir drawdown, a non-structural measure for providing flow conveyance, was also considered. Next, the traditional method of dredging to meet the maintenance requirements and maintain the flow conveyance capacity of Lower Granite was considered. Finally, construction of a sediment trap and levee modifications were considered. These plan measures are listed in table 2-1 with an indication (noted by 4) of the program purposes that each address.

To provide a baseline for consideration of the alternatives, and in accordance with the requirements of NEPA, a "No Action (No Change)" alternative was considered. For the purposes of the DMMP/EIS, this alternative was a continuation of maintenance of the authorized navigation channel as directed by Congress in PL 87-874 (see section 1.4) and related maintenance features in the five reservoirs.

These categories of methods are summarized in sections 2.2.1 through 2.2.6. Alternatives were developed and screened to evaluate their feasibility, to determine which alternatives should be evaluated in the DMMP/EIS, and to select a preferred alternative, if appropriate.

Table 2-1. Measures Addressing Program Purposes

Plan Measures	Program Purposes		
	Navigation	Flow Conveyance	Environmental Suitability
Change Upstream Land Uses	√	√	√
Reservoir Drawdown		√	
In-Water Sedimentation Controls			
• Bubble Curtain	√		
• Bendway Weir	√		√
Dredging and Disposal of Dredged Materials			
• Dredging with In-Water Disposal	√	√	√
• Dredging with Upland Disposal	√	√	√
• Beneficial Use	√	√	√
Construct Upstream Sediment Traps	√	√	
Levee Modification		√	√

Characteristics of the dredging options are summarized beginning in section 2.2.4, followed by a discussion of the upland disposal, beneficial uses, upstream sediment control structures, and levee modification measures. Summary descriptions of dredging operations are included in appendix A, Hydrologic Analysis, and cost information for each measure is presented in appendix B, Cost Estimates.

2.2.1 Change Upstream Land Uses and Land Management Practices to Control Sediment

Navigation channel and flow conveyance capacity in the lower Snake and Columbia River systems are, in part, reduced by eroded sediments entering the systems from upstream sources. Similarly, sedimentation that has reduced flow capacity in the upstream reach of the Lower Granite reservoir is a result of sediments flowing into the reservoir from the Snake and Clearwater Rivers. Sediments enter the river systems through a number of sources. Some erosion occurs as a natural physical process; however, land uses and land management practices also affect the amount of erosion and sediments entering the river system.

Studies have shown that non-irrigated cropland is a predominant land use in the watershed draining to Lower Granite reservoir and is responsible for approximately 37 percent of the sediment yield to the Lower Granite reservoir (Reckendorf, et al., 1988). Other sources of sediment yield in the watershed include forest lands, streambank erosion, rangeland, irrigated farmland, and other land uses. Best management practices, including modified timber harvesting practices, erosion and sedimentation controls, and agricultural conservation reserve practices (e.g., creating riparian buffers, or removing highly erodable land from agricultural production) can reduce sediments entering the river systems and draining to the lower Snake and Columbia

Rivers. Reckendorf et al. estimated in 1988 that implementation of Food Security Act conservation practices (e.g., the Conservation Program, which takes highly erodable land out of production) could reduce the overall sediment yield to Lower Granite reservoir by up to 37 percent.

The Corps owns and, in most locations, manages shoreline lands along the lower Snake and Columbia Rivers. However, it is not within the Corps' authority to control land uses and land management practices in the vast majority of the watershed that drains to the lower Snake and Columbia Rivers. While control of upstream land uses to control erosion and sedimentation is potentially part of a strategy to reduce sedimentation. This measure was considered useful in minimizing the need for other measures to fully meet the program purposes and was recommended for continued consideration and implementation through the LSMG.

2.2.2 Reservoir Drawdown

Reservoir drawdown was considered in two different ways to increase the flow conveyance capacity of the Lower Granite Dam Project in the Snake and Clearwater Rivers confluence area. Lower Granite reservoir was designed to operate at a pool elevation of 733 feet msl, while allowing the safe passage of flows through the confluence area at or below elevation 738. Over time, the sedimentation in the confluence area has affected the project's ability to pass flows at or below elevation 738. To correct this loss of conveyance capacity, first, an action, flow conveyance, was considered to draw the reservoir down in anticipation of high flows to reduce the pool or backwater affects on channel flow in the confluence area. This action would result in greater channel conveyance capacity with reduced water surface elevations and a lowered risk of flooding. Second, an action, sediment flushing, to periodically lower the reservoir at regular intervals was considered to increase the flow velocities in the confluence area and flush the sediments further down river to areas of excess conveyance capacity.

2.2.2.1 Flow Conveyance

The first drawdown measure considered to increase flow capacity at the confluence of the Clearwater and Snake Rivers adjacent to Lewiston, Idaho, was to draw down the Lower Granite reservoir to allow the SPF flow to pass without exceeding elevation 738. Lower Granite reservoir was designed to operate at a pool elevation of 733 feet msl, while allowing the safe passage of flows through the confluence area at or below elevation 738. Over time, the sedimentation in the confluence area has affected the project's ability to pass flows at or below elevation 738. Model studies have shown that Lower Granite reservoir is still able to pass up to 300,000 cfs (8 495.1 m^3/s) flows both while maintaining a water surface elevation at the confluence of the Clearwater and Snake Rivers of 738 feet msl, and while maintaining 15 feet (4.6 m) of navigation clearance over the lock sills at Lower Granite. Flows above 300,000 cfs (8 495.1 m^3/s), up to the SPF of 420,000 cfs (11 893.1 m^3/s), are predicted to result in water surface elevations above 738 feet msl due to the influence of post-construction sedimentation in the confluence area and the existing dam. Accordingly, a reservoir drawdown would not lower the water surface elevation in the confluence area to or below 738 feet msl during flows of 300,000 cfs (8 495.1 m^3/s) or greater.

2.2.2.2 Sediment Flushing

Drawdown of the Lower Granite reservoir below elevation 724 at the forebay, was considered for the purpose of flushing sediments downstream thus improving conveyance capacity and reducing shoals in the confluence area. Reservoir drawdown that would scour the historic river channel, thus potentially flushing sediments downstream, would be well below the authorized operating pool elevation of Lower Granite reservoir and would severely impact project uses. Based on the 1992 Lower Granite Reservoir drawdown, significant adverse impacts to public infrastructure (e.g., roads, drainage systems) and fish passage facilities at Lower Granite Dam would result from substantial drawdown needed to flush sediments. A drawdown alternative would also have an adverse effect on the navigation, causing a further reduction in the navigation clearances provided in the Lower Granite reservoir. This measure was eliminated from further consideration to meet the needs of this program.

2.2.3 In-Water Sedimentation Control

2.2.3.1 Bubble Curtain

Technologies are available that limit or prevent deposition of suspended sediments within a specific area. One such method involves using air or water circulation in the water column to keep sediments from depositing within a protected area, thus minimizing the need for dredging. Currently, the Port of Grays Harbor, Washington, uses this technology to prevent sedimentation around its terminal ship berths. Also, an “air curtain” can be generated from a submerged perforated pipe to contain sediments and keep them from settling.

This method is appropriate and effective for localized applications such as specific ports, boat basins, or other areas of limited size. However, these methods are not particularly applicable to the scope of navigation channel maintenance contemplated in the proposed plan. Use of either circulated water or air bubbles would require many miles of piping and numerous pumps and/or compressors. It would also require nearly constant operation, resulting in localized noise, air quality impacts, and ongoing system maintenance. Additionally, introduction of air into some areas of the lower Snake River would likely contribute to or exacerbate gas saturation. For these reasons, the use of bubble curtains was dismissed as neither a feasible nor reasonable alternative to address the plan’s purpose and need.

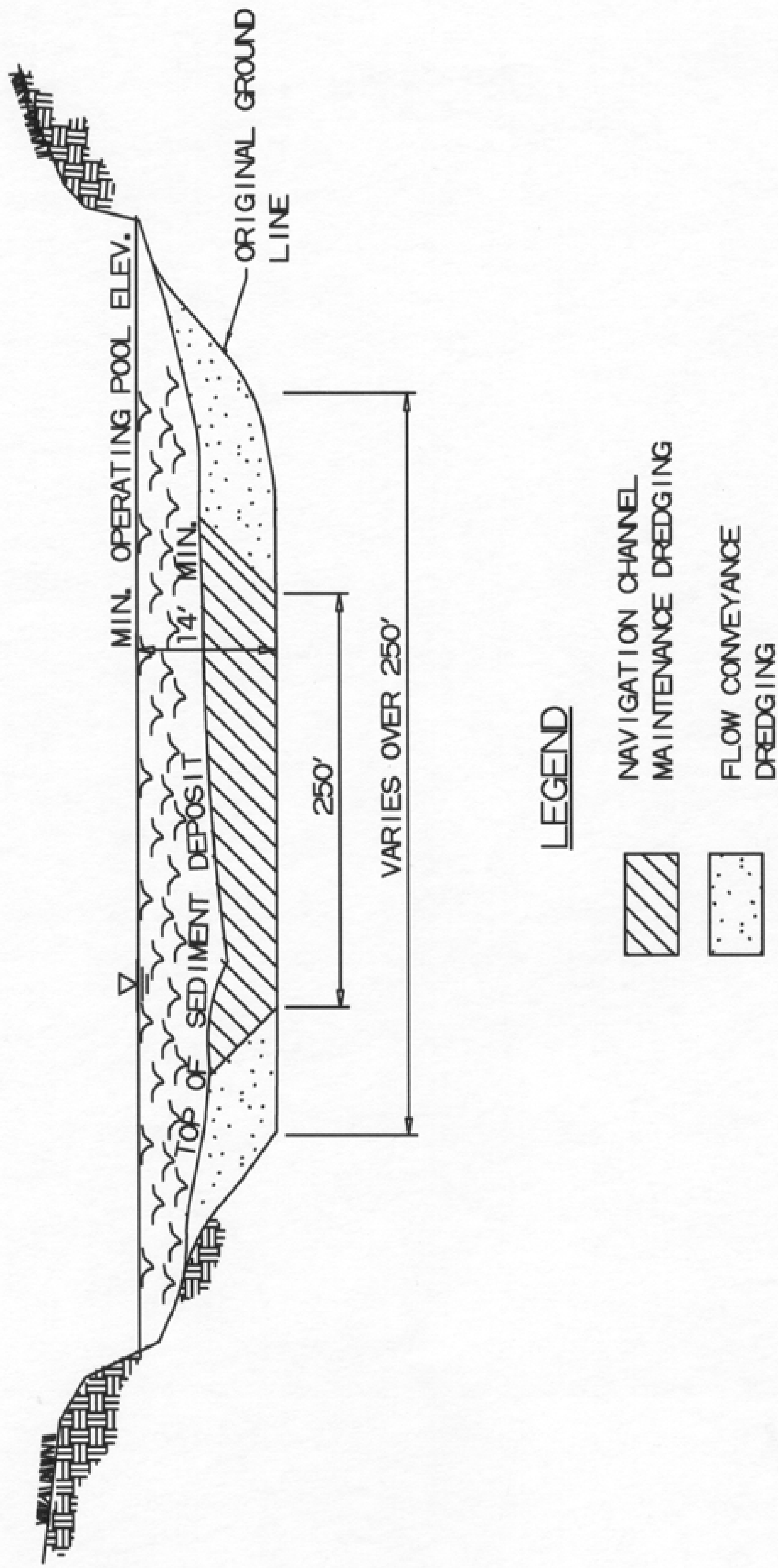
2.2.3.2 Bendway Weir

Another method of controlling the sedimentation of the navigation channels to reduce dredging is the use of Bendway weirs. A Bendway weir is a well-engineered, environmentally sensitive approach to reducing streambank erosion and redirecting sediment flow to reduce costly maintenance. The concept for Bendway weirs was developed by the Waterways Experiment Station in 1988 and has been used to realign and stabilize a number of streams and rivers across the United States, including the Mississippi River. This method may have the potential to reduce the shoaling at critical points such as the Port of Clarkston navigation channel at RM 139 on the Snake River; however, it is not included as a part of the recommended plan without further consideration. The placement of these rock weir structures requires considerable care to achieve overall reduction in the sedimentation of the navigation system while avoiding adverse reductions in flow capacity. A successful weir installation requires thorough understanding of the Bendway weir theory and extensive knowledge of the river location where the structure is to be placed. The method may warrant further consideration as a method to prevent persistent shoaling, as experienced at the Port of Clarkston, but is not considered as a method to be adopted throughout the system to reduce sedimentation. Although it is likely that Bendway weirs could be designed to solve the local navigation problems, they would either trap additional sediment or move it only a short distance downstream. In addition, the weirs themselves would raise the water-surface profile. While Bendway weirs do not represent substantial, complete, or, in many cases, feasible stand-alone solutions to the issues addressed in the DMMP, the proposed adaptive management program provides an opportunity for on-going evaluation of these and other measures to address sedimentation and dredged material management issues. If this method were pursued, mathematical modeling of the hydraulic conditions with and without the Bendway weirs in place would be required to ensure maintenance of the flow conveyance capacity.

2.2.4 Dredging and Disposal of the Dredged Material

A range of dredging and disposal measures has been considered in formulating the alternatives presented in this plan. Most of these measures can be coupled with some degree of levee modification in the Lewiston-Clarkston area. The measures range from dredging to maintaining the authorized navigation channel and related facilities in the five reservoirs to dredging up to 2 million cy (1 529 110 m^3) annually in the main river channel for improvement of flow capacity. Increasing dredging amounts in the Lower Granite reservoir at the confluence of the Clearwater and Snake Rivers was designed to provide proportionately increasing flow conveyance in that area. Figure 2-2 presents a schematic comparison of channel maintenance for flow conveyance and navigation clearance. Although the focus of the dredging program measures for increased flow conveyance is in the Lower Granite reservoir, the program measures also consider dredging in the other reservoirs in the lower Snake River system to maintain the navigation channel. All measures that contemplate volumes greater than that required for maintenance of the navigation channel apply only to the Lower Granite reservoir. All dredging measures include the maintenance of the navigation channels and related facilities in all five reservoirs with varying dredged material quantities for flow conveyance options in Lower Granite reservoir.

Dredging would be performed using either mechanical or hydraulic methods. Mechanical dredging with a clamshell dredge would be the preferred dredging method for the maintenance of the navigation channels and recreation facilities. Mechanical dredging involves excavation of sediments. A "clamshell" dredge generally involves a crane-mounted, hinged bucket to scoop up and move dredged material. Hydraulic dredging employs suction to move sediments. Hydraulic dredging may be considered for small areas off the main river channel, such as irrigation intakes.



SCHEMATIC COMPARISON OF NAVIGATION CHANNEL MAINTENANCE DREDGING AND FLOW CONVEYANCE DREDGING

NOT TO SCALE

FIGURE 2-2

The NMFS and Washington Department of Fish and Wildlife have not allowed use of hydraulic dredging methods for over 10 years because of concern for entrainment of juvenile ESA-listed endangered or threatened fish species. However, the agencies have indicated they would consider the use of hydraulic dredging for small, off-channel areas on a case-by-case basis.

2.2.4.1 Dredging With In-Water Disposal

When determining options and criteria to use for in-water disposal of dredged material for beneficial use, the Corps reviewed a study designed in 1987 by numerous scientists from federal, state, university and tribal entities. These entities included the Corps, USFWS, NMFS, ESSA, Battelle-PNNL, WDFW, ODFW, University of Idaho, University of Washington, Oregon State University, and the Yakima (now Yakama) Indian Nation (Web et al 1987). The researcher involved with many of the studies was David Bennett, Ph.D., a tenured professor at the University of Idaho. The multiple-year study design, a lead researcher independent from the federal government, and study design from the region's leading experts yielded scientifically sound results for consideration in dredged material management planning as explained in the following sections.

Initially, in-water disposal of dredged material was considered to be in one of three types of areas: (1) shallow water, 0 to 20 feet (0 to 6.1 m) below the surface; (2) mid-depth water, 20 to 60 feet (6.1 to 18.3 m) below the surface; and (3) deep-water, 60 feet (18.3 m) and deeper. The selection criteria of the in-water disposal area usually included the physical characteristics of the material, the potential to optimize the benefit to fish, and the absence of known cultural resource sites. Once materials were placed aboard the bottom-dump barges, they would be judged for their suitability for use as fish habitat and assigned a disposal area. Samples taken from the barge while loading would be used to determine the appropriate disposal area. This plan called for disposing of material judged suitable for fish habitat, with at least 80 percent sand or larger [greater than 0.008 inch (0.2 millimeters (mm)) in diameter], at a shallow- or mid-depth water disposal area. Sands, gravels, and cobbles are expected to comprise 85 percent of the total dredged material. The remaining 15 percent of material that was silt or finer and, therefore, not suitable for fish habitat would be deposited in deep water directly from bottom-dump barges beginning at the upstream end of the designated deep-water disposal areas. Disposal of the silt in deep-water sites would have little impact, either positive or negative, on aquatic species. The capacities of these disposal sites exceed the quantity of dredged material expected from all sources in the next 20 years. Small amounts of material may require disposal at upland sites. While this plan would adequately dispose of the expected dredged material, it was not considered the optimum plan because the Clean Water Act specifies that placing fill within the waters of the United States should be avoided if there is a practicable alternative. However, Region 10 of the Environmental Protection Agency has stated that in-water disposal of dredged material would be acceptable if the material was used in a beneficial way.

A revised plan considered utilizing all of the dredged material for the creation of shallow water fish habitat rather than placing the fine sediment in the deep portions of the reservoir. The fine grain silts would be used in a mixture with sands and gravels to fill mid-depth areas and form the foundation for the later placement of sand and gravel for shallow-water habitat. In-water disposal sites designated for each of the reservoirs included shallow-water and mid-depth disposal areas that had no known cultural resource sites. The objective of this disposal plan is to establish shallow-water habitat from 0 to 20 feet (0 to 6.1 m) deep to restore fish habitat. Equipment limitations may restrict the disposal of material to at or below -10 feet (-3 m) in the near-shore shallow areas. While the formation of shallow water habitat of depths from 0 to 10 feet (0 to 3 m) is desirable, disposal of dredged material to form these shallow areas would be restricted to sites identified as suitable to provide an environmental restoration opportunity and where a sponsor is willing to share costs.

Juvenile fall chinook salmon prefer shallow, open sandy areas along shorelines for rearing (Bennett et al 1997). Bennett et al (1998) showed that fall chinook salmon utilized the shallow-water habitat created with in-water disposal of dredged material that surrounds Centennial Island in Lower Granite reservoir, near RM 120. In some years, as many as 10 percent of the total sample of subyearling chinook salmon from Lower Granite reservoir originated from the habitat created by in-water disposal. Bennett et al (1998) reported that fall chinook salmon were most commonly collected over lower gradient shorelines that have low velocities and sandy substrate. Habitat having these physical characteristics can be effectively constructed in any of the lower Snake River reservoirs with appropriate placement of dredged material.

Differences in habitat suitability exist for habitat created by dredged material depending upon substrate size. For example, at the Centennial Island site in Lower Granite reservoir, the shoreward station with sandy substrate often supported a different fish community structure than that from the channel side that was armored with cobble/boulders to secure the shoreline. Species that prefer larger substrate, such as smallmouth bass, were consistently collected in higher abundance along the large substrate than in the area with finer substrate, without armoring of larger substrate. Therefore, preliminary data suggest that fish community structure can also by “fine tuned” with manipulation of the size of substrate as well as changes in depth.

A contingency upland disposal site has also been identified for each alternative to provide storage for a portion of dredged material that may, for whatever reason, need to be deposited on a separate upland site. In the event that dredged material may be unsuitable for in-water disposal (e.g., dredged material that may contain low levels of contaminants that prohibit its use for in-water habitat creation, but would not otherwise be considered solid or hazardous waste), it would be placed at the Joso upland disposal site, and appropriate confinement measures would be taken to isolate it.

The Joso upland disposal contingency site is located on the south shore of the Snake River between RM 56.5 and RM 58.6, in the Lower Monumental reservoir (plate 11). This document presents the conceptual design for development of this site and disposal plans for dredged material at this site should the need occur in the future. The Joso site is designated as a wildlife HMU, but was formerly used as a borrow site and contains a gravel pit at its center. It is estimated that this site can accept the full amount of material from all five reservoirs through the 20-year life of this DMMP/EIS. The initial construction of the site would include reestablishing the barge berth at the west end of the site. A temporary storage area would be developed by constructing a containment berm around an area adjacent to the barge berth. Permanent disposal would be developed in the old gravel pit area in the center of the Joso site. Dredged material would be off-loaded at the site using a barge-mounted crane and mobile transport equipment to haul material from temporary storage to the permanent disposal site. The Corps would conduct tests on material to be dredged and prepare final design of the permanent disposal features before disposing of material at the Joso site.

Below are descriptions of the four options of dredging that were considered for this DMMP/EIS. The main differences between the options are the quantity of material to be dredged and the dredging template design.

2.2.4.1.1 Navigation and Facility Maintenance Dredging

Dredging Areas. The maintenance dredging area is the current authorized navigation channel for the lower Snake River and McNary reservoirs and maintenance of public recreation areas, such as swimming beaches and boat basins, and irrigation intakes for wildlife HMU's managed by the Corps.

Dredging Template Design. As noted above, the dredging template is based on the authorized navigation channel, public recreation areas, and irrigation intakes for HMU's. The authorized navigation channel is 250 feet (76.2 m) wide and 14 feet (4.3 m) deep for all five reservoirs. The template would not extend down into original riverbed or shoreline material.

Disposal Sites. In-water locations for shallow, mid-depth, and deep water dredged material disposal are identified in each of the five reservoirs. In-water disposal areas in Ice Harbor and Lower Granite reservoirs used in the recent maintenance dredging operations have created mid-depth and shallow-water sites. The methods used in these latest disposal operations would be employed in this base plan and applied to all five reservoirs. Dredged material containing sand, gravel, and cobbles would be disposed of in either mid-depth, as a base, or shallow water to create shallow water habitat. Silts and fine material would be restricted to disposal at mid-depth sites. Collectively, the designated in-water disposal sites have adequate capacity to contain all materials dredged under this option.

Upland disposal may be used for some of the recreation area dredging and irrigation intake dredging on a case-by-case basis. Disposal would likely be adjacent to the dredging site.

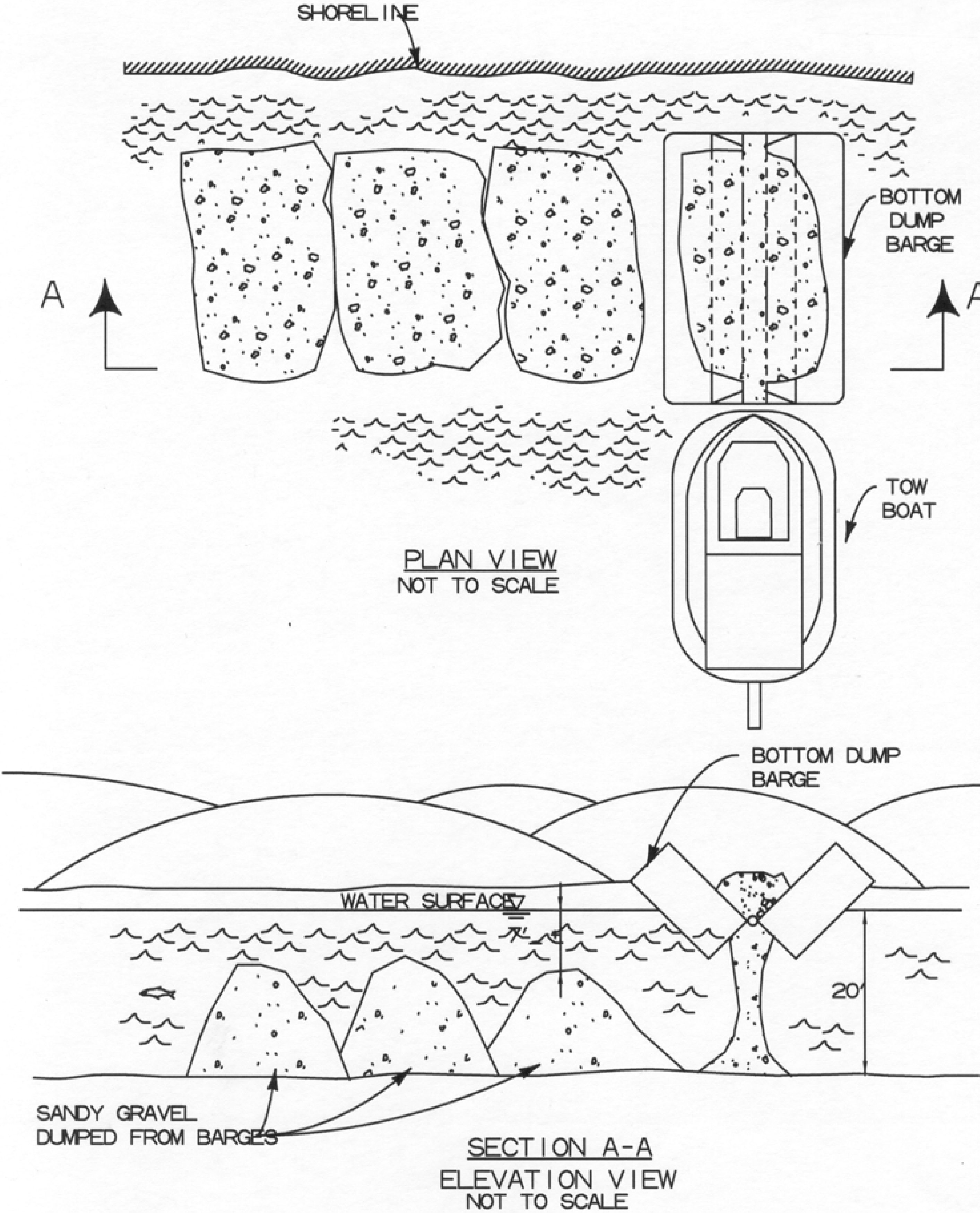
Material Types and Volume. Dredged materials consist of silts, sands, gravels, and cobbles. Historically, composition of dredged material from the study area has been approximately 85 percent sand, gravels, and cobbles, and approximately 15 percent silts and fines. A volume of dredged material up to 340,000 cy (259 948.7 m^3) would be dredged from the five reservoirs about every 2 years over the next 20 years for a total volume of up to 3,400,000 cy (2 599 487 m^3) of dredged material.

Program Schedule and Duration. For planning purposes, it was assumed that maintenance dredging using a clamshell dredge would be conducted every 2 years in each reservoir. However, the length of time between actual dredging operations will vary depending on sediment inflow and deposition. Dredged materials would be transported by bottom-dump barge to the appropriate in-water disposal sites. Dredging would usually occur between December 15 and March 1 in the Snake River and between December 1 and March 31 in the Columbia River during periods (windows) established to minimize the impacts on ESA-listed endangered or threatened anadromous fish species. Dredging in the summer, possibly in August, would be considered on a case-by-case basis for off-channel dredging. Dredged material containing predominantly sands, gravels, and cobbles would be transported by bottom-dump barge to the shallow and mid-depth areas for in-water disposal. Barges containing silt and other fines would be restricted to disposal at mid-depth sites. A minimum water depth of 15 feet (4.6 m) is required for bottom-dump barges to access the disposal sites. Disposal would be done by bottom-dump barge at a rate of approximately 15,000 cy per acre (28 338 m^3 per hectare) to create shallow water habitat with a minimum depth of 10 feet (3 m). A drag beam or some other device would be used to smooth the surface of the material dumped from the bottom-dump barges. Figures 2-3 and 2-4 illustrate the disposal process. Channel maintenance average annual costs are estimated at $560,000 computed over the 20-year period at a 6.875 percent interest rate. This cost estimate is based on maintaining the authorized navigation channel dimensions over the next 20 years using clamshell dredging, bottom-dump barges, and in-water disposal of the dredged material. Use of hydraulic equipment was not considered acceptable because of the anticipated adverse impact on endangered fish resources. Disposal at upland sites instead of in-water sites was considered, but found to be more costly and provide less environmental benefit than in-water disposal.

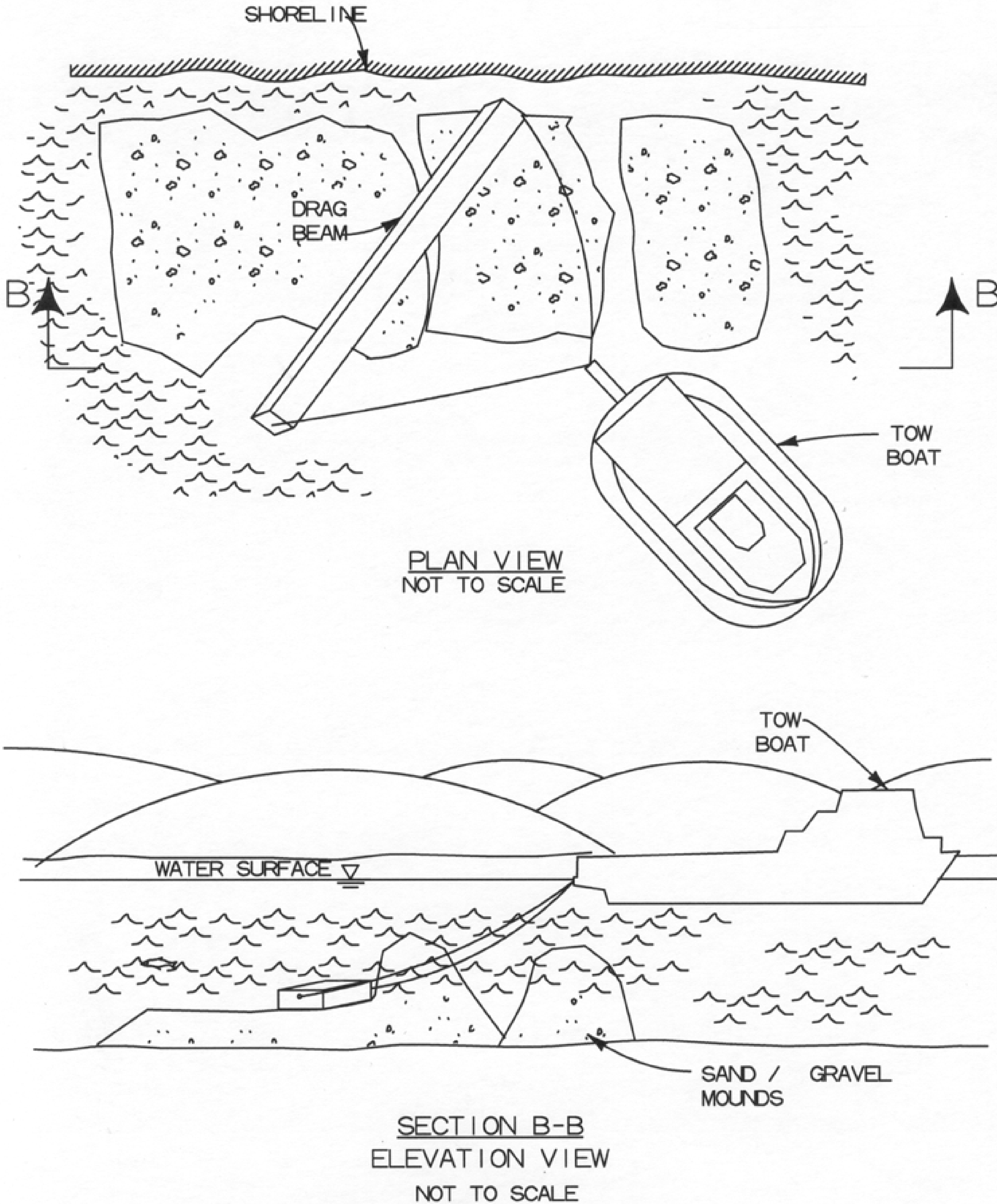
2.2.4.1.2 Dredge 300,000 cy Per Year

Dredging Areas. This option would meet the requirements for navigation maintenance in each of the five reservoirs as well as improve the flow conveyance capacity of the Lower Granite reservoir. Dredging to improve flow conveyance capacity would be conducted only in the Lower Granite reservoir. Navigation maintenance dredging described above would remain unchanged. Dredging in Lower Granite reservoir would extend from the Port of Wilma near Snake RM 134 to the U.S. Highway 12 bridge located upstream of the confluence of the Snake and Clearwater Rivers, near Snake RM 139.5. The Clearwater River dredging would extend from the Snake River confluence upstream approximately 1.5 miles (2.4 km) to the Port of Lewiston.

Dredging Template Design. Dredging templates for all of the reservoir areas except the Snake/Clearwater Rivers confluence area of the Lower Granite reservoir would remain the same as the navigation and facility maintenance dredging option. The Snake/Clearwater Rivers confluence area dredging template would increase in size and vary in width from 300 feet (91.4 m) near the Port of Wilma to 1,700 feet (518.2 m) in the Clearwater River confluence area. This portion of the template is a large volume to be dredged over multiple years to improve flow conveyance as well as provide navigation clearances. The average dredging width on the Snake River within this area would be 750 feet (228.6 m). The average depth of dredging on the Snake River would be approximately 10 feet (3 m) below the elevation of the bottom of the river channel as it existed in 1997 and would extend down into original riverbed or shoreline material.



SHALLOW WATER DISPOSAL - BOTTOM DUMP PROCESS
FIGURE 2-3



SHALLOW WATER DISPOSAL - DRAG BEAM CONTOURING PROCESS

FIGURE 2-4

Disposal Sites. Disposal areas for all reservoirs would remain the same as the navigation and facility maintenance dredging option and have adequate capacity to contain all materials dredged under this option. In-water disposal in Lower Granite reservoir would be accomplished downstream of Centennial Island near Snake RM 120.4.

Material Types and Volume. Dredged materials would be composed of a mixture of silts, sands, gravels, and cobbles. Approximately 6.4 million cy (4.9 m^3) would be dredged from the five reservoirs over the next 20 years and 23.1 million cy (17.6 m^3) between the years 2002-2074.

Program Schedule and Duration. Dredging would usually occur from December 15 to March 1 for the Snake River reservoirs and December 1 to March 31 for the McNary reservoir. Dredging in the summer, possibly in August, would be considered on a case-by-case basis for off-channel dredging.

Approximately 300,000 cy (229 366.5 m^3) of material would be dredged annually throughout the study period from the Lower Granite reservoir for flow conveyance and navigation maintenance dredging. Navigation channel maintenance dredging of 40,000 cy (30 582.2 m^3) from the other four reservoirs would occur about every 2 years, as previously described. The average annual cost of this measure computed over the period 2001 to 2074 at 6.875% interest is $1,233,000.

2.2.4.1.3 Dredge 1 Million cy (764 555 m^3) Per Year

Dredging Areas. This option would meet the requirements for navigation and facility maintenance in each of the five reservoirs as well as improve the flow conveyance capacity of the Lower Granite reservoir. Only the Lower Granite reservoir dredging area and template would change. Dredging in the Lower Granite reservoir would extend from the Port of Wilma near Snake RM 134 to the U.S. Highway 12 bridge located upstream of the confluence of the Snake and Clearwater Rivers, near Snake RM 139.5. The Clearwater River dredging would extend from the Snake River confluence upstream 1.5 miles (2.4 km) to the Port of Lewiston. Navigation maintenance dredging of the channel would occur in the other reservoirs.

Dredging Template Design. The dredging template would be the same as the 300,000 cy (229 366.5 m^3) alternative. The Snake/Clearwater Rivers confluence area dredging template varies in width from 300 feet (91.4 m), near the Port of Wilma, to 1,700 feet (518.2 m) in the Clearwater River confluence area. The average dredging width on the Snake River within this area would be 750 feet (228.6 m). The average depth of dredging on the Snake River would be approximately 10 feet (3 m) below the elevation of the bottom of the river channel as it existed in 1997 and would extend down into original riverbed or shoreline material. It would take fewer years to remove material from the template than for the 300,000 cy (229 366.5 m^3) dredging alternative.

Disposal Sites. Disposal sites identified in the navigation and facility maintenance dredging option are adequate to contain all materials dredged under this option.

Material Volume and Types. Dredged materials would be composed of a mixture of silts, sands, gravels, and cobbles. Approximately 13.7 million cy (10 474 400 m^3) would be dredged from the five reservoirs over the next 20 years and more than 31.8 million cy (24,351,210 m^3) dredged between the years 2001 and 2074 under this option.

Program Schedule and Duration. Dredging would usually occur from December 15 to March 1 for the Snake River reservoirs and December 1 to March 31 for McNary reservoir. Dredging in the summer, possibly in August, would be considered on a case-by-case basis for off-channel dredging. Approximately 1 million cy (7 64 555 m^3) of material would be dredged annually from Lower Granite reservoir for a 10-year period to establish the Lower Granite dredging template area described above. The dredging activity would then drop back to 325,000 cy (248 480 m^3) annually for the remainder of the study period through the year 2074 to ensure the template is maintained for the period. For planning purposes, it was assumed that navigation channel maintenance dredging of 40,000 cy (30 582.2 m^3) from the other four reservoirs would occur every 2 years. The average annual cost of this measure is $1,911,000 when computed at 6.875% interest over the period 2001 to 2074.

2.2.4.1.4 Dredge 2 Million cy (1 529 110 m^3)Per Year

Dredging Areas. This option would meet the requirements for navigation and facility maintenance in each of the five reservoirs as well as improve the flow conveyance capacity of the Lower Granite reservoir. Only the Lower Granite reservoir dredging area and template would change from the 1 million cy (764 555 m^3) per year measure. Dredging in the Lower Granite reservoir would extend further downstream from the vicinity of Silcott Island near Snake RM 131 upstream to the U.S. Highway 12 bridge upstream of the confluence of the Snake and Clearwater Rivers, located near Snake RM 139.5. The Clearwater River dredging areas extend from the Snake River confluence upstream to the Port of Lewiston at Clearwater RM 1.66.

Dredging Template Design. The proposed Lower Granite reservoir template on the Snake River is larger than the previous alternative and would vary in width from 600 feet (182.9 m) near Silcott Island to 1,700 feet (518.2 m) in the confluence area. The average width on the Snake River is 950 feet (289.6 m). The Clearwater dredging template varies in width from 300 feet (91.4 m) near the Camas Prairie Railroad bridge crossing to 1,000 feet (304.8 m) in the Port of Lewiston turning basin. The average width is 750 feet (228.6 m). The average depth of dredging would be 20 feet (6.1 m) below the elevation of the bottom of the river channel as it existed in 1997 and would extend down into original riverbed or shoreline material.

Disposal Sites. Disposal sites identified in the navigation and facility maintenance dredging option (section 2.2.4) would be adequate to contain all materials dredged under this option.

Material Types. Dredged materials would be composed of a mixture of silts, sands, gravels, and cobbles. Approximately 40.4 million cy (30.9 m^3) would be dredged from the five reservoirs in the next 20 years and approximately 79.2 million cy (60.6 m^3) between the years 2001 and 2074 under this option.

Program Schedule and Duration. Dredging would usually occur from December 15 to March 1 for the Snake River reservoirs and from December 1 to March 31 for the McNary reservoir. Dredging in the summer, possibly in August, would be considered on a case-by-case basis for off-channel dredging. Approximately 2 million cy (1.5 m^3) of material would be dredged annually for a 20-year period to establish the dredging template area described above. The dredging activity would then be reduced to 725,000 cy (554 302.3 m^3) annually for the remainder of the study period through the year 2074 to ensure the dredging template remains clear of sediment. For planning purposes, it was assumed that dredging of 40,000 cy (30 582.2 m^3) total from the other four reservoirs would occur about every 2 years. The average annual cost of this measure when computed over the period of 2001 to 2074 at 6.875% interest is $4,706,000.

2.2.4.2 Dredging with Upland Disposal

This measure employs the same dredging equipment and operation methods as the previous measures, but uses a standard barge 240 feet (73.2 m) long by 42 feet (12.8 m) wide to transport the dredged material. The dredged material would either be transferred directly to an upland disposal site or stockpiled at a temporary site for future transfer to a permanent upland disposal site. This measure includes navigation and facility maintenance dredging in the McNary reservoir and in the four lower Snake River reservoirs.

As part of the DMMS process, the Corps identified multiple upland sites on each reservoir that could potentially serve as dredged material disposal areas. A preliminary screening of these sites was conducted to assess their feasibility and/or suitability to serve as sites for upland disposal of dredged material. This screening process narrowed the list of potential sites to a total of 10 sites: a primary and secondary upland site in each of the five reservoirs. Anticipated costs and impacts of these 10 primary and secondary sites were used to further screen and narrow the list of potential upland sites to three: the Joso site (plate 11) and Page Creek disposal site (1 mile south of Snake RM 131), and the Chief Timothy "transfer site" (Snake RM 130.5).

All upland disposal options would include a contingency upland disposal site, similar to the in-water options, for material found unsuitable for disposal in the standard upland disposal site. This site has been identified as Joso (plate 11), located on the south shore of the Snake River (between RM 56.5 and RM 58.6) in the Lower Monumental reservoir.

The alternatives that involve upland disposal of varying dredged material volumes are described below.

2.2.4.2.1 Navigation and Facility Maintenance Dredging

All material would be disposed in the Joso upland disposal site. The Joso site is located along the southern shore of the Snake River between RM 56.5 and RM 58.6, in the Lower Monumental reservoir. The site is bounded on the south side by the Union Pacific Railroad. The entire site is approximately 568 acres (229.9 hectares) and is constrained by a habitat area approximately 600 feet (182.9 m) wide along the Snake River site boundary and by wetlands in the eastern corner. With the 600-foot (182.9-m) riparian boundary protected, the Joso site provides a barge slip, material unloading areas, and an area of approximately 280 acres (113.3 hectares) for permanent disposal of dredged material. A portion of the permanent disposal area would be set aside as a confined area, with a liner, to accommodate the material found to be unsuitable for disposal in the standard upland disposal area.

The Joso site would receive dredged material by barge and permanently store up to 6.4 million cy (4.9 m^3) of material. The site is adequate to hold all of the navigation and facility maintenance dredged material from the five reservoirs over the 20-year maintenance period. Barge access to the site would be provided by reestablishing the berth at the west end of the site. Anchored sheet pile walls would be used along the barge slip sides to provide vertical wall docking surfaces and to retain the adjacent platform walls. Barge tie-offs would be constructed at the top of the slip adjacent to the sheet pile. Temporary dredged material dewatering and storage areas with containment berms and detention ponds would be developed adjacent to the slips. Material handling at the Joso site would include off-loading of dredged material from the barges using cranes on rubber tires. The material would be placed in the temporary storage area adjacent to the barge slip for dewatering and loading onto trucks for transport into the disposal area. The material would then be placed in lifts with track-type tractors and compacted, resulting in a large structural fill conforming to the established final topography for the disposal area. All disposal activities would avoid known cultural resource sites. Areas that reach final grades would be restored on a periodic basis by placing 6 inches (15.2 cm) of topsoil and re-seeding to achieve a vegetative cover similar to surrounding site areas. A conceptual site layout for the Joso site is presented in figure 2-5 and described in detail in appendix D, Upland Disposal Conceptual Design.

2.2.4.2.2 Dredge 300,000 cy Per Year

For the first 20 years of the program, most material dredged under this option would be deposited in the Joso site. At the conclusion of the 20-year period, the Joso site would be filled to capacity and another site would have to be developed.

The Page Creek site in Lower Granite reservoir would be used to hold the remaining material once Joso is filled. The Page Creek disposal site is located approximately 1.5 miles (2.4 km) south of the Snake River adjacent to Page Creek near the mouth of Alpowa Creek, downstream of Snake RM 130. The entire site is approximately 985 acres (398.6 hectares), but only a portion of the site, at the northern end, would be used for disposal of dredged material. The site has a capacity of 80 million cy (61 164 390 m^3) and is capable of containing all the material expected to be dredged for all alternatives considered over the life of the project to year 2074.

The site has a plateau on the northern portion that is presently used for agricultural crops. The remainder of the site has relatively steep slopes from the plateau down to Page Creek, a drop of about 600 vertical feet (182.9 vertical meters). Dredged material would be placed in lifts starting at the lower end of the northerly portion of the site and would progressively fill the site in a southerly direction. Fill placement operation would use track-type tractors and steel-wheeled compactors. The disposal and fill construction operation would take place throughout the year. Site restoration would occur periodically throughout the life of the fill construction.

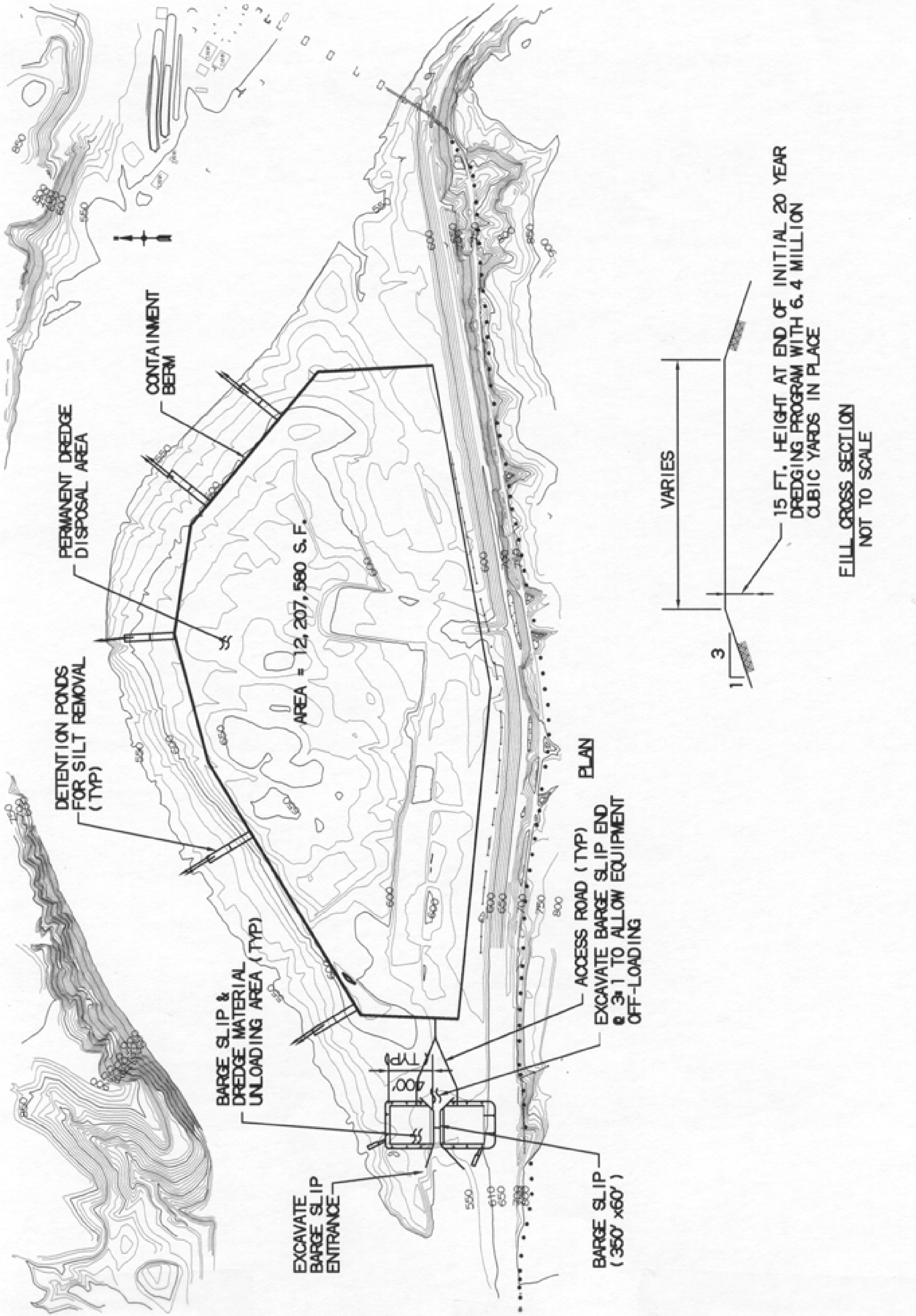


FIGURE 2-5, JOSO DREDGED MATERIAL DISPOSAL SITE
NOT TO SCALE

Use of the Page Creek site would require development of a transfer facility on the left bank of the Snake River, located adjacent to Chief Timothy State Park at RM 131, that would allow barge off-loading, staging of dredged material, and facilities for transporting material across U.S. Highway 12 to the Page Creek site. The Chief Timothy transfer site was proposed to meet this need. The Chief Timothy site, an open water embayment, is an area of about 66 acres (26.7 hectares) in 21 feet (6.4 m) of water located at the mouth of Alpowa Creek in the Snake River. The facility would consist of a rock berm around the site perimeter with a top elevation 3 feet (0.9 m) above normal operating pool for the Lower Granite reservoir. The interior of the berm would be filled with approximately 2 million cy (1 529 110 m^3) of dredged material to form a platform of dredged material for a temporary storage area. A barge berthing area would be developed and gantry-type cranes installed for off-loading barges. The transfer of up to 2 million cy (1 529 110 m^3) per year of dredged materials to the Page Creek disposal site would require the construction of a bridge across U.S. Highway 12. The Page Creek and Chief Timothy sites are described in more detail in appendix D, Upland Disposal Conceptual Design. The average annual cost of this measure computed over the period 2001 to 2074 at 6.875% interest is $5.6 million.

2.2.4.2.3 Dredge 1 Million cy (764 555 m^3) Per Year

This plan would use the Chief Timothy transfer site and the Page Creek disposal site for dredged material from Lower Granite reservoir for the entire period. The Joso site would be used for disposal of dredged material from McNary, Ice Harbor, Lower Monumental, and Little Goose reservoirs. The average annual cost of this measure computed over the period 2001 to 2074 at 6.875% interest is $6.8 million.

2.2.4.2.4 Dredge 2 Million cy (1 529 110 m^3) Per Year

This plan would use the Chief Timothy transfer site and the Page Creek disposal site for dredged material from Lower Granite reservoir for the entire period. The Joso site would be used for disposal of dredged material from McNary, Ice Harbor, Lower Monumental, and Little Goose reservoirs. The average annual cost of this measure computed over the period 2001 to 2074 at 6.875% interest is $19.3 million.

2.2.4.3 Beneficial Use of Dredged Material

Dredged material can be used to benefit and restore the environment. This use is consistent with Corps policy to secure the maximum practicable benefits through the use of material dredged from navigation channels. Opportunities to use dredged material beneficially become available over time and cannot be anticipated in a programmatic document such as this. In order to be able to take advantage of such beneficial uses, this document sets forth a process to identify and evaluate the opportunities as each major dredging activity is being planned. Part of this process is the formation of an LSMG that would help identify beneficial uses such as creation of aquatic and wildlife habitat, replenishment of beaches, or filling of upland sites.

The LSMG described in section 1.8 would provide an interagency approach to management of dredged material including definition of disposal plans coordinated with and amenable to the public stakeholders and resource agencies. In accomplishing this function, the LSMG would facilitate a process involving participation of affected agencies, organizations, and groups to identify and recommend the most environmentally sound and practical beneficial use of dredged material for each major dredging activity.

Each time a dredging activity covered under this DMMP/EIS is planned, the following steps would be followed:

- The Corps would notify parties such as the ports, municipalities, environmental groups, agencies, and others known to have an interest in the beneficial use of dredged material. The Corps would provide the location, estimated quantity, dredging method, expected characteristics of dredged material and estimated time of the dredging activity. The Corps notification would precede the proposed dredging activity by allowing sufficient time to negotiate an agreement with a local sponsor for the beneficial use of the dredged material.

- A public notice would be published and distributed prior to the dredging activity.

Beneficial uses defined by this process may be achieved when a local sponsor is willing to contribute a share of the cost. Table 2-2 describes the various measures and cost-sharing options that apply to the beneficial use of dredged material.

Table 2-2. Cost Sharing of Beneficial Use of Dredged Material.

Purpose	Authority	Cost Share % (Fed./Non-Fed.)
Creation of Land	Section 101 of Water Resources Development Act of 1986	0/100
Restoration and Nourishment of Beaches	Section 933 of Water Resources Development Act of 1986	50/50
Protection, Restoration, and Creation of Aquatic and Ecologically Related Habitats, Including Wetlands	Section 204 of Water Resources Development Act of 1992	75/25

The cost of a "beneficial use of dredged material" project is determined to be the difference in disposal costs of the "beneficial use project" compared to the cost of the least-cost, environmentally acceptable dredged material disposal option. This DMMP/EIS identifies the basis for determining the least-cost option for dredged material disposal. At any time, the Corps can identify another beneficial use, and the non-Federal interest would be given reasonable opportunity to finance the additional cost.

In specific circumstances, the Corps has the authority and appropriations to go forward with a beneficial use without a local sponsor (i.e., woody riparian)

The opportunities that currently exist and were considered for early implementation are presented section 2.5.4.

2.2.4.4 Emergency Dredging

Under any dredging and dredged material disposal measure considered, the Corps may need to perform dredging on an emergency basis. An emergency, as defined in 33 CFR 335.7, Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving the Discharge of Dredged or Fill Material into Waters of the U.S. or Ocean Waters, is a situation that would result in an unacceptable hazard to life or navigation, a significant loss of property, or an immediate and unforeseen significant economic hardship if corrective action is not taken within a time period less than the normal time needed under standard procedures.

There are several potential situations that could occur in the Snake and Columbia Rivers that may require emergency dredging. High flows could deposit enough sediment at a point or points in the Federal navigation channel to block navigation. Rock could be swept into the navigation lock approach and form a shoal or sediment could build up on the inside bend of the navigation channel, posing an unacceptable navigation hazard.

For an emergency dredging situation, the Corps would perform environmental coordination on an expedited basis. The Corps would perform as much coordination as possible before initiating the emergency dredging, but some coordination may be performed during the dredging or after the dredging is completed.

2.2.5 Construct Upstream Sediment Traps

A qualitative evaluation of sediment control structures was conducted to assess structures that might provide sufficient control of sediment transport on the Clearwater and Snake Rivers. The objective was to identify structures that reduce the sediment load sufficiently to avoid dredging and/or levee raises in the Lewiston-Clarkston area. This, in turn, would mitigate the probability of flooding due to sediment deposition. Sediment control structures must slow velocities for a sufficient length of time to allow sediment to drop out of the water column and be deposited behind the control structures.

The U.S. Geological Survey (USGS) has estimated the amount of sediment being transported annually to be 1.9 million tons (1.72 million metric tons) in the Snake River at Lewiston, and 0.47 million tons (0.43 million metric tons) in the Clearwater River. Sediment sampling in Lower Granite reservoir found that approximately 95 percent of the sediments being deposited are fine-grained materials [typically smaller than 0.01 inch (0.25 mm)]. The relatively small size of the sediment material suggests that a submerged structure, such as a silt trap, would be marginally effective. The Corps investigated the possibility of dredging an area of the Snake River sufficiently to form a reservoir of slack water where sediments could settle. These investigations determined that the amount of material that would need to be dredged was so great that the scenario was determined impracticable. Data also suggests that the existing dams and reservoirs on the lower Snake River retain approximately 80 percent of the sediments that enter the reservoir. It is unlikely that a new structure would be capable of better performance.

Estimates imply that removal of 80 percent of the sediment transported down the Snake River [approximately 1.5 million tons (1.36 million metric tons) per year] would be sufficient to mitigate sediment deposition concerns in the Lewiston-Clarkston area, excepting some deposition in a few areas that would adversely affect barge traffic. Therefore, it would not be necessary to construct structures on both the Snake and Clearwater Rivers.

The dredged material removed from the navigation channels in Lower Granite reservoir are composed of 85 percent sand, gravels, and cobbles and 15 percent finer silt material. This would suggest that the majority of the material entering this reservoir as silt does not contribute significantly to shoaling of navigation channels. This silt is either deposited in other portions of the reservoir or relocated by prop wash from navigation activities, eliminating it from the navigation channels. Since the larger materials (sand, gravels, and cobbles) are the sediment of primary concern to navigation channels, it is assumed that a smaller sediment trap might be capable of trapping a sufficient amount to be an economical alternative to dredging the channel. However, the legislative history concerning further structures on the Snake River for this purpose would indicate that this is not an acceptable alternative.

It is clear from the legislation passed since the authorization of Asotin Dam that Congress now intends no further Federal dam structures immediately upstream of Lower Granite on the Snake River. Portions of both the Snake and Clearwater Rivers have been identified in the Wild and Scenic River Act [PL 90-542, as amended, 16 United States Code (U.S.C.) 1271-1287] as rivers with sections that have been protected from further development or have qualities that make them candidates for protection. Public Law 94-199, dated December 31, 1995, de-authorized Asotin Dam because of its location with respect to the Hells Canyon National Recreation Area. Public Law 100-677, dated November 17, 1988, further prohibits the licensing of any dam, diversion, or bypass under the Federal Power Act on the Snake River above Lower Granite reservoir including the Asotin Dam site.

In addition to the clear legislation prohibiting Federal involvement, local, state, and Federal regulators indicate that there is no adequate justification for constructing a sediment detention structure on the Snake River near Asotin. The plan to construct a sediment detention structure has, therefore, been removed from further consideration.

2.2.6 Levee Modification

The cities of Lewiston and Clarkston are adjacent to the Lower Granite reservoir. Lewiston is protected by a backwater levee system installed in lieu of relocating its business district. The levee system is an upstream extension of the dam and was designed to allow the Lower Granite reservoir to be operated to protect the Lewiston and Clarkston area from inundation during the SPF.

The upper reach of the Lower Granite reservoir collects much of the sediment carried in suspension in the free-flowing reaches of the upstream rivers. Sediment accumulation in the reservoir over time has reduced the flow conveyance capacity in this upper reach and has compromised the level of protection provided by the levees. Dredging has been performed over the recent past to restore and retain flow capacity in this upper reach of Lower Granite reservoir.

Consideration was given to a variety of levee modifications including raising the levees and moving the levees back from the river to allow for a greater flow conveyance. Four levee modification plans were selected for further consideration based on their ability to provide the flow conveyance capacity most effectively with the least impacts. Concept designs and cost estimates were developed for the four levee raises, nominally identified as 12-foot (3.7-m), 8-foot (2.4-m), 4-foot (1.2-m), and 3-foot (0.9-m) raises, and the increased flow conveyance capability has been identified for each.

The following sections describe each of the levee raise plans.

2.2.6.1 The 12-Foot (3.7-m) Levee Raise

The 12-foot (3.7-m) levee raise involves constructing bin walls and earth embankment raises of existing levees, extending the existing levees in certain areas, and constructing new levees in some locations. The plan would include:

- Raising a portion of the west, east, and north Lewiston levees and building a new levee at the city of Asotin.
- Modifying U.S. Highway 12, County Road 900 along the north bank of the Snake River opposite Clarkston, Highway 129 along the west bank of the Snake River at Clarkston, Red Wolf Bridge access in northwestern Clarkston, Snake River Avenue along the east bank of the Snake River at Lewiston, and the Snake River Road above Asotin.
- Implementing changes to the Clarkston Sewage Treatment Plant, Asotin Sewage Treatment Plant, Lewiston Sewage Treatment Plant, and Lewiston Water Intake.
- Raising the U.S. Highway 12 bridge between Lewiston and Clarkston, the Camas Prairie Railroad (CPRR) bridge crossing the Clearwater River at Lewiston, the Memorial Bridge over the Clearwater River at Lewiston, the Asotin Memorial Bridge, the Highway 129-10 bridge, and the pedestrian bridge.
- Raising the CPRR track in Lewiston.
- Decreasing the risk of flooding to facilities including, but not limited to, the Ports of Wilma, Lewiston, and Clarkston.
- Increasing the risk of flooding at the following recreational areas: Hellsgate State Park on the Snake River opposite Asotin, Swallows Park between Asotin and Clarkston, Chief Timothy State Park on the south bank of the Snake River west of Clarkston, the county boat ramp on the north bank of the Clearwater River near RM 3, bike and walking trails along many of the levee segments, and the Clarkston Golf Course at the west end of Clarkston; as well as Rooster's Landing Restaurant, the convenience store and restaurant at Hellsgate State Park, a U.S. Forest Service building at Swallows Park, and the Corps' resource buildings at Clarkston.
- Possibly purchasing several residences along Highway 129.

The construction cost estimate for this plan is $87,661,500. The details for this plan are presented in appendix E, Lewiston Levee Modification Extension Analysis.

2.2.6.2 8-Foot (2.4-m) Levee Raise

The 8-foot (2.4-m) levee raise involves constructing bin walls and raising the earth embankment of existing levees, extending some existing levees, and constructing new levees in some locations. The plan includes:

- Raising the west, east, and north Lewiston levees and building a new levee at the City of Asotin.
- Modifying U.S. Highway 12, County Road 900, Highway 129, Snake River Avenue, and Snake River Road above Asotin.
- Implementing changes to the Asotin Sewage Treatment Plant and Lewiston Sewage Treatment Plant.
- Raising the U.S. Highway 12 bridge between Lewiston and Clarkston, the CPRR bridge, the Memorial Bridge, the Asotin Memorial Bridge, the Highway 129-10 bridge, and the pedestrian bridge.
- Raising the CPRR track.
- Decreasing the risk of flooding to facilities including, but not limited to, the ports of Wilma, Lewiston, and Clarkston.
- Increasing the risk of flooding at the following recreational areas: Hellsgate State Park, Swallows Park, Chief Timothy State Park, the county boat ramp on the Clearwater River near RM 3, and bike and walking trails along the levees, as well as Rooster's Landing Restaurant, the convenience store and restaurant at Hellsgate State Park, the U.S. Forest Service building, and the Corps' resource buildings.

The construction cost estimate for this plan is $50,999,500. Details are presented in appendix E, Lewiston Levee Modification Extension Analysis.

2.2.6.3 4-Foot (1.2-m) Levee Raise

The 4-foot (1.2-m) levee raise involves constructing bin walls and raising the earth embankment of existing levees. The plan would include:

- Raising a portion of the west and north Lewiston levees.
- Modifying Highway 129 and Snake River Road above Asotin.
- Raising the U.S. Highway 12 bridge between Lewiston and Clarkston, the Camas Prairie Railroad (CPRR) bridge, and the Memorial Bridge.

- Decreasing the risk of flooding to facilities at the Port of Lewiston.

- Increasing the risk of flooding at the following recreational areas: Hellsgate State Park and Swallows Park, as well as Rooster's Landing Restaurant, the convenience store at Hellsgate State Park, the U.S. Forest Service building, and the Corps' resource buildings.

The construction cost estimate for this plan is $15,623,500. The details for this plan are presented in appendix E, Lewiston Levee Modification Extension Analysis.

2.2.6.4 3-Foot (0.9-m) Levee Raise

The 3-foot (0.9-m) levee raise involves adding an earth embankment raise to existing levees. The plan would include:

- Raising a portion of the west Lewiston levee.

- Modifying Highway 129 and the Snake River Road upstream of Asotin.

- Increasing the risk of flooding at the following recreational areas: Hellsgate State Park and Swallows Park, as well as the convenience store at Hellsgate State Park, the U.S. Forest Service building, and the Corps' resource buildings.

The construction cost estimate for this plan is $2,273,500. Details are presented in appendix E, Lewiston Levee Modification Extension Analysis.

2.3 FORMULATION OF ALTERNATIVES TO BE CONSIDERED IN DETAIL

2.3.1 Screening Process

The screening process consisted of formulating alternatives from the most viable program measures discussed in section 2.2, evaluating each alternative, and selecting alternatives for further detailed consideration. Preliminary evaluation criteria were developed to determine the alternatives that were feasible, reasonable, and should be considered in detail. These criteria considered whether:

- The alternatives were cost-effective, while either providing environmental benefits or causing the least environmental damage.

- The alternatives provided a way to regain and/or maintain channel capacity to provide an acceptable level of flow conveyance capacity resulting in flood protection (based on the results of a risk-based analysis) in the Lewiston-Clarkston area.

- The alternatives have acceptable impacts on other project uses (such as shippers and recreational users).

A set of detailed screening criteria was then developed to evaluate the relative impacts, costs, and/or benefits of a set of dredging and levee alternative combinations. Use of these criteria in an evaluation process facilitated a selection of alternatives that were considered feasible, reasonable, and would be evaluated in detail in the EIS. An initial set of 12 dredging and levee alternatives included the "No Action (No Change) alternative" and combinations of dredging and levee raises. Ten alternatives go beyond navigation maintenance by combining increased dredging and levee raises to meet approximately the same levels of navigation and flow conveyance needs. The methodology and criteria used to evaluate each of the 12 alternatives against the screening criteria are discussed below.

2.3.2 Methodology and Evaluation Criteria

A set of evaluation criteria was established that allowed an across-the-board comparison of the 12 alternatives. The criteria were chosen because they represented key indicators of environmental impacts and economic benefits and costs. These criteria also pointed out potential "fatal flaws" in an alternative and allowed a planning-level comparison of the alternatives. Using this process, high-cost, high-impact alternatives were dismissed and low-cost, low-impact alternatives were advanced for further consideration. The evaluation criteria are listed in table 2-3.

The criteria were divided into three categories or "tiers" based upon their relative priority as indicators of the advantages or constraints of each alternative. The following sections provide details of how each criterion was applied through the screening process.

Table 2-3. Evaluation Criteria.

Category	Criteria
Primary	
Criteria with positive or negative impacts. Important in determining if the alternative is considered further.	▪ Expected annual "damage reduction" should not exceed average annual costs ▪ Endangered species impacts ▪ Hazardous, Toxic, and Radioactive Waste (HTRW) ▪ Traffic safety ▪ Wetlands impacts ▪ Water quality impacts
Secondary	
Criteria whose impacts could be mitigated. Important to the overall evaluation.	▪ Cultural resources impacts/State Historic Preservation Office (SHPO) requirements ▪ Lower Snake River Fish and Wildlife Compensation Plan
Considered	
Evaluated for direct, indirect, and cumulative impacts.	▪ Aquatic impacts (non-listed species) ▪ Terrestrial impacts ▪ Regional economic impacts ▪ Land uses ▪ Public opinion ▪ Other public interest factors

2.3.2.1 Expected Annual Damages

The estimated level of flood damage reduction provided by the alternatives for Lower Granite reservoir was analyzed based on the elevations of the structures in the floodplain and on simulated water surface profiles for the alternatives. No distinction was made in this preliminary screening between the flood damage reduction of the two dredged material disposal methods considered (e.g., in-water or upland disposal of dredged material).

The evaluation was based on the results of a risk-based, flood damage assessment computer model study. This flood damage assessment considered the hydrologic statistical risk of floods, hydraulic variations in flood flow water surface elevations, and associated damages to various types of buildings, structures, and activities in the floodplain.

2.3.2.2 Average Annual Costs

The present value of future costs for each alternative was calculated from the total costs of dredging, disposal of dredged material, and construction of the proposed levee raises over the projected lives of the alternative scenarios and the estimated phasing of construction, operation, and maintenance over that period. The alternatives were compared based on the present value of future costs over a 74-year period computed at an interest rate of 6.875 percent. The interest rate used for discounting is the current Department of the Interior rate to be used for Federal water resource planning purposes (63 FR 63329). Table 2-4 presents a summary of average annual costs of plan measures.

Table 2-4. Average Annual Costs.

Alternative	Annual Alternative Costs
No Action (No Change) Maintenance Dredging	$0.0
3-Foot (0.9-m) Levee Raise	$152.0
4-Foot (1.2-m) Levee Raise	$938.0
8-Foot (2.4-m) Levee Raise	$2,595.0
12-Foot (3.7-m) Levee Raise	$4,259.0
300,000 cy (229 366.5 m^3) Dredge	$1,233.0
1 million cy (764 555 m^3) Dredge	$1,911.0
2 million cy (1 529 110 m^3) Dredge	$4,706.0

2.3.2.3 Endangered Species

Listings of endangered species were obtained from the NMFS and U.S. Fish and Wildlife Service (USFWS). Habitat requirements, timing of occurrence, and the potential location of listed species relative to the dredging and disposal sites were determined. A potential impact determination was made based on the likelihood of ESA-listed individuals being present or if required habitat was in the project vicinity. If no individuals were likely to be present or no habitat existed, a "no effect" determination was made. If habitat was available, but because of timing of the project the species would not be present, a determination of "may affect but not likely to adversely affect" was made. If habitat was available and individuals could be present, a determination of "may affect and likely to adversely affect" was made. Biological Assessments (BAs) were prepared and sent to both the NMFS and USFWS. Copies of the BAs along with documentation of consultation activities with NMFS and USFWS can be found in appendices F and G.

In the case of salmonids, certain in-water disposal alternatives have the potential for improving habitat conditions. In these cases, the mitigation was assumed and a beneficial impact was determined to occur.

2.3.2.4 Hazardous, Toxic, and Radioactive Waste (HTRW)

Impacts associated with HTRW materials were assumed if HTRW materials were present in the dredging template or disposal areas. The potential presence of HTRW in sediments was a consideration for the in-water disposal sites and was determined by a review of previous dredging experience and by review of the Corps' sediment testing data. The presence of HTRW materials at the upland disposal sites was determined from Phase 1 environmental site assessments that included interviews with the property owners, searches of title records and environmental databases, and field inspections of the proposed disposal sites.

2.3.2.5 Traffic Safety

Impacts associated with traffic safety were evaluated for construction activities and for the transport of dredged material. Potential impacts could occur from the additional traffic on existing roadways and from truck traffic crossing major roadways that would occur under some of the alternatives. Therefore, the development of the conceptual designs for the upland disposal and transfer sites took into account traffic safety. However, a further assessment of safety goes beyond the manageable traffic safety aspects of the project and focuses on the longer term, unavoidable traffic safety issues. Where heavy, industrial-type activities (such as the transfer and handling of large quantities of dredged material) would be located immediately adjacent to major highways and or recreation facilities, the distraction was considered an unavoidable safety impact.

2.3.2.6 Wetlands

Wetlands were identified using spatial data provided through the National Wetlands Inventory (NWI), field reconnaissance, and aerial photo interpretation. The NWI inventory was compiled from aerial photo interpretation and is not inclusive of all wetlands.

The proposed upland disposal and transfer sites and the Snake River shoreline adjacent to Asotin and Asotin Creek were visited to evaluate impacts from the proposed upland storage and levee raise alternatives. Most of the alternatives involved minor indirect effects on wetlands; however, the alternatives that proposed use of a transfer site for handling dredged material were determined to have major impacts on wetlands.

2.3.2.7 Water Quality

The preliminary assessment of water quality impacts of alternatives was based on existing water quality data, previous Corps environmental documentation, and consultation with Corps staff.

The following factors were used in evaluating potential water quality impacts of the alternatives:

- Turbidity is the primary water quality criterion of concern.
- Sediment quality could affect water quality and required consideration.
- Monitoring and mitigation could reduce turbidity impacts to below significant levels.
- Upland disposal and dewatering of dredged material would be unlikely to cause significant water quality impacts.

2.3.2.8 Cultural Resources

The cultural resources assessment is based on review of available literature and the resource files at the Washington Office of Archaeology and Historic Preservation, the Idaho State Historic Preservation Office, and the Walla Walla District Corps of Engineers. Information on cultural resources was gathered for proposed upland and in-water disposal areas and proposed dredging templates. Preliminary evaluations of impacts to cultural resources were based on the presence of identified cultural properties that a given alternative could potentially affect through activities such as dredging and disposal of dredged material.

2.3.2.9 Lower Snake River Fish and Wildlife Compensation Plan (LSRFWCP)

As part of the LSRFWCP, a terrestrial wildlife mitigation program was initiated to:

- Protect existing habitat.
- Provide high-quality upland habitat for a variety of wildlife.
- Obtain additional land to fully compensate for upland game habitat losses that resulted from the construction of the lower Snake River dams.

The plan called for the creation of a number of HMUs to accomplish these goals. The Joso site that was considered for upland disposal of dredged material is managed as an HMU, and the Chief Timothy transfer site is adjacent to an HMU. Use of any of these upland disposal sites would require avoiding adverse impacts to the HMUs, and mitigation of unavoidable adverse impacts. Beneficial uses, such as woody riparian habitat development, would assist in meeting the compensation goals of the plan.

2.3.2.10 Aquatic Impacts on Non-Listed Species

Findings from previous Corps documents, a review of scientific literature, and first-hand knowledge by Corps and University of Idaho biologists were considered to determine the presence or absence of non-listed species. As with the endangered species, an analysis of habitat requirements, presence or absence of fish species, and the timing of migrations were evaluated to determine potential impacts to resident fish. By disposing of materials near shore and building shallow water benches, certain in-water disposal alternatives would provide an opportunity to enhance habitat for resident fish species. In other cases, such as upland disposal, the alternative would not impact aquatic species.

2.3.2.11 Terrestrial Impacts on Non-Listed Species

A Corps terrestrial ecologist determined the potential effects of alternatives on terrestrial wildlife habitat for non-listed species. Proposed upland disposal involving the Chief Timothy and Page Creek sites was determined to have the greatest impact because of the value of the habitat at Page Creek.

2.3.2.12 Regional Economic Impacts

Regional economic impacts are a measure of changes in personal income, sales, or value added expected in the region as a result of each alternative. This criterion considers the impacts from navigation transportation and flood-related activities on employment changes and shifts, and their effects on the regional economy. Each alternative would be expected to provide the same level of navigation benefits and, therefore, no change in that sector of employment or business activity was considered. Each alternative would produce a different flood damage reduction effort and a variety of different effects on jobs.

2.3.2.13 Land Use Impacts

The evaluation of potential land use effects of the alternatives was based primarily on the local property effects and the acquisition requirements of each alternative. The focus of this evaluation was the developed/urbanized areas around Lewiston, Clarkston, and Asotin, but also considered upland disposal impacts. While all levee alternatives would involve impacts to infrastructure and recreation activities, none of the alternatives would cause substantial shifts in land use.

2.3.2.14 Public Perception

Public perception of each of the alternatives was qualitatively assessed based on the DMMS Public Scoping Meeting Summary prepared by the Corps following two regional public meetings held in Richland, Washington, and Lewiston, Idaho, in September 1998. Public comments represented in the Scoping Meeting Summary were general in nature and did not address specific dredging, levee modification, and disposal scenarios considered as part of this preliminary evaluation process. Comments received on the Draft DMMP/EIS were considered and are attached as Appendix O.

2.4 MEASURES REMOVED FROM FURTHER CONSIDERATION

Following preliminary screening, a distinction emerged between those measures that most efficiently met the purpose and need and those measures that had high environmental and economic impacts. Through this screening process, alternatives that were infeasible and/or had potentially high costs and environmental impacts in comparison to other measures could be removed from further consideration.

Table 2-5 summarizes the measures that were removed from further consideration.

Table 2-5. Measures Removed From Further Consideration in this DMMP/EIS.

Measures	Reason(s) Removed from Further Consideration
Change Upstream Land Uses	Not a complete solution to maintain navigation; initial authority and resources development.
Reservoir Drawdown	Does not meet purpose and need, particularly navigation.
In-Water Sediment Control	Not practical or feasible for the entire project.
Dredging Up to 2 Million cy (1 529 110 m^3) with Upland Disposal	High adverse environmental impacts; high cost; beyond scope of action required to address purpose and need.
Dredging Between 300,000 and 2 Million cy (229 367 to 1 529 110 m^3) Per Year	Scope of action not required or feasible to meet flow conveyance.
Construct Upstream Sediment Traps	Prohibited by PL 100-677; potential impact to Wild and Scenic River.
Levee Modification - Raising Levees 4, 8, or 12 Feet (1.2, 2.4, or 3.7 m)	Scope of action not required or feasible to meet flow conveyance.

The measures that were advanced for further consideration are presented in the following section.

2.5 ALTERNATIVES SELECTED FOR FURTHER CONSIDERATION

Following a process of defining the purpose and need for the programmatic DMMP/EIS and developing a broad range of plan measures, the Corps conducted a screening of those measures, considering environmental, technical, and economic factors. From those measures, alternatives that are reasonable and fulfill the requirements of the purpose and need were formulated. These alternatives are subject to detailed environmental and socioeconomic review (presented in sections 3 and 4 of this DMMP/EIS); from this set of alternatives, a preferred alternative was selected.

This section presents the alternatives that have been formulated from plan measures that passed the screening process and are evaluated in this DMMP/EIS. In addition, this section presents the "No Action" alternative, which provides a baseline for comparison, and is required by NEPA.

For the purposes of this DMMP/EIS, the "No Action" alternative is defined as no change and referred to as the "No Action (No Change)" alternative. The "No Action (No Change)" alternative includes the Corps' anticipated program of continued maintenance dredging in the lower Snake River and McNary reservoirs. This maintenance program includes dredging the navigation channels and other related facilities (ports, moorages, recreation areas, and irrigation intakes), and providing some restoration of flow conveyance at the confluence area of the Lower Granite reservoir. Selection of "No Change" is consistent with the Council on Environmental Quality's guidance in *NEPA's Forty Most Asked Questions* which states that where ". . . on-going programs initiated under existing legislation or regulations will continue, even as new plans are developed…. 'no action' is 'no change' from current management direction or level of management intensity." (46 Federal Register 18026, as amended, 51 Federal Register 15618)

Table 2-6 provides a summary comparison of the alternatives and sections 2.5.1 through 2.5.4 provided detailed descriptions of the alternatives.

Table 2-6. Comparison of Alternatives.

Alternative	Dredging Requirement	Dredged Material Disposal	Annual Dredging Costs	Levee Modification	Relocation/ Acquisition Requirements
1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal	Maintenance[(1)]	In-water, primarily to create shallow water fish habitat	$560,000	None	None
2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise	Maintenance[(1)]	In-water to create shallow water fish habitat	$560,000	Raise levees up to 3 feet (0.9 m) to maintain flow convey-ance capacity	Limited raising of roadways
3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise	Maintenance[(1)]	Upland at "Joso" site in Lower Monumental reservoir	$730,000	Raise levees up to 3 feet (0.9 m) to maintain flow convey-ance capacity	Limited raising of roadways
4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise	Maintenance[(1)]	Beneficial use	$560,000 [(2)]	Raise levees up to 3 feet (0.9 m) to maintain flow convey-ance capacity	Limited raising of roadways

Note:

(1) Includes maintenance of the authorized navigation channels of the lower Snake River reservoirs and McNary reservoir; maintenance dredging of access channels to port and moorages on an as-needed basis, public recreation areas (swimming beaches and boat basins), irrigation intakes for wildlife HMU's and recreation sites; and flow conveyance capacity of the Lower Granite reservoir.

(2) Beneficial use see Section 2.5.4.2

2.5.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

2.5.1.1 General Description

This alternative considers those activities (mechanical dredging and in-water disposal) that have been performed in the recent past to maintain the authorized depths in the navigation channels of the lower Snake River dams and McNary navigation project. The areas covered include Lake Wallula behind McNary on the Columbia River and the reservoirs behind the four lock and dam projects on the lower Snake River: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. This navigation project provides for a 14-foot (4.3-m) channel with at least 14 feet (4.3 m) over the sills at each of the locks and 14-foot (14-m) by 250-foot (76.2-m) channels providing access to port and barge loading facilities in each reservoir. Sediment has been deposited over time, reducing the navigation clearances in places in each reservoir and the flow conveyance capacity of the upper reservoir behind Lower Granite. This alternative would provide navigation clearance and provide some restoration of the flow conveyance capacity based upon maintenance dredging.

Additionally, maintenance dredging of access channels to ports and moorages occurs infrequently, on an as-needed basis. The Corps also periodically conducts maintenance dredging around public recreation areas, such as swimming beaches and boat basins, and irrigation intakes for wildlife HMU's managed by the Corps.

2.5.1.2 Dredging Areas and Quantities

Maintenance dredging is a project component to maintain navigation clearances in each of the five reservoirs and maintain flow conveyance of the Lower Granite reservoir. Dredging templates were designed for each reservoir to achieve the maintenance dredging requirements. For the Lower Granite reservoir, the areas that require dredging for navigation are located on the Clearwater River between the Snake River confluence and the Port of Lewiston, located between Clearwater RM's 0.00 and 1.56, and on the Snake River from the vicinity of Silcott Island near Snake RM 131 upstream to the U.S. Highway 12 bridge located near Snake RM 139.5. A range of dredging volumes between 16,000 and 300,000 cy (12 232.9 and 229 367 m^3) are required on a 2-year cycle to develop and maintain the designed navigation channels in the Lower Granite reservoir. An estimated 4,000 cy (3 058 m^3) are to be dredged from behind Little Goose, and 2,000 cy (1 529 m^3) from behind Lower Monumental and Ice Harbor dams at 2-year intervals. The areas to be dredged in each case are located at the upstream end of each reservoir. The maintenance dredging for the McNary reservoir is estimated to be approximately 32,000 cy (24 466 m^3) every 2 years. The maintenance dredging and disposal areas for each of the five reservoirs are identified on the plates.

2.5.1.3 Dredging Template Design

The navigation dredging template is 250 feet (76.2 m) wide, with dredging to provide a channel depth of 14 feet (4.3 m) below the minimum authorized pool elevation of 733 feet msl at Lower Granite, 633 feet msl at Little Goose, 537 feet msl at Lower Monumental, 437 feet msl at Ice

Harbor, and 335 feet msl at McNary. The dredging template for other maintenance activities would vary, but includes access to port and moorage facilities, public recreation areas, and irrigation intakes.

2.5.1.4 Dredging Program and Process

Dredging would be accomplished mechanically, probably using a clamshell with an approximate 15-cy (11.5-m^3) capacity discharging to a barge with a capacity of 3,000 cy (2 293.7 m^3). The barges would have a maximum size of 240 feet (73.2 m) long by 42 feet (12.8 m) wide with a maximum draft of 14 feet (4.3 m). The expected rate of dredging is 5,000 cy (3 822.8 m^3) per 8-hour shift. Dredging would be performed in the Snake River during the period of December 15 through March 1 and for a longer period from December 1 to March 31 in the Columbia River. Multiple shift dredging workdays would be used when necessary to ensure that dredging was completed within these windows.

All material dredged in the Lower Granite reservoir would be disposed of downstream of Centennial Island, located near Snake RM 120.46. The entire channel below elevation 670 feet msl is available to be used for material disposal as required. Sands, gravels, and cobbles, expected to comprise 85 percent of the total material, would be dumped in the shallow to mid-range depths from 15 to 60 feet (4.6 to 18.3 m) to form shallow water habitat. Approximately 15,000 cy (11 468.3 m^3) of dredged material would be deposited per acre. The remaining 15 percent of material that is silt or finer would be deposited in deep water. This alternative would use only a small portion of the total volume of dredged material available for deposition. The total disposal volume available for the entire disposal area based on a level horizontal surface at elevation 670 feet msl was computed from a 1997 survey as approximately 120 million cy (91 746 600 m^3).

The 4,000 cy (3 058 m^3) of dredged material originating from behind Little Goose reservoir and 2,000 cy (1 529 m^3) of material from Lower Monumental and Ice Harbor reservoirs at 2-year intervals would be disposed of at in-water sites immediately upstream of the respective dams. The 32,000 cy (24 466 m^3) of material removed from the McNary reservoir at 2-year intervals would be disposed of at in-water sites near the confluence of the Columbia and Snake Rivers to form improved fish habitat and in deep-water sites downstream of the Walla Walla River (plates 3 and 4).

2.5.1.5 Material Types

Dredged materials would be comprised mostly of sediments containing a mixture of silts, sands, gravels, and cobbles carried by inflowing waters as suspended and bedload material. Based on previous experience, 85 percent of the material is expected to be sands, gravels, and cobbles, and 15 percent of the material is expected to be silts and finer-grained material. Small amounts of material unsuitable for in-water disposal may require disposal at an upland site.

2.5.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

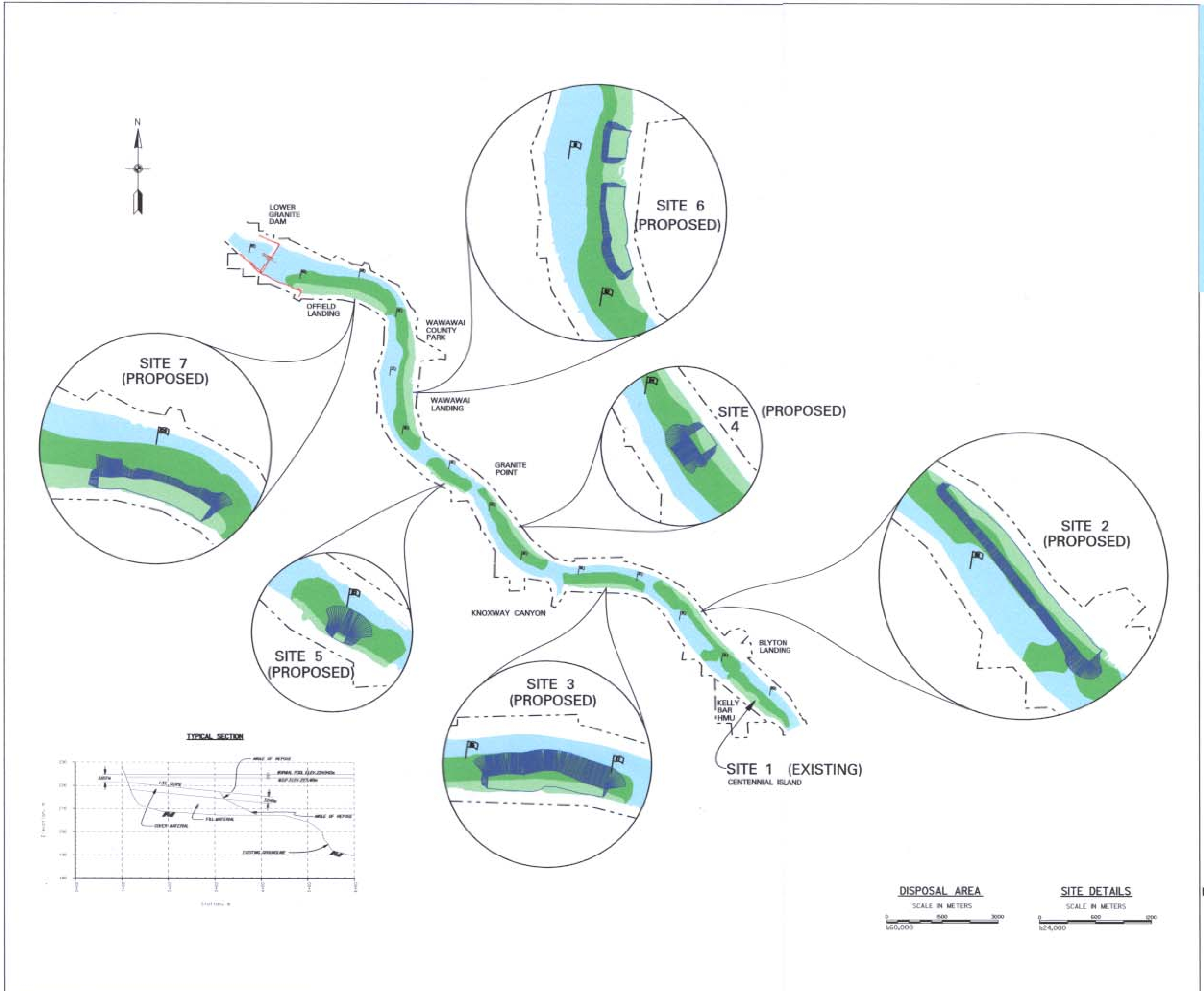
2.5.2.1 General Description

This alternative considers the same dredging activities as alternative 1, "Maintenance Dredging" or "No Action (No Change)," but with changes in dredging methods, work window, and disposal location for silt. Mechanical dredging would still be the primary dredging method used, but hydraulic dredging would also be considered for off-channel areas on a case-by-case basis. The majority of the dredging would be done during the winter in-water work windows used in the "No Action (No Change)" alternative, but a summer work window, possibly August, would be considered for off-channel areas on a case-by-case basis. All summer dredging would use upland disposal of the dredged material. The disposal method for winter dredging is formalized to include in-water disposal of most of the dredged material to create shallow water fish habitat. Silt would no longer be disposed of in deep-water sites. The areas dredged for channel maintenance remain the same and include Lake Wallula behind McNary on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River. Additionally, maintenance dredging of access channels to ports and moorages occurs infrequently, on an as-needed basis. The Corps would continue to periodically conduct maintenance dredging around public recreation areas, such as swimming beaches and boat basins, and irrigation intakes for wildlife HMU's managed by the Corps.

The disposal sites for this alternative would likely differ from alternative 1. The Corps evaluated all five reservoirs for potential sites suitable for in-water disposal. Sites were restricted to areas in the lower ends of each reservoir to eliminate the potential to negatively affect water surface levels at the upper end of each reservoir. For several reasons, the Corps concentrated its evaluation of sites on Lower Granite reservoir. One is that it is the uppermost reservoir and juvenile salmonids found in that reservoir would benefit more from additional rearing areas and associated increased growth potential. Another reason is that there are no collection and transport facilities above Lower Granite; therefore, more juveniles use Lower Granite reservoir than the other reservoirs. Finally, most of the dredging would occur in Lower Granite reservoir; therefore, it would be more cost-effective to dispose of the material within the reservoir. However, in-water disposal to create shallow-water habitat in other reservoirs would be considered depending upon the location of the dredging area, the type of material to be dredged, and the quantity to be dredged.

The Corps identified seven potential sites in Lower Granite reservoir suitable for shallow water rearing habitat creation (figure 2-6). The sites were identified because they are on the inside of a river bend, have suitable water velocities and underwater contours to facilitate habitat creation, and they are configured so the dredged material can be deposited without burying known cultural resource sites.

Alternative 2 would employ an "adaptive management" approach to the overall implementation of the DMMP. The Local Sediment Management Group (LSMG) (see Section 1.8) would provide input and feedback to the Corps with respect to dredging and dredged material management that would be implemented under this alternative, as well as Alternatives 3 and 4.



Conservation Pool

USACE Project Boundary

Shallow In–Water Disposal
Water Surface to 20 ft Below

Mid–Depth In–Water Disposal
20 ft Below Water Surface to 60 ft Below

Slope of Fill Material

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Lower Granite Reservoir

IN–WATER DISPOSAL AREAS

GIS Data Entry & Graphic Assembly: Bob Meyer (CENWW-ED-D-SC) GIS Conversion: George Hardin CENWW-PD-EC GIS Applications Coordinator: Bolse Grden CENWW-PD-EC GIS Coordinator: Tom Selner CENWW-IM-SM Study Manager:

PLOTTED: 10-JUN-2002 15:15

FIGURE 2–6

The adaptive management approach would allow the Corps and the LSMG to regularly evaluate dredging and dredged material management activities and monitoring results, and make needed adjustments to the overall course of action.

A levee raise of up to 3 feet (0.9 m) at critical locations is added to this alternative to maintain the flow conveyance capacity of the upper reservoir behind Lower Granite at the confluence of the Snake and Clearwater Rivers.

2.5.2.2 Disposal Process

The disposal process is dependent on the physical characteristics of the material and the potential to optimize the benefit to fish. Sediment samples would be taken from the areas to be dredged and would be evaluated for particle size, contaminant levels, and suitability for in-water disposal. Particle size analysis would identify which dredging sites or portions of sites contain mostly silt and which ones contain mostly sand or coarser material.

The sequence of dredged material disposal for the majority of the dredging activities is designed to accomplish two goals: (1) create shallow-water habitat for juvenile salmon, and (2) dispose of silt in a beneficial manner. To meet these goals, the dredged material would be placed in steps. The first step would be to use the silt [less than .008 inch (0.2 mm) in diameter] in a mixture with sand and gravel/cobble to fill the mid-depth portion of a site and form a base embankment. The dredged material would be placed aboard bottom-dump barges and analyzed to determine the percentage sand or silt to ensure the mixture in the embankment was not more than 30 percent silt. The barges would then proceed to the disposal area and would dump the material within the designated footprint close to the shoreline to raise the river bottom to create an underwater shelf about 10 feet (3 m) below the desired final grade. The second step would be to place sand on top of the sand/silt embankment. An area of sand would be reserved as the final area to be dredged during that dredging activity. Barges would be used to dump the sand on top of the base embankment in sufficient quantity to ensure that a layer of sand at least 10 feet (3 m) thick covers the embankment once the final step of the process is completed. The footprint of the disposal area would be sized so that the maximum amount of shallow water habitat is created with the estimated quantities of material to be dredged during that dredging activity. The final step would be to use a beam drag to flatten and level the tops of the mounds to form a flat, gently sloping (3 to 5 percent) shallow area with water depths up to 20 feet (6.1 m) as measured at minimum operating pool level. The sand cap layer would be created with a minimum thickness of 10 feet (3 m) to ensure the most desirable substrate (sandy with limited fine-grained or silt material) is provided for salmonid rearing habitat.

To determine the minimum surface acreage of habitats to be created, pre-impoundment aerial photos of the shorelines of the lower Snake River were studied and the sandy, shallow water areas conducive to rearing fall chinook were measured. Historically, a wide size range of these habitats existed but a minimum surface area for shallow water habitat creation was designated as 4 acres (1.6 hectares). This acreage was actually lower than the average habitat area found pre-impoundment but was calculated as the minimum necessary to attempt to mimic the free-flowing shoreline habitat required by fall chinook salmon.

On a case-by-case basis, hydraulic dredging may be considered for off-channel areas such as irrigation intakes. This would probably be done in the summer when salmonid fish are less likely to be found in these shallow water areas because of elevated water temperatures. To minimize turbidity, the hydraulic dredging would be limited to methods that do not agitate the sediments. The dredged material would exit the dredge as a slurry that is likely to be 65 to 80 percent water and would not be suitable for in-water disposal as described above. Instead, this slurry could be incorporated into the wildlife habitat planting areas or used to restore eroded streambanks near the intakes.

Summer dredging may also be considered for other off-channel areas such as swim beaches or boat basins on a case-by-case basis. These shallow-water areas would be expected to have elevated water temperatures during the summer and would not likely have salmonid fish present. The material dredged from these sites would probably be disposed of at an upland location since the in-water disposal areas are located in the main river channel and may have salmonid fish present during the disposal activity.

Table 2-7 compares the dredging options of timing, method, and disposal location for the various areas that would be dredged under this DMMP/EIS.

Table 2-7. Dredging Options by Area.

Area to be Dredged	Dredging Option*		
	Time of Year to Dredge	Method of Dredging	Disposal Location
Navigation Channel	Winter	Mechanical	In water or upland
Ports	Winter	Mechanical	In water or upland
Boat Basins	Winter	Mechanical	In water or upland
	Summer	Mechanical or hydraulic	Upland
Swim Beach	Summer	Mechanical or hydraulic	Upland
	Winter	Mechanical or hydraulic	In-water or upland
Irrigation Intakes	Summer	Mechanical or hydraulic	Upland
	Winter	Mechanical or hydraulic	In-water or upland

* Options listed in order of preference

A contingency upland disposal site has been identified to provide storage for dredged material that may, for whatever reason, need to be deposited on a separate upland site. In the event that dredged material may be unsuitable for beneficial use or disposal in-water, it would be isolated at the Joso upland disposal site (RM 56.5 and RM 58.6) and appropriate confinement measures would be taken to isolate this material (e.g., installing an impervious liner to prevent leaching of contaminated materials).

2.5.2.3 Levee Raise

Sediment accumulation in the Lower Granite reservoir continues to reduce the level of protection provided by the levees at Lewiston, Idaho. The proposed levee raise would result in the following:

Levees: The west Lewiston levee would be raised as much as 3 feet (0.9 m) in some locations. However, on the whole, most levee raises would be less than 3 feet (0.9 m).

Highways/Roads: Highway 129 downstream of Asotin and the Snake River Road upstream of Asotin would be raised.

Recreation Areas: The plan calls for cleanup of Hellsgate State Park, Swallows Park, and the Corps Clarkston office, boat ramp, and restrooms in the event of a flood.

Commercial Buildings: The plan would increase in the risk of flooding one commercial building, a U.S. Forest Service building, and a Corps building.
The levee raise would not affect utilities, bridges, railroad tracks, or private homes.

2.5.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

2.5.3.1 General Description

This alternative considers the same dredging activities as alternatives 1 and 2, but with upland disposal of all dredged material and no in-water disposal. The 3-foot (0.9-m) levee raise described as a part of alternative 2 would be included with this alternative (see section 2.5.2.3). The areas dredged for channel maintenance in this alternative remain the same and include Lake Wallula behind McNary on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River. This alternative would continue to maintain the navigation clearances in each reservoir and maintain the flow conveyance capacity of the upper reservoir behind Lower Granite. Additionally, maintenance dredging of access channels to ports and moorages occurs infrequently, on an as-needed basis. The Corps would continue to periodically conduct maintenance dredging around public recreation areas, such as swimming beaches and boat basins, and irrigation intakes for wildlife HMU's managed by the Corps. This alternative would ensure navigation clearance and maintain the flow conveyance by raising levees that protect Lewiston, Idaho, as in alternative 2. Under this alternative, dredged materials would be transported by barge to the Joso upland disposal site.

2.5.3.2 Upland Disposal Site

The location for upland disposal of dredged material would be the Joso site on the Snake River below Little Goose on the south bank at RM 56.5 to RM 58.6 (plate 11). The site is located at a bend in the river and is bounded on the southern side by the Union Pacific Railroad, giving it a roughly triangular shape. The entire site is approximately 568 acres (229.9 hectares), with open space/habitat management being the present use. Barge access to the Joso site would be at the west end providing access to a disposal area of approximately 280 acres (113.3 hectares) located in the center of the site with 600-foot (182.9-m) buffers from the river. Initially, the disposal area would be confined to a disturbed site that was historically used for gravel extraction and currently contains an exposed open gravel pit.

Use of the Joso site would require reconstruction of some facilities and construction of others. The existing barge slip would need to be dredged to restore access. The barge slip would also be reconstructed using anchored sheet pile to provide vertical walls and tie off facilities. Temporary dredged material dewatering and storage areas with containment berms and detention ponds would be constructed adjacent to the slip. The material would be off-loaded from the barges and placed in the temporary storage for dewatering, then would be loaded onto trucks for transport to the disposal area. The material would then be placed in lifts using track-type tractors and compacted, resulting in a large structural fill conforming to the established final topography for the disposal area. Areas that reach final grades would be restored on a periodic basis by placing 6 inches (15.2 cm) of topsoil and re-seeding with native grasses to achieve a vegetative cover similar to the surrounding site areas. Filling the gravel pit with sediment and seeding it to grass would improve the site's value as wildlife habitat. Contaminated or unsuitable dredged materials would be isolated and appropriate confinement measures taken (e.g., an impervious liner installed to prevent leaching).

2.5.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

2.5.4.1 General Description

This alternative considers the same dredging activities as alternatives 1, 2, and 3 with mechanical dredging as the primary dredging method. Hydraulic dredging would be considered on a case-by-case basis for off-channel irrigation intakes only. The areas dredged for channel maintenance remain the same and include Lake Wallula behind McNary on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River. Additionally, maintenance dredging of access channels to ports and moorages occurs infrequently, on an as-needed basis. The Corps would continue to periodically conduct maintenance dredging around public recreation areas, such as swimming beaches and boat basins, and irrigation intakes for wildlife HMUs and recreation sites managed by the Corps.

As with alternatives 2 and 3, a levee raise of up to 3 feet (0.9 m) at critical locations is added to this alternative to maintain the flow conveyance capacity of the upper reservoir behind Lower Granite at the confluence of the Snake and Clearwater Rivers (see 2.5.2.3).

2.5.4.2 Beneficial Uses

The management strategy for dredged material under this alternative would be beneficial use. Beneficial uses could include creation of shallow-water fish habitat, creation of riparian habitat, fill material for construction, etc. For each dredging activity, the Corps would identify potential beneficial uses and coordinate the uses with the LSMG prior to selecting a use. Beneficial uses, as defined by this process, may be achieved when a local sponsor is willing to contribute a share of the cost. Potential beneficial uses that have been identified to date include:

2.5.4.2.1 Fish Habitat Creation

Fish habitat creation would be the same disposal method used in alternative 2 "Maintenance Dredging With Beneficial In-Water Disposal and a 3-Foot (0.9-m) Levee Raise." This method is described in section 2.5.2.2. This beneficial use would result in the creation of shallow-water fish habitat to benefit juvenile salmonid fish.

2.5.4.2.2 Woody Riparian Habitat Program

The Corps has proposed the "woody riparian" program to help meet the goals of the Lower Snake River Fish and Wildlife Compensation Plan within the state of Washington. The woody riparian program would create and enhance riparian habitats along the lower Snake River.

The Lower Snake River Fish and Wildlife Compensation Plan (LSRFWCP) was drafted in 1975 to provide direction and funding for environmental mitigation as a result of the construction of lower Snake River lock and dam projects. The LSRFWCP was divided into components to address anadromous fish, resident fish, and terrestrial wildlife. The woody riparian program has been developed to address the LSRFWCP's specific goals for terrestrial wildlife mitigation.

Initially, the Corps proposes to implement the woody riparian program in Lower Granite Reservoir near the Chief Timothy Habitat Management Unit. Proposed woody riparian habitat creation would consist of developing a shallow, sloping bench (approximately two feet below surface at the maximum operating pool), extending along approximately 3,000 linear feet of shoreline between RM 131.6 and 133.4. The Corps has identified this particular site because it has a high potential for successful woody riparian habitat development, would not interfere with navigation, would not impact known cultural resources, and would be close to the Snake/Clearwater River confluence where most dredging is proposed to occur. Dredged material placed in this proposed area would accomplish three goals consistent with the LSRFWCP:

- Create planting zones for woody riparian habitat;
- Increase suitability and acreage of shallow water rearing habitat for Snake River fall chinook juveniles; and
- Provide a beneficial use of dredged material.

The Corps proposes to use dredged material from planned 2002-2003 dredging to develop woody riparian areas as described above. Details of proposed woody riparian habitat development are provided in Appendix N.

2.5.4.2.3 Hanford Site Capping

The Richland Office of the U.S. Department of Energy (USDOE) has responsibility for management of the nearby Hanford site (plate 7). The 570-square-mile (1 476.3-square-km) Hanford Site was founded early in World War II to produce plutonium for the nation's first atomic weapons. Since the mid-1950's, the mission of Hanford has broadened to meet energy and defense needs. One of the many uses of the Hanford site has been the storage of contaminated wastes including commercial, low-level radioactive waste received from hospitals, research facilities, industries, and nuclear power stations. Treatment and storage of these contaminated wastes often involves the use of clean soils as a capping material. While the quantities of material required for capping of burial sites on the Hanford site have yet to be determined, Comprehensive Environmental Response Compensation Liability Act (CERCLA) of 1980 and Resource Conservation and Recovery Act (RCRA) compliance indicates that there could be requirements for large volumes of materials including: fine-grained clays and silts, fine to coarse gravel, cobbles, and larger stone or riprap material. The quality of materials imported onto the Hanford site is of concern and all such materials must be sampled to identify constituents and/or contaminants. The USDOE is in the process of evaluating sources of fill for uses on the Hanford site. The USDOE will be addressing issues such as availability of off-site materials, the impact of utilizing on-site borrow material, site restoration requirements, and the anticipated volume of materials required in the near future (USDOE, 1999).

Dredged material would provide an excellent source of clean material for this use. Dredged material from channel maintenance dredging in McNary reservoir (Lake Wallula) could be used by barging these materials an additional 10 miles (16.1 km) and off-loading them at facilities owned by the Port of Benton adjacent to the Hanford site. Costs for this beneficial use would be determined by the added cost to transport the material to the off-load and temporary storage facilities. The added maintenance dredging costs for this additional 10 miles (16.1 km) of barge transport and off-loading would be borne by the USDOE. Storage at the temporary site and transportation of the material to the use location would be the responsibility of the USDOE.

2.5.4.2.4 Potting Soil

Dredged material removed from the Lower Granite reservoir has constituents that make it excellent as a potting soil or soil enhancer. The Port of Whitman County has investigated a system that processes straw, digestible solid waste, and soil (dredged material as proposed in this alternative) in a continuous digester to produce a final product that is used as potting soil, top dressing for turf areas such as golf courses and parks, or to enhance production of agricultural crops. Straw, a surplus commodity from the highly productive Palouse Hills grain growing area adjacent to the Port of Wilma, is an ideal raw material for this process. Solid waste from the Lewiston-Clarkston-Pullman-Moscow metropolitan areas can be classified to remove recyclable materials and other unsuitable materials that might make it unusable as a raw material for this digestive process. Dredged materials from Lower Granite reservoir would supply the third raw material for this process. The net result would be to convert straw, solid waste, and dredged materials into a marketable commodity. This would create a new industry for this region of Washington and Idaho with resultant gains in employment and spendable income. The Port of Whitman County has proposed packaging this material for sale in the region. Their plans call for up to 300,000 cy (229 367 m^3) per year of dredged material to be delivered by barge to a temporary holding site at the Port of Wilma. The additional cost of this activity would be paid by the Port of Whitman County.

2.5.4.2.5 Riparian Habitat Restoration

Dredged material has been used to construct riparian habitat in this reach of the Columbia/Snake River system, similar to that described in section 2.5.4.2.2 above. Where additional opportunities exist to barge and off-load material to cover riprap, to create islands or to build sub-impoundment areas, local sponsors may contract with the Corps to construct these projects on a one-time basis. The added cost of dredging maintenance required to use the dredged material to restore the environment would be cost-shared 25 percent by a local sponsor and 75 percent by the Federal government. Section 204 of the Water Resources Development Act of 1992 provides the authority for this cost sharing, provided that the local sponsor provides all lands, easements, rights-of-way, and relocations necessary, and owns and operates the finished project. The following projects and sponsors were tentatively identified as potential beneficial uses of dredged material to restore the ecosystems on existing levees:

- Levee 2C - City of Richland: Create shallow shoreline areas by filling over existing steep slopes.
- Levee 4A - City of Richland: Create shallow backwater near the Yakima River confluence.
- Levee 12-1 - City of Pasco: Fill at the toe of the existing levee creating a gentle shelf to 15-foot (4.6-m) water depth.
- Levee 12-2 - Franklin County: Create a gently sloping shallow-water area to 15 feet (4.6 m) deep.
- Levee 5D - City of Kennewick: Fill from Clover Island to Blue Bridge at a slope of 7 feet horizontal to 1 foot vertical (7:1).
- Clover Island - Port of Kennewick: Fill from east end of the island to the Cable Bridge at a slope of 7:1 and fill from the west end of the island to create a flat shallow extending to a berm angling at 30 degrees from the levee.
- Levee 6B - Benton County: Fill along the shore downstream of the Cable Bridge to produce flat shallows.
- East of Two Rivers Park and Levee 15D - Benton County: Fill near shore areas to create flat shallow fish habitat.

2.5.4.2.6 Port of Wilma Fill

The Port of Wilma has long-term plans to fill the empty dredged material disposal cells previously formed west of and adjacent to the currently developed port facilities. This potential dredged material disposal area currently has the capacity to accommodate approximately 370,000 cy (282 885.3 m^3) of dredged materials in Cell #2 and 100,000 cy (76 455.5 m^3) in Cell #3. Access to this site for future disposal of dredged materials is currently hampered by near-shore shallow waters designated as critical habitat for listed juvenile fall chinook salmon and potential cultural resource impacts.

Access for unloading of dredged materials appears to be available at two locations adjacent to these potential dredged material disposal sites. Barge access is currently available at the west end of the developed area at the Port of Wilma (e.g., land leased by Tidewater Barge Lines for the purpose of constructing and launching barges). It may be possible to off-load dredged material from barges at this site and to stockpile these dredged materials on site. These stockpiled dredged materials could then be transferred across a previously filled and currently undeveloped dredged material disposal cell to currently available dredged fill disposal areas. These materials could be transferred hydraulically using pumps and pipelines or mechanically by using earthmoving equipment.

A second potential site for off-loading dredged material from barges exists approximately 3,000 feet (914.4 m) downstream from the west end of the Port of Wilma developed area. This is an area, offshore from the potential disposal area, approximately 700 feet (213.4 m) long by 150 feet (45.7 m) wide that is filled to an elevation of 740 feet msl. This appears to be downstream of juvenile salmonid habitat areas and appears to have sufficient water depth adjacent to the riverside face to accommodate loaded barges. Dredged material could be moved via a causeway some 500 to 600 feet (152.4 to 182.9 m) shoreward to the disposal area by conveyor or earthmovers for placement in the potential disposal area.

The increased cost of transport and off-load of the dredged material would be borne by the Port of Wilma.

2.5.4.2.7 Fill of Non-Federal Public Land

Non-Federal requests for beneficial use of dredged material to fill land may be allowed, provided additional implementation costs are non-Federal and no additional cost would accrue to the Federal project. The non-Federal cost share shall be the difference between the base plan presented in this document and the cost of delivering the dredged material to meet the non-Federal sponsor's beneficial use.

2.5.4.2.8 Lower Granite State Route (SR) 193/SR 194 Road Connection

The Port of Whitman County has promoted the construction of a section of roadway along the north shore of the Lower Granite reservoir linking SR 193 at Wawawai to SR 194 at Lower Granite. A new 3-mile (4.8-km) section of roadway at this location would eliminate use of a 32-mile (51.5-km) stretch of steep, narrow roadway via SR 193 and SR 194 to access Lower Granite from the Port of Whitman County's Port of Wilma facility near Lewiston and Clarkston. The proposal is to use dredged material to construct a structural berm in Lower Granite reservoir on which this 3.5-mile (5.6-km) roadway would be constructed. This berm would be constructed in conjunction with placement of additional dredged materials between the shoreline and the structural berm to create a shallow-water habitat, along the north shore of this deeper part of Lower Granite reservoir, to facilitate downstream migration of juvenile salmon and steelhead. A Feasibility Study entitled "Construction of Road from Lower Granite to Wawawai Canyon, Whitman County, Washington", dated September 1981, prepared by the Walla Walla District, U.S. Army Corps of Engineers presented nine alternative routes for construction of this road.

There are numerous benefits associated with this alternative. The Whitman County Sheriff's Department has documented that construction of this 3.5-mile (5.6-km) road segment would eliminate the current 45-mile (72.4-km) drive from Wawawai to Boyer Park near Lower Granite. They cite emergency response times, icy winter driving conditions and heavy usage of both Wawawai and Boyer Parks by university students as safety issues that justify the construction of this road segment. Recreational benefits, presented by the Whitman County Parks and Recreation Department, include increased recreational usage of both Boyer Park and Wawawai Park; increased access to the Snake River (Lower Granite reservoir); and completion of recreational facilities for the Lower Granite project. The economic benefits are related to movement of bulk commodities, mostly grain, by truck from the Lewiston-Clarkston area and from grain growing areas closer to Almota. Travel distance from the Lewiston-Clarkston area to government-owned and -operated facilities at Lower Granite would also be reduced.

Examination of preliminary roadway sections developed during the 1981 Corps study indicates that significant quantities of dredged materials could be incorporated into construction for one of the proposed routes. The initial route involves construction of this roadway upon fill placed adjacent to and on the riverward side of the existing railroad tracks. It is estimated that this route could accommodate 500,000 cy (382 277.4 m^3) of dredged materials. The Corps estimated the total cost of constructing this route at \$14.8 million in 1981. Allowing a 30 percent cost escalation for inflation, the present day construction cost for this route would be approximately \$20 million.

The 1981 Corps study had identified the least expensive route as constructing a roadway on the landward side of the railroad tracks and involved mostly excavation into the steep terrain adjacent to the railroad. The estimated costs for the least expensive route were estimated at \$6.71 million in 1981. The Corps identified another route as the preferred route. This route was generally constructed on the landward side of and parallel to the existing railroad tracks; however, it involved three railroad crossings and approximately 6,000 feet (1 828.8 m) of roadway in or adjacent to Lower Granite reservoir. It is estimated that this route could accommodate approximately 200,000 cy (152 911 m^3) of dredged materials. In 1981, the Corps estimated construction costs for the preferred route at \$7.87 million. Allowing a 30 percent cost escalation for inflation, the present day cost would be approximately \$10.25 million.

Comparing the beneficial use for these two roadway routes to the proposed in-water dredged materials disposal alternative results in an additional cost for disposal. Construction of the various routes considered would utilize some 500,000 cy (382 277.4 m^3) of dredged materials. Construction of the preferred route would utilize some 200,000 cy (152 911 m^3).

Utilization of dredged materials is subject to determining a satisfactory means of placing the dredged materials, the structural suitability of these dredged materials, and environmental considerations. Use of dredged materials for roadway embankment could significantly reduce the overall cost of construction for either the initial route or the preferred route as proposed by the Corps in the 1981 study.

2.5.4.2.9 Research of Beneficial Uses

Two research groups at the Corps of Engineers Waterways Experiment Station (WES) in Vicksburg, Mississippi, are investigating measures to use this type of material. One group may be interested in determining economic and biological values to be obtained from the use of the material in the riparian environment. The other group may be interested in demonstrating the application of this material as a top dressing composed of sewage sludge, dredged material, and other ingredients. Dredged material removed from the Port of Walla Walla barge channel at Boise Cascade is expected to be predominantly fine grain sediment suitable for use as a top dressing and habitat restoration. There are various locations within proximity to the Boise Cascade channel that provide the opportunity including sites in The Dalles reservoir (The Cliffs), John Day reservoir (Goodnoe, Plymouth), and McNary reservoir (Hood Park and the various Shot Rock Islands). The LSMG may look for opportunities to participate with the WES research groups to implement these research efforts.

2.6 MITIGATION

The environmental effects of the alternatives are discussed in detail in section 4. In general, none of the alternatives under consideration are expected to result in significant environmental impacts. Mitigation strategies have been developed to address the environmental impacts that are expected to result from the alternatives. These strategies are also discussed in section 4.

A prominent programmatic mitigation measure that is relevant to dredging and disposal of dredged material is the creation of woody riparian habitat and shallow-water habitat with the dredged material. Implementation of this mitigation measure would compensate for effects of dredging and disposal activities on aquatic resources, and in particular, endangered salmonid species. The Corps would conduct long-term monitoring of shallow-water disposal sites to evaluate the success and quality of habitat creation.

Mitigation is also proposed for direct and indirect impacts due to dredging, disposal (both upland and in-water), and construction activities related to proposed levee height modifications. In general, mitigation strategies include:

- Avoiding impacts through timing of specific activities or location of upland disposal facilities and construction activities.
- Sampling and analyzing sediments prior to dredging following criteria in the Dredged Material Evaluation Framework.
- Monitoring water quality during dredging and disposal activities to ensure impacts are identified and actions are modified as necessary.
- Minimizing impacts through techniques such as erosion and sedimentation control and other construction best management practices to minimize soil loss, compaction, fugitive dust, and runoff to surface waters.
- Documenting affected cultural resources and incorporating appropriate mitigation measures.

Other programs provide mitigation for impacts attributed to dam construction and operation. In the case of the four Snake River dams, the Lower Snake River Fish and Wildlife Compensation Plan (Corps, 1983), a congressionally authorized program, provides fish and wildlife mitigation for the impacts caused by the construction and operation of the four dams and reservoirs. The proposed woody riparian program would further the goals of this particular mitigation plan. Mitigation for salmonid fishery impacts includes construction and operation of several fish hatcheries and their satellite facilities to provide salmon and steelhead for commercial and sport fishermen. Mitigation for wildlife impacts includes maintenance of irrigated and non-irrigated HMU's on Corps-owned land adjacent to the lower Snake River. It also includes the purchase and development of additional lands in the lower Snake River basin suitable for wildlife habitat development.

Other Federal laws contain provisions to protect and mitigate impacts to the aquatic environment. The Corps conducts a Clean Water Action Section 404(b)(1) evaluation, which includes evaluating alternatives that do not impact or have a lesser impact on aquatic environment. The evaluation also includes an analysis of the unavoidable adverse impacts and ways to minimize those impacts. The Corps prepared a 404(b)(1) evaluation for the DMMP/EIS and it is included as Appendix I. This appendix is being coordinated with state agencies.

The ESA compliance process will also identify ways to reduce or avoid impacts to listed species and their habitat. In their Biological Opinion for the DMMP, NMFS identified reasonable and prudent measures that would minimize the impacts to listed anadromous fish species and their habitat. In their response document, the USFWS provided similar recommendations for listed terrestrial and non-anadromous fish species. See Appendix F and G for details.

2.7 EVALUATION/SELECTION OF PLAN

The Corps evaluated each of the plans identified previously as "selected for further consideration" based on the following criteria:

- Will the plan maintain the navigation channels of the system?
- Will the plan provide optimal use of material dredged from the reservoirs?
- Will the plan maintain sufficient flow capacity through the Lewiston levee system?
- Does the plan maximize environmental benefits/minimize environmental impacts?
- Does the plan have a favorable cost/benefit ratio?
- Does the plan allow for adaptive management through the 20-year period of the DMMP?
- Does the plan complement regional ESA habitat goals?
- Is the plan regionally acceptable?
- Does the plan address comments identified through the public review process?

The sensitivity of plan measures to variable parameters is discussed in appendix C, Economic Analysis. As also discussed in appendix C, the risk and uncertainty of plan measures were evaluated through the use of the Corps' Hydrologic Engineering Center Flood Damage Assessment model that performs a risk-based analysis of flood control alternatives.

The environmental effects of the four alternatives are discussed in section 4. When preparing the effects analysis, the Corps considered unavoidable effects, short-term uses, long-term productivity, and irreversible or irretrievable commitments of resources. The Corps also considered direct, indirect, and cumulative effects. Table 2-8 summarizes the environmental effects of each of the four alternatives. More detailed discussions of environmental effects are found in select appendices. Appendices F and G contain the Biological Assessments that evaluated the effects of the preferred alternative on plant and animal species listed under the ESA. Appendix K provides a detailed analysis of the effects of the alternatives on aquatic organisms.

Table 2-9 presents a matrix comparing the four alternatives' performance in the areas of the criteria listed above.

Based on the current best available information as summarized in table 2-9, the Corps determined that alternative 4 best met the Corps' needs while minimizing negative environmental impacts and/or maximizing environmental benefits. Therefore, the Corps selected alternative 4 as the preferred alternative for the DMMP. As a result of the initial screening and the final evaluation of alternatives, the Corps also determined that alternative 4 is the environmentally preferred alternative. Appendix O displays the comment letters received on the Draft DMMP/EIS and the Corps' responses to those comments.

2.8 RECOMMENDED PLAN/PREFERRED ALTERNATIVE

The Corps' preferred alternative or recommended plan for long-term management of dredged material is "Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise." Alternative 4 is the preferred plan to meet the need to maintain the navigation channels of the system, manage dredged material from the reservoirs, and maintain flow conveyance capacity in the Lower Granite reservoir. Alternative 4 most completely and efficiently meets the project purpose and need at the least cost, while presenting potential environmental impacts that are no greater, and often less, than other alternatives considered. Further, the plan incorporates mitigation features that would restore valuable aquatic and terrestrial habitat to the system. The plan represents the greatest beneficial use of dredged material that can be implemented on a programmatic basis at this time. Furthermore, the plan incorporates an adaptive management approach that provides for on-going evaluation of proposed dredging and dredged material management activities and opportunities to adapt and adjust actions based on these evaluations. The plan becomes the base for cost sharing of other beneficial uses of dredged material that may be identified in the future as each separate dredging

TABLE 2-8. Environmental Effects Summary Matrix.

Discipline	Alternative 1 No Action (No Change) - Maintenance Dredging with In-Water Disposal	Alternative 2 Maintenance Dredging with In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise	Alternative 3 Maintenance Dredging with Upland Disposal and a 3-Foot (0.9-m) Levee Raise	Alternative 4 Maintenance Dredging with Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise
Aquatic Resources	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term effects anticipated. Potential beneficial effects from creation of some in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. Potential beneficial effects (greater than Alternative 1) from creation of shallow water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. No creation of in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species; no long-term effects anticipated. Potential beneficial effects from creation of shallow water fish habitat, woody riparian habitat and/or beneficial use that may restore habitat.
Terrestrial Resources	Indirect, short-term minor effects on terrestrial wildlife and habitat	Similar effect as Alternative 1; Minor, short-term, indirect impacts on terrestrial species through disruption of habitat from levee raise and displacement during dredging.	Direct, moderate effects to terrestrial species from loss of habitat at upland disposal site and disruption of habitat from levee raise. Positive effects from habitat creation in old borrow area at disposal site.	Indirect, minor, short-term, negative effects through disruption of habitat from levee raise; potential long-term positive effects from beneficial use of dredged material to create upland habitat and woody riparian habitat.
Endangered Species	• *Fish* – "May affect and would likely adversely affect" salmonids but no jeopardy to listed species; "may affect, not likely to adversely affect" bull trout. • *Terrestrial Wildlife* – "May affect, not likely to adversely affect" bald eagle. • *Plants* – "May affect, not likely to adversely affect" Ute ladies' tresses and water howelia; "no effect" on Spalding's silene.	Same effects as Alternative 1.	• Same effects as Alternative 1.	• Same effects as Alternative 1.
Recreation	Minor, short-term impact on access to portions of the river for recreational boats near proposed dredging and disposal activities. Maintains ability to use recreational facilities.	Minor, short-term, direct impact due to disruption of recreational facilities in Lewiston area due to levee raise, and minor short-term impact to recreational boating near dredging and disposal. Maintains ability to use recreational facilities.	Same effects as Alternative 2 except for dredged material disposal. Minor indirect effects to recreational users in the vicinity of the upland disposal site. Maintains ability to use recreational facilities.	Same effects as Alternative 2. Potential long-term, beneficial effect from beneficial use of dredged material if used to enhance recreation sites. Maintains ability to use recreational facilities.
Cultural Resources	Known submerged cultural properties would be avoided to the maximum extent practicable during dredged material disposal and management activities.	Same effects as Alternative 1.	Same effects as Alternative 1. Cultural properties in vicinity of upland disposal site would be avoided.	Same effects as Alternative 1. Potential effects of beneficial uses would be evaluated as proposals are developed.
Socioeconomics	Long-term, positive effect from maintaining navigation. Indirect, long-term, moderate negative effect from greater potential flood risk (no levee raise). Minor effects could occur. Low-income and minority populations not disproportionately affected.	Long-term, positive effect from maintaining navigation. Direct, short-term and long-term positive effect from levee raise due to added jobs and materials required by levee construction. Reduction of flood risk from levee raise. Low-income and minority populations not disproportionately affected.	Same effects as Alternative 2.	Same effects as Alternative 2.
Transportation	Maintains existing transportation systems.	Direct, short-term, minor effect on roadways and railroads from proposed levee/road raise construction activities.	Same effects as Alternative 2.	Same effects as Alternative 2. Potential positive effect if dredged material is used for transportation projects.
Geology and Soils	Local displacement of soils and alluvial material.	Potential short-term effect to soils in the vicinity of levee raise due to construction activities.	Potential short-term effect to soils in the vicinity of the levee raise. Long-term effect on soils at upland disposal site due to construction and disposal activities.	Potential short-term effect to soils from implementation of beneficial use due to construction activities.
Water Quality/ Water Resources	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No effect. • *Flood Plains* – No impacts	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise. • *Flood Plains* – Minor, short-term impact at proposed upland containment site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise and upland disposal. • *Flood Plains* – Minor, short-term impact at upland disposal site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity and placement of fill in shoreline areas for woody riparian habitat creation. • *Wetlands* - Minor direct effect from woody riparian habitat creation adjacent to wetland. Minor indirect effects associated with levee raise. • *Flood Plains* – No impact to floodplain from woody riparian development. Future beneficial uses may require assessment of floodplain impacts.
Hazardous, Toxic, and Radioactive Waste	No effects anticipated; sediments will be tested for contamination.	Same effects as Alternative 1.	Same effects as Alternative 1.	Same effects as Alternative 1.
Air Quality	Direct, minor, short-term effects to local air quality due to dredging and disposal equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation and upland disposal activities.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation, including implementation of beneficial use(s).
Noise	Direct, minor, short-term effects due to noise from dredging and disposal equipment operation.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.
Aesthetics	Direct, minor, short-term effect on aesthetics from dredging and disposal activities.	Direct, minor, short-term effects on aesthetics from dredging and disposal activities; long-term, minor impacts from levee raise.	Direct, minor, short-term effects from dredging. Long-term, minor impacts from levee raise. Direct, minor, long-term effects from upland disposal.	Direct, minor, short-term effects from dredging and disposal; long-term, minor impacts from levee raise; and long-term beneficial effect to shoreline area for woody riparian habitat creation.
Native American Tribal Communities	Potential positive effects on salmon fishing from creation of salmon rearing habitat and cultural resources to be avoided.	Potential positive effects (greater than Alternative 1) on salmon fishing from creation of salmon rearing habitat.	No effects anticipated.	Same effects on salmon fishing as for Alternative 2.
Cumulative Effects	Potential positive effects on salmonid fish from creation of shallow-water fish habitat. Other resources were evaluated regarding cumulative effects and nothing was determined to preclude the selection of this alternative.	Potential positive effects on salmonid fish (greater than Alternative 1) from creation of shallow-water fish habitat. Same effects on other resources as Alternative 1.	Potential positive effects to terrestrial species from filling old borrow area at disposal site and establishing vegetation. Same effects on other resources as Alternative 1.	Same effects as Alternative 2. Positive effects from proposed beneficial use of dredged material (e.g., woody riparian habitat development). Same effects on other resources as Alternative 1.

[1] "Impacts" and "effects" are used interchangeably. Unless otherwise noted as beneficial or positive, impacts described are negative.

activity is planned and executed. Beneficial uses of dredged material may be adopted on a case-by-case basis under this plan as opportunities become available and when local sponsors agree to fulfill sponsorship requirements. To ensure that the plan continues to optimize the use of dredged material, the Corps will coordinate potential beneficial uses for each dredging activity with the LSMG prior to the start of dredging.

Table 2-9. Final Alternative Evaluation Matrix.

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Maintain Navigation Channels	M	M	M	M
Optimize Use of Dredged Material	M	MH	ML	H
Maintain Sufficient Flow Capacity	L	M	M	M
Maximize Environmental Benefits/Minimize Environmental Impacts	M	MH	ML	H
Provide Favorable Benefit/Cost Ratio	ML	MH	L	MH
Incorporate Adaptive Management	ML	M	ML	H
Complement Regional ESA Habitat Goals	M	MH	L	H

The ratings indicate the performance of each of the alternatives in satisfying the criteria statement.
Ratings are: L- Low, ML-Medium/Low, M-Medium, MH-Medium\High, H-High

The 3-foot (0.9-m) levee raise feature is the preferred plan for maintaining the flow conveyance capacity in the Snake and Clearwater Rivers confluence area of Lower Granite reservoir because it meets the purpose and need and produces maximum net benefits in excess of costs. Raising the levee was found to reduce the need for dredging in the confluence area of Lower Granite reservoir and, therefore, is considered as a part of this DMMP/EIS. Selection of the levee raise as the preferred conveyance restoration method was based on the maximization of net benefits determined from a risk-based flood damage assessment and annual costs amortized over the remaining 74 years of the project life. Since the original Lower Granite slackwater levee system required no local cost sharing, this levee modification at a cost of $2.3 million is recommended to be 100 percent Federal cost.

The following sections provide detailed descriptions of the components of the recommended plan.

2.8.1 Dredging Activity

The dredging procedure to be used varies depending on the location of the dredging. For the dredging proposed for the navigation channels, slips, and berths of the Columbia/Snake/ Clearwater Rivers navigation system, mechanical dredging would be used. Mechanical dredging methods would include clamshell, dragline, backhoe, or shovel/scoop. Based on previous dredging activities, the clamshell method would probably be used for the larger quantities. Material would be scooped from the river bottom and loaded onto a bottom-dump barge for in-water disposal or a bin-type barge for upland disposal. The contractor would be allowed to overspill excess water from the barge while the barge is being loaded. The water would be discharged a minimum of 2 feet (0.6 m) below the river surface. Clamshell dredges of approximately 15-cy (11.5-m) capacity and barges with a capacity of up to 3,000 cy (2 293.7 m) with maximum drafts of 14 feet (4.3 m) would be used. The Corps estimates it could take about

6 to 8 hours to fill a barge. The expected rate of dredging is 3,000 to 5,000 cy (2 293.7 to 3 822.8 m^3) per 8-hour shift. The barge would then be pushed by a tug to the disposal site. No material or water would be discharged from the barge while it is in transit. For in-water disposal, when the barge arrives at the appropriate disposal site, the bottom would be opened to dump the material all at once. A clamshell or excavator would be used to unload barges for upland disposal. The barge would then be returned to the dredging site for additional loads. The contractor could be expected to work between 10 and 24 hours per day, 6 to 7 days per week. Dredging would be performed within the established in-water work windows, which currently are December 15 through March 1 in the Snake and Clearwater Rivers and December 1 to March 31 in the Columbia River. Multiple shift dredging workdays would be used when necessary to ensure that dredging was completed within these windows. Dredging outside these work windows, such as summertime, would be subject to coordination with LSMG and state and federal resource agencies and would meet the requirement of NEPA, Clean Water Act, Endangered Species Act, and other applicable environmental laws.

Multiple shift dredging workdays would be used when necessary to complete dredging within the work windows. Mechanical dredging methods would likely be used. The disposal plan would be the beneficial use selected for that dredging activity. Figure 2-7 displays the decision tree that would be used by the Corps to determine the disposal method and location for each activity.

Maintenance of irrigation intakes and beaches has often required small-quantity dredging [under 5,000 cy (3 822.8 m^3)]. Small-quantity dredging projects would involve either mechanical methods or non-agitation hydraulic methods (irrigation intakes only) and would include discharging to barge or truck for transport. If a truck were used, disposal of the material would be made on an appropriate upland site. Appropriate upland disposal sites include, but are not limited to, Corps land, beneficial use upland applications, and local landfills. The mechanical dredging equipment for these small dredging projects may be a clamshell, dragline, backhoe, or shovel/scoop. This small quantity dredging activity would use the in-water work window or possibly an alternate summer work window if one were approved for the specific project.

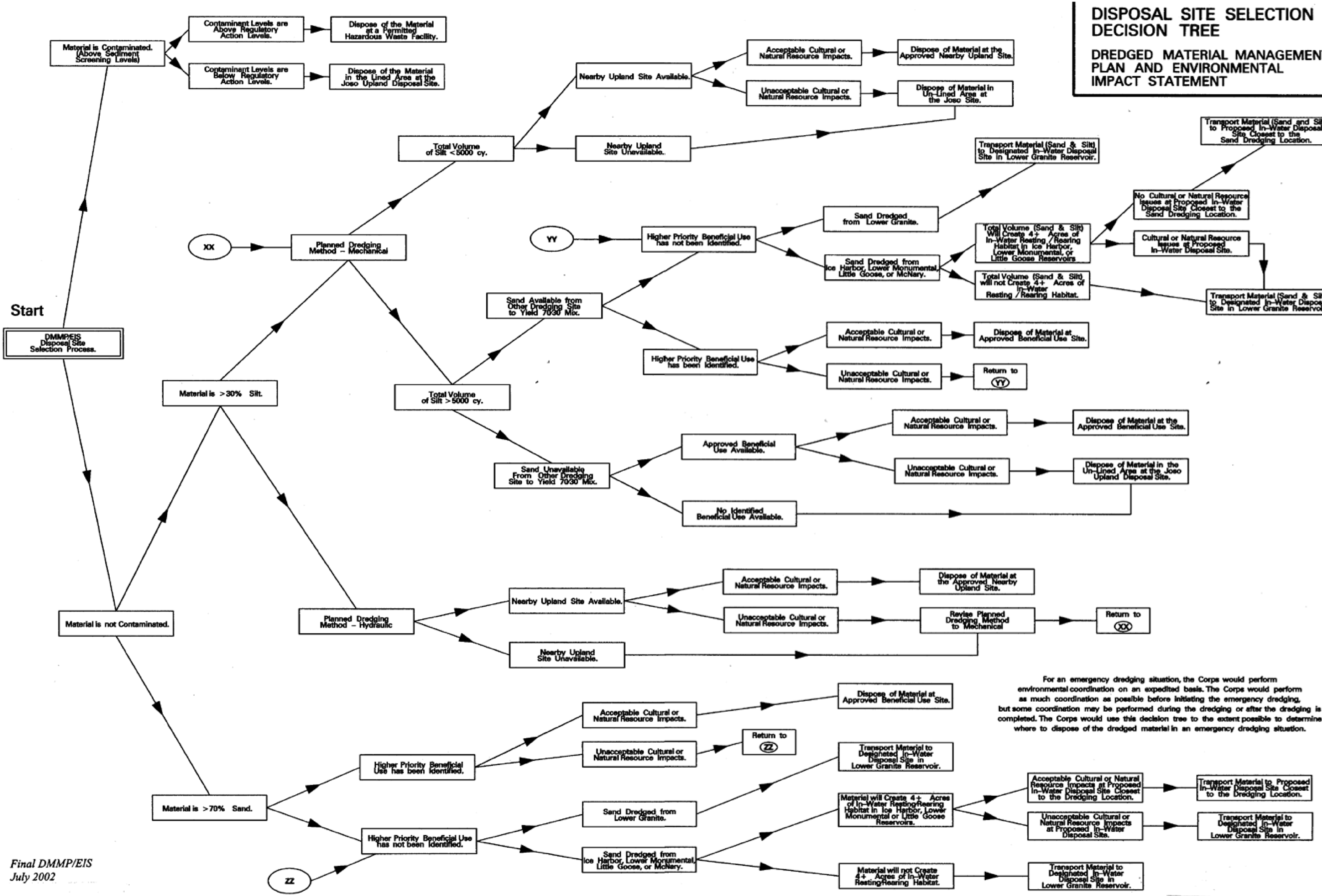
Following are descriptions of dredging activities anticipated in each of the five reservoirs in this system. The dredging areas described and depicted on the plates are intended as an inclusive list of dredging locations that might be dredged in the 20-year period of this DMMP/EIS. Many of the areas listed and shown on the plates are not considered to need maintenance dredging in the near future.

2.8.1.1 Lower Granite Reservoir

Maintenance dredging in the Lower Granite reservoir may be done at several sites (plates 15 through 17). The largest concentration of dredging would be at the confluence of the Snake and Clearwater Rivers in the Lewiston-Clarkston area. The area that requires frequent dredging extends from the vicinity of Silcott Island near Snake RM 131 upstream to the U.S. Highway 12 bridge located near Snake RM 139.5 and from the confluence at RM 139 up the Clearwater River to just downstream of Memorial Bridge at RM 2 as shown on plate 17. The Federal navigation channel extends to within 50 feet (15.2 m) of existing port structures and the Corps is

DISPOSAL SITE SELECTION DECISION TREE

DREDGED MATERIAL MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT



For an emergency dredging situation, the Corps would perform environmental coordination on an expedited basis. The Corps would perform as much coordination as possible before initiating the emergency dredging, but some coordination may be performed during the dredging or after the dredging is completed. The Corps would use this decision tree to the extent possible to determine where to dispose of the dredged material in an emergency dredging situation.

responsible for maintaining this channel. The port areas parallel the Federal channel and the ports are responsible for maintaining access from the Federal channel. Ports have expressed interest in entering into an agreement for the Corps to dredge these areas. The dredging area includes the Federal navigation channel and port facilities in the area. Areas in the Lower Granite reservoir that may require dredging at some time over the next 20-year period include the Port of Wilma slip, the Port of Clarkston berthing area on the Snake River, the Port of Lewiston berthing area on the Clearwater River, the Green Belt Boat Basin, Potlatch Corporation dock, Hells Gate State Park moorage, Chief Looking Glass moorage, Hells Canyon Resort marina, and the irrigation intake for Chief Timothy HMU.

2.8.1.2 Little Goose Reservoir

Maintenance dredging in the Little Goose reservoir (plates 12 through 15) would include the Federal channel downstream of the Lower Granite navigation lock guidewall and the Federal channel opposite Schultz Bar, RM 101.5. Dredging may also be required to maintain navigation facility clearances at the Port of Garfield, Port of Central Ferry, Port of Almota, and Boyer Park Marina. In addition, small dredging projects of 5,000 cy (3 822.8 m^3) or less would be required at the irrigation intakes of the Ridpath, New York Bar, Willow Bar, and Swift Bar HMU's over the 20-year period.

2.8.1.3 Lower Monumental Reservoir

In Lower Monumental reservoir (plates 10 through 12) periodic dredging may be required to maintain adequate navigation clearances into Little Goose navigation lock and at Lyons Ferry Dock and Marina. Small dredging projects may also be required to maintain the irrigation intakes for Skookum and 55 Mile HMU's.

2.8.1.4 Ice Harbor Reservoir

Maintenance dredging in Ice Harbor reservoir (plates 8 through 10) is required periodically for the Lower Monumental navigation lock approach channel and may be required to provide navigation clearances at Walla Walla Grain Growers at Sheffler, Louis Dreyfus Windust Station, and Charbonneau Park boat moorage. Also, small amounts of dredging may be required periodically to maintain the irrigation intake for the Big Flat, Lost Island, and Hollebeke HMU's.

2.8.1.5 McNary Reservoir

In McNary reservoir (plates 2 through 8) navigation maintenance dredging is required in the downstream approach channel to Ice Harbor navigation lock for a length of approximately 7 miles (11.3 km). Periodic dredging may also be required at the Port of Umatilla; the Port of Benton barge slip; the Port of Pasco marine terminal, barge slip, and container terminal; the Port of Walla Walla facilities; and the Pasco Boat Basin.

2.8.2 Dredging Template Design

The navigation dredging template of the Federal navigation channels in this system is 250 feet (76.2 m) wide and 14 feet (4.3 m) deep below the minimum authorized pool elevation. The authorized minimum pool elevations are: 733 feet msl at Lower Granite; 633 feet msl at Little Goose; 537 feet msl at Lower Monumental; 437 feet msl at Ice Harbor; and 335 feet msl at McNary. Dredging templates for other maintenance dredging activities would vary.

2.8.3 Dredging Quantities

Dredging quantities presented here assume a dredging cycle of 2 years; however, actual dredging frequencies are dependent on variable sedimentation rates and actual dredging cycles may vary from 2 to 10 years. For planning purposes, the maximum volume of dredged material was estimated to be 300,000 cy (229 367 m^3), based on a 2-year cycle, in order to maintain the designed navigation channels in the Lower Granite reservoir. Estimated dredging cycles and dredged material volumes for the lower Snake River and McNary reservoirs are presented in table 2-10.

Table 2-10. Estimated Dredging Cycles and Dredged Material Volumes per Cycle

Reservoir	Estimated Dredging Cycle (years)	Estimated Maximum Volume of Dredged Material (cy/m^3)
Lower Granite	2	300,000 (229 367)
Little Goose	2	4,000 (3 058)
Lower Monumental	2	2,000 (1 529)
Ice Harbor	2	2,000 (1 529)
McNary	2	32,000 (24 466)

2.8.4 Material Types

The type of material to be dredged depends on the location of the dredging. In the Snake/Clearwater Rivers confluence area, the Corps expects to find a mix of coarse and fine sand, silt, fine silt, and organic material (wood particles). This determination is based on samples taken during previous dredging operations. The Corps expects to find sand in the main navigation channel and silt/fines near the shore in such locations as the port areas and the Greenbelt Boat Basin. In the area below the Lower Granite navigation lock, the Corps expects to find river cobbles 2 to 6 inches (5.1 to 15.2 cm) in diameter with little fines and possibly some large rock up to 18 inches (45.7 cm) in diameter. Samples taken earlier from the Ice Harbor navigation channel indicate the material is rock with some river cobble (Corps 1997). The materials expected in the downstream approach channel of Lower Monumental based on previous Corps experience is river cobble and rock (Corps 1997). In general, dredged materials would be composed mostly of sediments containing a mixture of silts, sands, gravels, and cobbles carried by inflowing waters as suspended and bedload material. Based on previous dredging experience, 85 percent of the material to be dredged is expected to be sands, gravels, and cobbles and 15 percent of the material is expected to be silts and finer-grained material.

2.8.5 Dredged Material Management Process

2.8.5.1 Beneficial Uses Option

Each time a dredging activity covered under this DMMP/EIS is planned, the following steps would occur:

- The Corps would notify parties such as the ports, municipalities, environmental groups, agencies, and others known to have an interest in the beneficial use of dredged material. The Corps would provide the location, estimated quantity, dredging method, expected characteristics of dredged material, and estimated time of the dredging activity. The Corps notification would precede the proposed dredging activity by several months to allow time to negotiate an agreement with a local sponsor for the beneficial use of the dredged material.

- A public notice would be published and distributed prior to the dredging activity.

Beneficial uses may be performed by the Corps at its own expense or beneficial uses may be achieved when a local sponsor is willing to contribute a share of the cost. Beneficial uses performed by the Corps must be the least costly while meeting environmental requirements and being consistent with sound engineering practices. Beneficial uses cost-shared with a local sponsor do not have to be the least costly. Section 204 of Water Resources Development Act of 1992, as amended, authorizes the Secretary of the Army to implement projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands. Project implementation is conditional, based on non-Federal interests entering into a cooperative agreement to provide 25 percent of the cost associated with project construction and agreeing to pay 100 percent of operation, maintenance, repair, replacement, and rehabilitation costs. The cost of a beneficial use project is the difference between the base dredging disposal cost and the dredging and disposal costs of the beneficial use project. Dredged material may also be used in other ways, provided additional cost to the U.S. government is not incurred. This DMMP/EIS identifies the basis for determining the least-cost option for dredged material disposal. At any time, the Corps, with the consent of a non-Federal interest, can identify another beneficial use, and the non-Federal interest would be given reasonable opportunity to finance the additional cost.

The opportunities that currently exist and could be considered for early implementation are:

- Fish Habitat Creation (Figure 2-8)

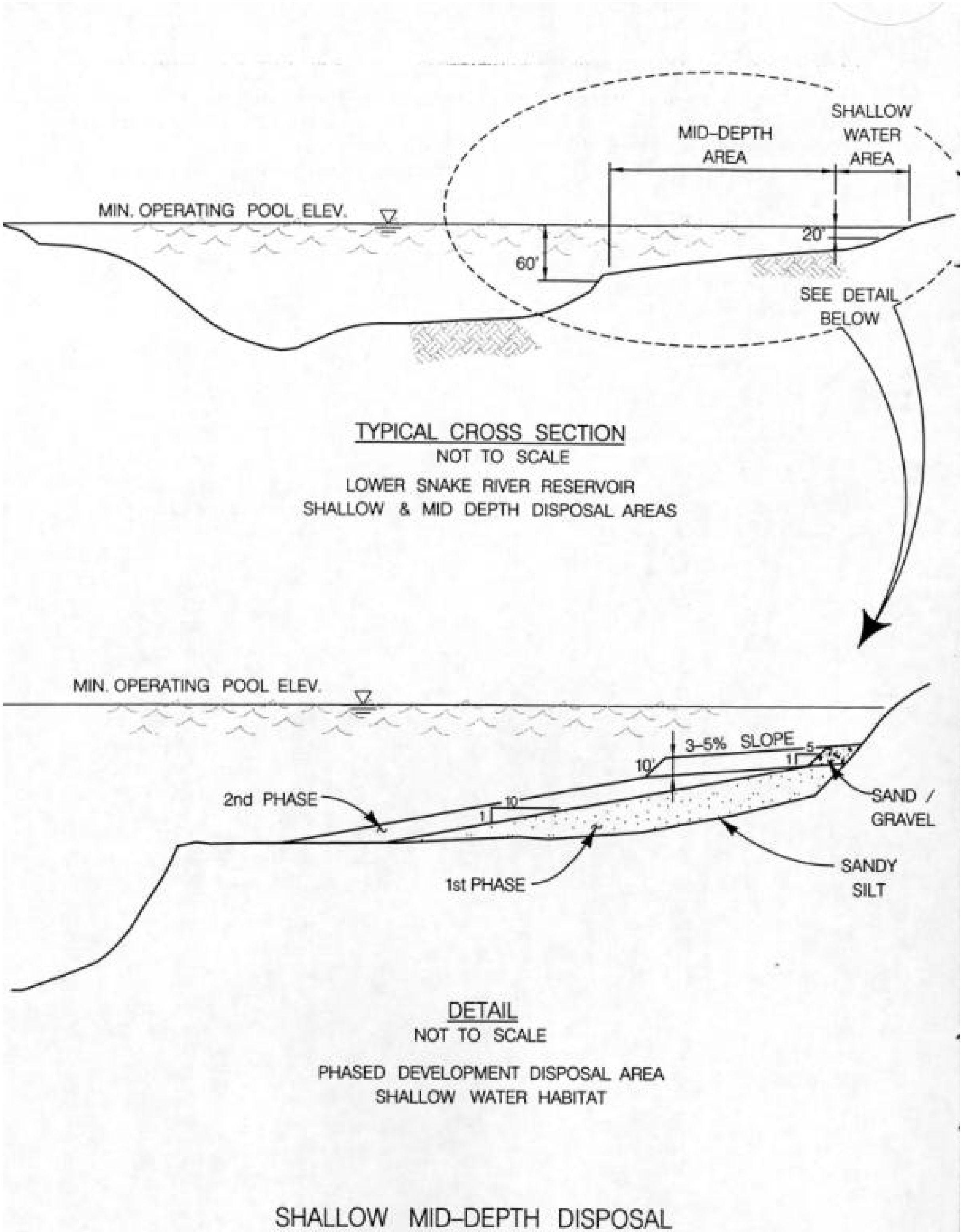
- Woody Riparian Habitat Creation

- Hanford Site Capping (Federal)

- Potting Soil (business)

- Riparian Habitat Restoration

Figure 2-8 Cross Section of the Phased Development Disposal Technique for Creating Shallow Water Habitat



- Port of Wilma Fill
- Fill of Non-Federal Public Land
- Highway or Road Construction

These opportunities are described in detail in section 2.5.4.

2.8.5.2 Unsuitable Material Disposal Option

A contingency upland disposal site has been identified to provide storage for dredged material that may, for whatever reason, need to be deposited on a separate upland site. A dredged material evaluation framework would be used to guide the evaluation of dredged materials and determine the appropriate management of those sediments (see Section 3.9). Based on existing sediment data, contaminated sediments that would be unsuitable for in-water disposal or other beneficial uses (per the framework) are not expected to be found in substantial quantities. In the improbable event that dredged material may be moderately contaminated, unsuitable for disposal in-water, but suitable for disposal in an unlicensed upland site, it would be isolated at the Joso upland disposal site (RM 56.5 to RM 58.6), and appropriate confinement measures would be taken to isolate this material (e.g., installation of an impervious liner to prevent leaching of unsuitable or contaminated materials). Should the material be uncontaminated, but not suitable for disposal in-water (e.g., too much silt for use in creating shallow-water fish habitat), the material would be disposed of at Joso, but in a different location from the moderately contaminated material.

Any use of the Joso site would require reconstruction of some facilities and construction of others. The existing barge slip would need to be dredged to restore access. The barge slip would also be reconstructed using anchored sheet pile to provide vertical walls and tie off facilities. Temporary dredged material dewatering and storage areas with containment berms and detention ponds would be constructed adjacent to the slip. The material would be off-loaded from the barges and placed in the temporary storage for dewatering, then would be loaded onto trucks for transport to the disposal area. The material would then be placed in lifts using track-type tractors and compacted, resulting in a large structural fill conforming to the established final topography for the disposal area. Areas that reach final grades would be restored on a periodic basis by placing 6 inches (15.2 cm) of topsoil and re-seeding with native grasses to achieve a vegetative cover similar to the surrounding site areas. Filling the gravel pit with sediment and seeding it to grass would improve the site's value as wildlife habitat.

Construction of the Joso facilities would likely be done in stages, depending upon availability of funding. The first stage would include dredging the barge slip and developing the off-loading and temporary storage facilities. If needed, this construction would begin in fall 2002 so the site will be ready to accept any unsuitable material dredged during the proposed 2002-2003 dredging. The temporary storage facilities would have the capacity to contain all the material directed to the site in 2002-2003 without requiring removal of any of the material to the permanent storage areas on the site. The second stage would be the construction of the containment berms, liner, and access roads for the permanent storage areas. These will be constructed concurrently with the temporary storage facilities if funding is available. If funding is not available the first year, they will be constructed at the first opportunity when funds do become available.

2.8.6 Levee Raise

For the 3-foot (0.9-m) levee raise alternative, an earth embankment raise is proposed. The levees would be raised a maximum height of 3 feet (0.9 m) and would consist of removing recreation paths and adding height to the levee using embankment of impervious gravel (20 percent to 30 percent fines). Generally, the side slopes would be 2:1 on the front slope (river side) with flatter back slopes to accommodate local conditions. A 12-foot (3.7-m) top width would be provided for access and maintenance and recreational paths would be reestablished. The top of the existing levee would first be excavated to the impervious core and filter to allow the new impervious gravel backfill to tie to the existing core and filter. In areas or conditions that require a 2-foot (0.6-m) or less raise, the extended levee slopes would be steepened to 1.5:1, providing the additional levee height without changing the footprint or impacting adjacent facilities. Highway 129 and Snake River Road upstream of Asotin would be modified.

The levee raise would not occur until after 2005. There is little risk of flooding in the near term since the next few dredging operations for navigation channel maintenance would also provide additional flow conveyance capacity in the Lewiston area, even though the protection level would remain below the SPF. However, delaying the levee construction date until after 2005 would allow consideration of the biological information available at the checkpoints in 2003 and 2005 for the NMFS 2000 Biological Opinion for Reinitiation of Consultation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin, which may impact the status and operating criteria of the four lower Snake River dams and reservoirs. Once the future operating criteria has been determined, and if that criteria still requires a levee raise, the construction could begin once funding is made available.

2.8.7 The 2002-2003 Dredging

The Corps has identified the first dredging activity that would be conducted under the DMMP/EIS. This dredging is currently proposed for winter 2002-2003 and includes dredging the navigation channel at the confluence of the Snake and Clearwater Rivers, several port facilities in the Lewiston-Clarkston area, several recreation facilities in Lower Granite and Little Goose reservoirs, navigation lock approaches to Lower Granite and Lower Monumental, and several other potential areas. The Corps briefed the LSMG, which provided input on the proposed 2002-2003 dredging and dredged material management. The Corps is currently proposing using woody riparian habitat creation at Chief Timothy as a primary beneficial use of dredged material. In-water disposal to create fish habitat in Lower Granite reservoir (RM 116) would be a secondary beneficial use of the dredged material if biological surveys indicate the Chief Timothy site would not be available. Appendix N provides a detailed description of the proposed dredging areas, the disposal plan, the sediment contaminant analysis, and the environmental impacts specific to this dredging activity.

2.8.8 Monitoring

The Corps anticipates the need to perform various types of monitoring of the dredging and disposal activities. Appendix M presents the proposed monitoring program for the DMMP. Monitoring would include the following parameters:

- water quality and sediment quality;
- biological;
- physical;
- cultural resources.

Appendix M describes the process for determining monitoring needs and methods. Monitoring activities will be coordinated with the LSMG.

2.8.9 ESA Consultation Provisions

The Corps consulted with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), pursuant to the requirements of the Endangered Species Act (ESA). The Corps prepared biological assessments (BAs) evaluating the potential effects of the proposed alternatives on species listed under the ESA. Full documentation of these consultations is presented in Appendix F (for NMFS) and Appendix G (for the USFWS).

NMFS determined, based upon implementation of a series of Reasonable and Prudent Measures, the Recommended Plan would not cause jeopardy to, or adversely modify the Critical Habitat of anadromous fish species listed under the ESA. Specifically, the Biological Opinion determined that the effects of the Recommended Plan will not jeopardize the continued existence of endangered Snake River sockeye, threatened Snake River Fall chinook, threatened Snake River Spring/Summer chinook, threatened Snake River Basin steelhead, endangered Upper Columbia River Spring chinook, endangered Upper Columbia River steelhead, or threatened Middle Columbia River steelhead or result in the adverse modification or destruction of their Critical Habitat.

The Corps completed informal consultation with USFWS for ESA-listed non-anadromous fish and terrestrial species that might be affected by implementation of the DMMP. In their concurrence letters, USFWS identified several conditions or assumptions, including the need for consultation on specific dredging and associated actions and compliance with the terms of the USFWS Biological Opinion for the Federal Columbia River Power System regarding bull trout in the lower Snake River system (see Appendix G). The Corps intends to comply with these conditions when implementing the DMMP.

2.8.10 Regional Acceptability and Public Comments

The acceptability by states, other Federal agencies, stakeholders, special interests, local governments, tribes, and the general public was assessed through the public review process for the DMMP/EIS and approximately 28 comments of the parties were considered in this Final DMMP/EIS. It seems generally accepted that to maintain the current navigation activities, maintenance dredging and disposal of resulting dredged material must be done. However, the public review process revealed that regional interest focused on water quality, ESA-listed fish species, and cultural resources. Several commentors expressed concerns regarding possible impacts from the proposed dredging and disposal activities within the project area. The method and timing of the dredging and location of disposal is of interest to the public and stakeholders. The local governments affected by the levee raise have concerns with timing and the effect it might have on future river front development. For review of these comments and responses, see Appendix O, Response to Public Comments. The Corps considered all of these comments in the evaluation and selection process to identify the recommended plan (preferred alternative). In an environment as described above, the recommended plan (preferred alternative) will be acceptable to some and not to others. Regarding state or local laws and regulations, the actions in the recommended plan (preferred alternative) are considered to be consistent. See Sections 5 and 6 for more specifics.

2.8.11 Other Considerations

Other important factors that were considered include, but are not limited to:

- How the alternatives affect long-term and short-term productivity
- If there are irreversible and/or irretrievable commitment of resources
- If there are unavoidable adverse impacts
- If mitigation is needed or required
- Whether the best information or science was available
- Which alternative is environmentally preferable
- Whether the recommended plan (preferred alternative) is in accordance with declared policies of NEPA and in compliance with Federal laws and regulations.

Other factors involving technical feasibility were considered. Even though this is a very basic criterion, it is an extremely important one, in that the recommended plan (preferred alternative) must be constructible and implement able. The rationale for selecting Alternative 4, Maintenance Dredging with Beneficial Use of Dredged Material and a 3-foot (0.9-m) Levee Raise, is a composite of analyses, information briefings, evaluations, hundreds of years of combined technical expertise, and comments concerning the factors that may or may not be affected by the alternatives discussed in the DMMP/EIS. The selection of the recommended plan (preferred alternative) resulted from the evolution and development of a collection of scientific data and information presented in this DMMP/EIS, its associated appendices, and supporting research materials and reports. Although not without uncertainties, the information contained herein was the result of researchers, contractors, Corps' staff, etc. and, in the Corps' judgment, is the best available science and information to date and contains sufficient rationale for selecting this plan/alternative.

SECTION 3
AFFECTED ENVIRONMENT

This section presents the existing environmental conditions in the DMMP study area that could be affected by the alternatives considered in this EIS. The descriptions of the biological, physical, cultural, and socioeconomic resources serve as a basis for evaluation and comparison of the anticipated effects of the plan alternatives evaluated in section 4. In most cases, sufficient existing data and documentation were available to allow reasonable assessments of the impacts to a particular resource. The Feasibility Study, the Corps Interim Columbia and Snake River Flow Improvement Measures for Salmon Final Supplemental EIS (Corps, 1993), the Final Columbia River System Operations Review EIS (BPA et al., 1995), and the Columbia River Flow Measures Options Analysis (Corps, 1992) evaluated some of the same resources and are incorporated by reference. For some resources, only limited data were available. In these instances, the limitations of the data are documented and the impact analysis was more qualitative in nature.

3.1 AQUATIC RESOURCES

Construction of the Snake and Columbia River Federal dams altered the character of the natural river from running to impounded water and created over 124 miles (200 km) of reservoirs on the lower Snake River and 62 miles (100 km) of reservoir behind McNary on the Columbia River. A continuing effect of dam construction is the deposition of sedimentary material in the lower velocity areas within the system. For example, in Lower Granite reservoir, sediment deposition has occurred around the confluence of the Snake and Clearwater Rivers and downstream to Silcott Island. The Corps is proposing to conduct navigation and maintenance dredging on the lower Snake River, the mid-Columbia River (specifically McNary reservoir in Washington and Oregon), and at the mouth of the Clearwater River in Idaho and Washington.

This section describes the lower Snake River and McNary reservoirs, some of their characteristics, and the habitats used by the various fish species. A summary of available data on fish spawning requirements, life histories, and predation of resident fish on juvenile salmonids is also presented.

3.1.1 Fish

The Columbia and Snake River systems support large and varied populations of fish. Within the project area, anadromous salmonids including chinook (*O. tshawytscha*), coho (*O. kisutch*), and sockeye (*O. nerka*) salmon and steelhead (*Oncorhynchus mykiss*) are seasonally present. Resident fish, of both native and introduced species, are also abundant in these reservoirs with community structure generally similar among reservoirs (Bennett et al., 1983). Of the current resident ichthyofauna of the reservoirs, about half are native species and half are introduced. Major resident species of concern include the white sturgeon (*Acipenser transmontanus*), northern pike minnow (*Ptychocheilus oregonensis*), and smallmouth bass (*Micropterus dolomieu*).

3.1.1.1 Anadromous Fish

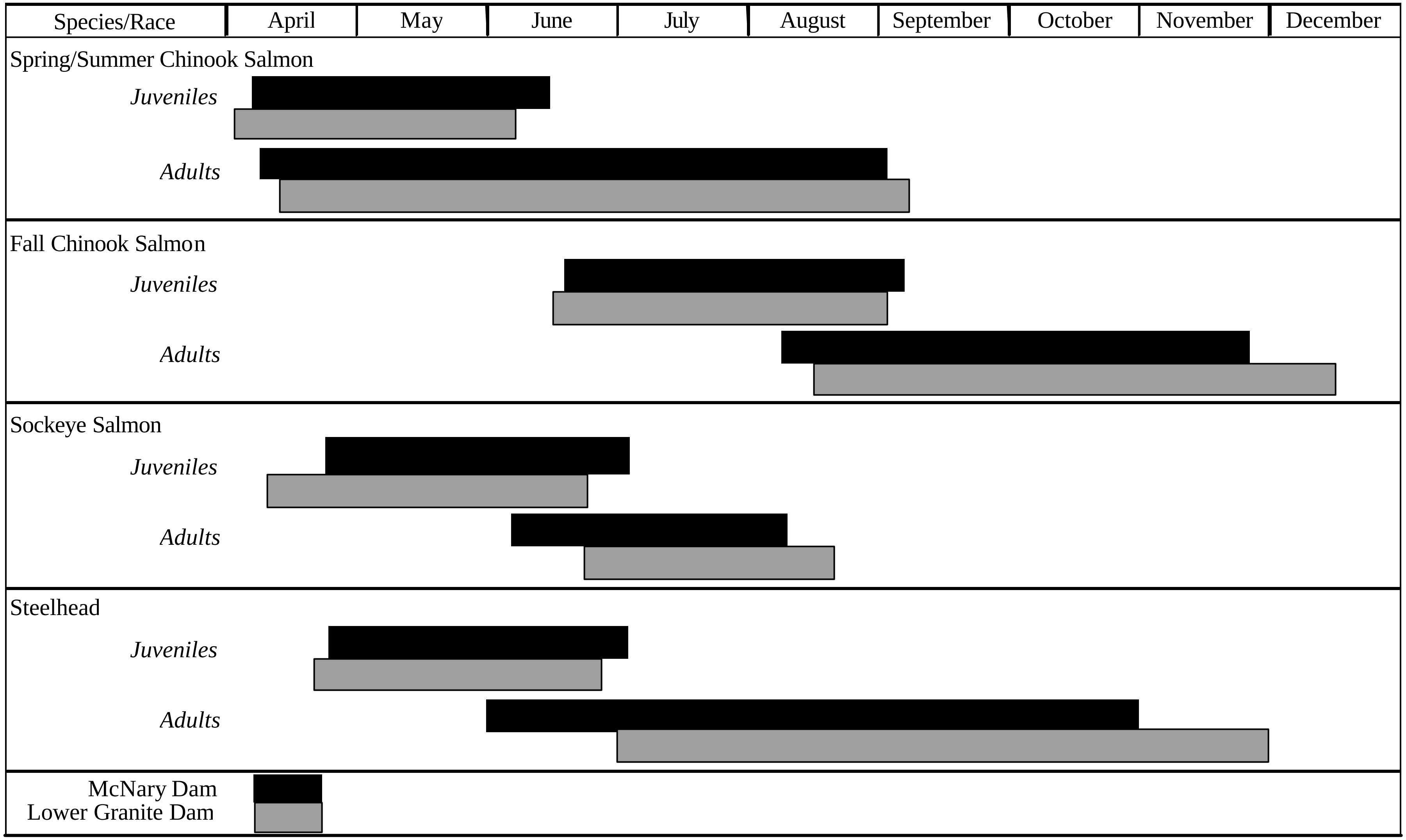
Seven anadromous fish species found within the project area have been designated as Evolutionarily Significant Units (ESU's) and are listed as Threatened or Endangered under the ESA. These species include Snake River Sockeye Salmon, Snake River Basin Steelhead, Snake River Basin Spring/Summer and Fall Chinook Salmon, Upper and Middle Columbia River Basin Steelhead, and Upper Columbia River Spring Chinook Salmon. Within the project area, Columbia River stocks are thought to occur primarily in McNary reservoir with few straying into the Snake River. Snake River basin stocks occur throughout the lower Snake River and McNary reservoir. Although not presently listed, Pacific lamprey is also a species of concern in the project area. Historically, white sturgeon exhibited diadromus behavior in the project area but were isolated after construction of the dams and will be discussed in the resident fish section.

The following analysis addresses a small portion of the total life history of these fish with emphasis placed on the threatened or endangered stocks. While a salmon or steelhead typically lives for 3 to 6 years, the duration spent within the direct influence of the hydro system is limited. The Corps is concerned, however, with that period of fresh water residence when the Federal Columbia River Power System (FCRPS) does specifically influence these stocks. This period may occur for a few days to a few months as juvenile salmonids either migrate through these areas or rear within them prior to migrating to the ocean. Also, depending on the stock of fish, adults will be influenced by the FCRPS for weeks to months as they migrate upriver. The life history and status of various stocks, with emphasis on those originating in the Snake River and McNary reservoirs and their headwaters, are presented in this section with migration windows shown in figure 3-1.

3.1.1.1.1 Sockeye Salmon

One run of ESA-listed sockeye salmon is known to occur in the project area. Snake River sockeye salmon were listed as endangered in November 1991.

Sockeye salmon are unique in that they are the only species of Pacific salmon that depends on higher elevation tributary lakes in the Salmon River subbasin of Idaho for spawning and rearing (Gustafson et al., 1997). Adult Snake River sockeye salmon passage typically occurs in the project area from June through early August. Juveniles rear in lakes for 1 to 2 years and typically actively migrate to the ocean (with minimal rearing in the reservoirs) from April to July; however, some migration can occur through November.



Source: Corps, 2002.

Figure 3-1. Typical Anadromous Salmonid Migration Windows.

The McNary reservoir and the lower Snake River corridor are designated as Critical Habitat for migration passage of wild Snake River sockeye salmon. Critical Habitat attributes and Essential Fish Habitat (EFH) components for potential rearing or overwintering for Snake River sockeye salmon are not present in the McNary reservoir, lower Snake River corridor, or any of the proposed project areas. The components of designated Critical Habitat and EFH for juvenile and adult migration passage are present between mid-March and mid- August. No spawning habitat for sockeye salmon is present in the proposed project area. Therefore, no individuals should use the dredging activity areas of the Columbia, Snake, or Clearwater Rivers for rearing, feeding, or overwintering during the designated in-water work period. This includes the off-channel areas that will only be dredged when water temperatures exceed 73 °F (22.7 °C). The high temperatures make the proposed dredging areas unsuitable for sockeye salmon.

3.1.1.1.2 Spring/Summer Chinook Salmon

Two runs of ESA-listed Spring/Summer Chinook Salmon seasonally exist in the project area. These include the Upper Columbia River Spring ESU, listed as endangered in 1999, and the Snake River Spring/Summer ESU, listed as threatened in 1992.

Upon returning to fresh water after spending 2 to 3 years in the ocean (Howell et al., 1985), adult spring chinook salmon typically pass through the McNary and Snake River reservoirs from mid-April to mid-June with 90 percent passing in the month of May (Stuehrenberg et al., 1995). Adult summer chinook salmon typically pass the main stem dams by September, with the majority passing between mid-June and mid-August. All populations are believed to spawn from August through October in tributaries upstream of hydro project influences (Corps, 1999). In tributary systems with both spring and summer runs, spring chinook salmon tend to spawn farther upstream and earlier than summer run salmon (Matthews and Waples, 1991); however, spawning area and timing may overlap in some areas. This overlap is one of the reasons that NMFS may designate these fish as one stock (spring/summer) in their ESA listing. Within the Snake River system, there are five major spawning and rearing basins for spring/summer chinook salmon. These include the Clearwater, Grande Ronde, Salmon, Tucannon, and Imnaha rivers. Columbia River stocks spawn and rear in the Wenatchee, Entiat, Methow, and Okanogan basins.

Juveniles typically rear in the tributaries for more than a year, migrating downstream during their second spring as yearlings from about early April to June. Snake River spring and summer chinook salmon have the same juvenile out-migration age and timing, with the majority of these fish passing the dams in April and May. Little, if any rearing occurs in the main stem Snake and Columbia Rivers (Chapman et al., 1995) as indicated by a relatively short reservoir residence time of juvenile spring chinook salmon (Giorgi and Stevenson, 1994). However, a few individuals of spring chinook salmon from undetermined origin have been documented as using backwater areas of the McNary reservoir for rearing, feeding, or overwintering (Easterbrooks, 1995, 1996, 1997, 1998) during the period sampled (mid-March through July).

The McNary reservoir is designated as Critical Habitat for migration passage of wild Upper Columbia River Spring and Snake River Spring/Summer Chinook Salmon. Designated Critical Habitat and EFH for potential rearing, overwintering, or resting during juvenile migration may be present in the McNary reservoir project areas for Upper Columbia River Spring Chinook Salmon between mid-March and mid-June.

The lower Snake River was designated as Critical Habitat for migration passage of wild Snake River Spring/Summer-Run Chinook Salmon. Critical Habitat attributes and EFH components suitable for potential rearing or overwintering for Snake River Spring/Summer-Run Chinook Salmon are likely present in the proposed project areas during the winter in-water work window and in November at the Joso site. No suitable habitat would be available in off-channel dredging areas if water temperatures exceed 73 °F (22.7 °C).

3.1.1.1.3 Fall Chinook Salmon

One run of ESA-listed Fall Chinook Salmon is known to occur in the project area. The Snake River Fall Chinook Salmon ESU was listed as threatened in 1992.

After 2 to 3 years in the ocean, adult wild Snake River Fall Chinook Salmon return to the Snake River between late summer and early winter with spawning activity beginning around mid-October (Connor, 1994). The current major spawning area for Snake River Fall Chinook Salmon exists in the 103 miles (166 km) of the Snake River below Hells Canyon Dam and in the lower reaches of the Clearwater, Grande Ronde, Imnaha, Tucannon, and Salmon Rivers. The majority of redds annually appear clustered in specific areas, such as at Snake River RM 162 in 1991 (Connor, 1994). Spawning of fall chinook salmon has also been known to occur in Little Goose, Lower Monumental, and Ice Harbor reservoirs, but only in tailwater areas directly downstream of the dams' bypass outfalls, where water velocity is high and substrate is relatively large (Dauble et al., 1995 and 1996).

Little is known about timing of emergence from the gravel for Snake River Fall Chinook Salmon (Howell et al., 1985); however, Bennett and Shrier (1986) and Bennett et al. (1988, 1990, 1991, 1993a, 1993b) captured subyearling chinook salmon in Lower Granite reservoir in April, suggesting emergence can occur in March to early April. After emergence and initial dispersal, fall chinook salmon exhibit a high fidelity for lower velocity backwater areas for rearing in the main stem river and reservoir reaches of the Columbia and Snake Rivers. Bennett and Shrier (1986) and Bennett et al. (1988, 1990, 1991, 1993a, 1993b) consistently captured subyearling chinook salmon over low gradient, low velocity, sandy substrates in Lower Granite reservoir, likely an anti-predation strategy at locations that produce suitable macroinvertebrate prey abundance. Habitat having these physical characteristics can be effectively constructed in any of the lower Snake River reservoirs with appropriate placement of dredged material. Subyearling salmon migrate through reservoirs more slowly than yearling chinook salmon and spend more time in reservoir habitats for rearing (Rondorf et al., 1990; Curet, 1994) since they are not afforded the additional year of freshwater rearing and overwintering in the subbasins that yearling chinook salmon are allowed.

Most juvenile fall chinook salmon from the Snake River migrate to the ocean as subyearlings (Bjornn, 1960). The wild juvenile fall chinook salmon typically pass mid-June through September, with double peaks in mid-July and some lingering proportion of the annual migration population lasting through November. Passive Integrated Transponder (PIT)-tag detections of

1993-1995 brood year juvenile fall chinook salmon from the Clearwater River were recorded in the spring of 1994-1996 at some lower Snake River dams (Arnsberg, 1996). It is apparent from these detections that some fall chinook salmon migrate to the ocean as yearlings rather than as subyearlings.

3.1.1.1.4 Steelhead

Three runs of ESA-listed steelhead are known to occur in the project area. Upper Columbia River and Snake River Basin ESU's were listed in 1997 and the Middle Columbia River ESU's were listed in 1999.

Upon returning to fresh water after spending 1 to 4 years in the ocean, most adult steelhead pass McNary between May and November and Lower Granite between July and December. Some adult steelhead are known to overwinter in the lower Snake River and begin migrating toward spawning grounds the following spring as water temperatures begin to warm up. Steelhead typically spawn in tributaries outside the influence of the hydrosystem between December and June (Bell, 1991). Unlike salmon species, steelhead have the potential to spawn numerous times; however, the current proportion of repeat spawners is expected to be low (Corps, 1999). Adult steelhead may be in the areas proposed for dredging and disposal in the reservoirs during the proposed dredging periods.

Juvenile steelhead rear in freshwater streams for 2 to 3 years prior to out-migrating. Out-migrants actively migrate through the reservoirs from late April through June and typically rear very little during their out-migration.

3.1.1.1.5 Pacific Lamprey

Adult Pacific lamprey enter the fresh water between April and June, migrating to spawning areas by September (Close et al., 1995). Spawning typically occurs in June and July of the following year in low-gradient-flowing-water stream sections where gravel is deposited. Spawning has been observed in small tributaries entering main stem reservoirs (Wydoski and Whitney, 1979). Lamprey distribution extends up the Snake River to Hells Canyon Dam and to Chief Joseph Dam on the Columbia.

After hatching, ammocoetes (a stage of juvenile lamprey) drift downstream to burrow into the substrate sand or mud. Ammocoetes rear in the substrate for 5 to 6 years when they metamorphose into juvenile lamprey and out-migrate to sea between April and July. After 20 to 40 months, the adults return to spawn in the river systems (Kan, 1975).

3.1.1.2 Resident Fish

3.1.1.2.1 General Ecology

Resident fish species in the lower Snake River and McNary reservoirs include a mixture of native riverine species as well as introduced species that are associated with lake-like conditions (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981; Mullan et al., 1986). Cold-water resident species (such as trout and whitefish) that were once common in the Columbia and Snake Rivers have declined since the construction of the dams and have been replaced by cool- and warm-water species. Species composition has changed due to the blockage of spawning migrations and modification of habitats (Mullan et al., 1986). The prey base has also changed since the construction of the dams, probably contributing to the decline of cold-water species (Sherwood et al., 1990).

Resident fish in the reservoirs occupy numerous habitats and often use separate habitats for different life history stages (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981; Bennett et al., 1991). Each reservoir has three general zones that are characterized by different habitats (Hjort et al., 1981). The first zone is the forebay area, which is typically lacustrine (lake-like) in nature. At the upper end of the reservoir is a second zone that tends to be shallower and have significant water velocities. In between these two zones is a transition area that changes in the upstream end from riverine to more lake-like in the downstream direction. Each zone can include several habitat types; however, most can be characterized as either backwater (including sloughs and embayments) or open-water habitats (Hjort et al., 1981; Bennett et al., 1983).

3.1.1.2.2 Habitat Use

Backwaters and embayments generally provide low water velocity, slightly warmer water, finer substrate, and submersed and emergent vegetation. Bass (*Micropterus spp*.), crappie (*Pomoxis spp*.), bluegill (*Lepomis spp*.), yellow perch (*Perca flavescens*), and carp (*Cyprinus carpio*) use backwater areas for spawning and rearing (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981; Bennett et al., 1991; Zimmerman and Rasmussen, 1981). The centrarchids (sunfishes, including bass and crappie) normally spawn in shallow water less than 6.5 feet (2.0 m) deep (Bennett et al., 1983) while yellow perch generally utilize waters less that 10 feet (3.0 m) deep (Stober et al., 1979). Spawning and incubation times vary between species; however, most of these backwater species spawn from May through mid-July (Corps, 1999).

Cypribinds (minnows, dace, and chub); catostomids (suckers); walleye (*Stizostedion vitreum)*; and sandroller (*Percopsis transmontanus)* spawn in open water. White sturgeon, a species that is considered non-anadromous above Bonneville (ODFW and WDFW, 1998), spawn over areas with rocky bottoms and high water velocity (Parsley et al., 1993). Prickly sculpin (*Cottus asper)* spawn in both open water and backwater based on the distribution of prolarvae (Hjort et al., 1981). Most fish larvae are generally found in the backwaters and near-shore areas. Only yellow perch and prickly sculpin larvae are commonly found in open-water areas. Most of the native species spawn in flowing water at the headwaters of the reservoirs or in tributary streams. Some species, however, also spawn in the reservoirs. Northern pike minnow may spawn either in flowing water or along gravel beaches in reservoirs (Wydoski and Whitney, 1979).

Juvenile fish are found in abundance in backwater and open-water areas where flowing water is found. The two habitats are occupied by distinctly different fish species. Introduced species, which are primarily lake-dwelling fishes, are more common in the forebay zone and backwater areas while native species are more common in the flowing water regions found in the tailrace zone (Hjort et al., 1981; Bennett et al., 1983; Bennett and Shrier, 1986; Mullan et al., 1986).

Adult distribution is generally similar to spawning and juvenile distribution, but can change depending upon feeding strategy. Adults may occur throughout the habitats and move seasonally or daily to different areas (Bennett et al., 1983; Bennett and Shrier, 1986; Hjort et al., 1981). Although adults will use various habitats, lake-dwelling species are generally more abundant in shallow, slower-velocity backwater areas, and native riverine species occur abundantly in areas with flowing water (Bennett et al., 1983).

Although there is a difference in numbers, there is little difference in the species composition of the five reservoirs. Species found in high abundance in all reservoirs include suckers, northern pike minnow, bass, chiselmouth (*Acrocheilus alutaceus)*, and redside shiners(*Richardsonius balteatus)* (Bennett et al., 1983; Bennett and Shrier, 1986; Bennett et al., 1988). Species such as crappies, sunfish, and largemouth bass are highly abundant in backwaters of all reservoirs. Minor variations in species composition are related to variations in the availability of backwater habitats and flowing waters in the various reservoirs.

Little Goose, Lower Monumental, and McNary reservoirs have a greater number of backwater areas than Lower Granite and Ice Harbor (Bennett et al., 1983). The confluence of two major tributaries (Palouse and Tucannon Rivers) with the Snake River provide additional backwater habitat in Lower Monumental reservoir. These reservoirs tend to support larger numbers of species that depend on shallow-water habitats during some part of their life histories.

3.1.1.2.3 Bull Trout

Bull trout, listed as threatened under the ESA, are found primarily in colder streams, although individual fish are found in larger river systems throughout the Columbia River Basin (Fraley and Shepard, 1989; Rieman and McIntyre, 1993, 1995; Buchanan and Gregory, 1997). Water temperature above 59 °F (15 °C) is believed to limit bull trout distribution. However, the USFWS reported 37 records of bull trout in the lower Snake River since 1991. Most were noted at adult-fish-counting stations and passed in April, May, or June (Hayley, 1999).

Bull trout typically spawn from August to September during periods of decreasing water temperatures. Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 155 miles (249 km) to spawning grounds. Temperature during spawning generally ranges from 39 to 51 °F (4 to 10 °C) with redds often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz, 1989). Bull trout require spawning substrate consisting of loose, clean gravel relatively free of fine sediments.

The only subpopulations of bull trout associated with the project area spawn and rear in the Tucannon River Basin with both resident and migratory forms present. Evidence suggests that migratory (adfluvial) bull trout from the Tucannon River also utilize the main stem Snake River on a seasonal basis (Buchanan and Gregory, 1997). Adult bull trout that are adfluvial generally spend about half of every year associated with a reservoir (November-May). These fish most likely forage in shallow areas where the majority of prey exists. Depending on water conditions, bull trout will occupy deeper areas of the reservoir where water temperatures are cooler [45 to

54 °F (7.2 to 12.2 °C)] and move to the surface when water temperatures drop to or below 54 °F (12.2 °C).

There have been several observations of adult bull trout passing Lower Monumental and Little Goose. From 1994 to 1996, 27 bull trout passed the adult fish counting station (mainly in April and May) at Little Goose. At least six bull trout passed counters at Lower Monumental and Little Goose in 1990 and 1992 (Kleist, 1993). Kleist also observed one bull trout in 1993 just downstream of the count window at Lower Monumental. Furthermore, one bull trout was captured in the Palouse River below Palouse Falls in 1998. These were likely migratory fish from the Tucannon River. However, one bull trout was observed at Lower Granite in 1998 that may indicate fluvial fish are migrating to other upstream populations.

The status of bull trout associated with the Tucannon River was rated as "healthy" by the Washington Department of Fish and Wildlife (WDFW, 1997), although some habitat degradation has occurred due to timber harvest and recreational use. It is not currently at risk of extinction and is not likely to become so in the foreseeable future because of sufficient habitat protection (wilderness designation) in the upper watershed and the lack of brook trout encroachment.

3.1.1.2.4 White Sturgeon

Historically, diadromus white sturgeon in the Columbia and Snake River system ranged freely and made extensive seasonal migrations to optimize changing habitats (Bajkov, 1951). Dams and resulting impoundments have isolated white sturgeon populations (North et al., 1992) and reduced habitat diversity by replacing riverine habitats with lentic environments. Populations of fish species adapted to riverine conditions typically decline at the highest rate (Parsley et al., 1993). Landlocked populations of white sturgeon in the Snake River are classified as a species of special concern (Mosley and Groves, 1990 and 1992) for the states of Washington and Idaho.

Presence of young of the year (YOY) and high abundance of juvenile white sturgeon in Lower Granite reservoir indicate recruitment has been occurring in the Lower Granite-Hells Canyon population. The high abundance of juvenile and YOY fish near the upper end of Lower Granite reservoir also suggests that the reservoir primarily serves as rearing habitat. McCabe and Tracy (1993) suggested that wide dispersal of white sturgeon larvae allowed more use of feeding and rearing habitats while minimizing competition. Lepla (1994) assumed no spawning occurred in Lower Granite reservoir since velocities measured in the reservoir [0.0 to 1.96 feet per second (0.0 to 0.60 meters per second (m / s))] are below threshold levels perceived to elicit spawning [3.28 feet per second (1.0 m / s)] (Anders and Beckman, 1993).

Parsley et al. (1996) captured YOY fish and fertilized eggs in 1994 and 1995 in the tailraces of Priest Rapids and Ice Harbor, indicating that recruitment has been occurring in McNary reservoir. Rien and Beinegen (1997) reported the density of white sturgeon in McNary reservoir was 0.86 fish/acre (0.35 fish/hectare), which is similar to John Day reservoir in 1990, but much less than Bonneville or The Dalles reservoirs in 1994. The estimated proportion of white sturgeon less than 32.3-inch (82-cm) fork length in the population estimate was smaller than that in the lower reservoirs. While this estimate may be negatively biased by gear limitations, low recruitment is likely limiting abundance.

Seasonal changes in distribution occur in Lower Granite reservoir (Lepla, 1994). Relative numbers of white sturgeon in the upper section of the reservoir increased from May through November, implying upriver redistribution/movement as the summer to fall season progressed. However, multiple comparison tests indicated seasonal use of mid- and lower reservoir transects was not significant with exception to RM 116.8 (1.6 RM upriver of Knoxway Bay). The number of white sturgeon sampled at RM 116.8 was highest (0.31 fish/hr) only during April-July 1991 and declined sharply as summer progressed. Catch rates at RM 116.8 in 1990 were low and were also similar in 1992 (Bennett et al., 1994 and 1995). Catch rates at remaining mid- and lower reservoir locations were low regardless of season. Movements from 0 to 16 miles (0 to 25 river km) were observed from recaptured white sturgeon with the majority of fish traveling 0.62 to 3.1 miles (1 to 5 river km). Differences in fish size did not appear to affect distance traveled in the reservoir. Approximately 65 percent of the fish recovered were collected within the upper 6.21 miles (10 river km) of Lower Granite reservoir where densities of white sturgeon were highest.

3.1.1.2.5 Margined Sculpin

Margined sculpins, a federal species of concern and considered a sensitive species by the state of Washington, are a small fish species that live in river gravels/cobbles whose requirements are poorly known. The former range of these sculpins is unknown; however, they currently inhabit the Walla Walla and Tucannon Rivers in Washington. Without competition, they seem to prefer cool [55 to 66 °F (12.8 to 18.9 °C)] water, moderate to rapid current, and rubble or gravel substrate. Margined sculpins spawn in the spring.

3.1.2 Plankton and Benthic Organisms

3.1.2.1 Plankton

Two other very important parts of the food chain that may be affected by dredging and disposal activities include phytoplankton and zooplankton. Both phytoplankton and zooplankton are food sources for larger aquatic organisms, such as snails and small fish. In addition, zooplankton can compose an important component to the diet of rearing anadromous and resident fish species (Bennett et al., 1983). The use of backwater areas by numerous species may be at least partially related to the availability of prey. High concentrations of zooplankton in the backwater areas attract smaller prey species that feed upon these organisms. In turn, high concentrations of prey fish attract larger predator fish species. Therefore, higher concentrations of zooplankton in backwater areas may affect the habitat selection of several species (Corps, 1999).

3.1.2.2 Benthic Organisms

The benthic community consists of organisms that live on the river bottom and provide significant input into the food chain. Benthic plants such as algae and benthic animals such as insects, worms, snails, and crayfish are components of this community. Benthic organisms contribute significantly to the diets of many reservoir fish species (Bennett et al., 1983). In particular, crayfish are an important component to the diet of smallmouth bass, northern pike minnow, and channel catfish (*Ictalurus punctatus*) in Little Goose and Lower Granite reservoirs (one can assume these species would be equally important in Lower Monumental, Ice Harbor, and McNary reservoirs). Benthic production is usually minimal in shallow-water areas if the water levels fluctuate and expose the organisms.

As reservoirs age, the invertebrate species composition and abundance convert from lotic flowing riverine macroinvertebrate species found in the shallower and higher velocity environments of the pre-dam river to lentic or pelagic reservoir invertebrate species found drifting in the photic zone of the deeper and slower velocity environments of the post-dam reservoir. Species abundance and composition for benthic macroinvertebrates sampled in the early 1980's (5 to 7 years following refill) were related to habitat differences including substrate type and size, depth, flow, and season of year (Bennett and Shrier 1986, Dorband 1980). By the early to mid-1980's, the dominant benthic invertebrate taxa in Lower Granite reservoir had already converted to dipteran chironomid midges and annelid oligochaete (bloodworms) (Bennett and Shrier, 1986; Bennett et al., 1988). Within a few years after reservoir filling, Dorband (1980) already found a shift in dominant benthic taxa at RM 135, approximately four-fifths the distance upriver from Lower Granite near the Port of Wilma. The Port of Wilma is about 4 to 5 RM's above Silcott Island at RM 131 where the hydraulic influence of the unimpounded flow input becomes dominated by the backwater effect of the reservoir volume and lower water velocities. Upriver of RM 135, there were more lotic species (larvae of tricopteran caddisflies, ephemeropteran mayflies, and plecopteran black flies), while below RM 135, lentic taxa were common (dipteran chironomid midges and annelid oligochaete blood worms). The transition zone between the lentic and lotic habitats had the lowest density of benthic macroinvertebrates, possibly attributable to deposition from sediment input where the average water velocity across the channel slows. Species diversity of macroinvertebrate communities at shallow sites increases with downstream movement or colonization of drifting organisms scoured from upriver habitats, provided that like substrate and associated habitat components are available and suitable.

In the early 1980's, shoreline distributed littoral areas [less than 15.5 feet (4.7 m) deep] generally had the highest invertebrate abundance, species diversity, and species evenness. Sites of similar depth within the reservoir appeared different based upon location in the reservoir (as defined by river mile) with regard to benthic invertebrate numbers within and across species (Bennett and Shrier 1986, Bennett et al. 1988). Annual and seasonal population abundance variations occurred, with increased variation evident for species exhibiting seasonal emergence (e.g., chironomids as they pupated into adults) than species that are aquatic through all life stages (e.g., oligochaetes). Oligochaetes are ubiquitous throughout the lower Snake River reservoir sediments. Oligochaete biomass does not appear to vary with depth of water. While the numerical densities can fluctuate widely with a pattern similar to chironomids, the average biomass density appears to remain relatively constant around 0.15 ounce per square yard (oz/yd^2) ($5 g/m^2$). Oligochaetes prefer fine sediments with a high percent of organic content.

Chironomids can make up a substantial portion of the diets of certain fishes. If food is a limiting resource to fall chinook salmon rearing and migrating through Lower Granite reservoir, then it is necessary to estimate chironomid densities as a function of depth and substrate type. Sampling by Bennett et al. (1988) showed a statistically weak pattern of biomass and abundance when measured by season and depth. The shallow water biomass peaks in summer at about 0.59 oz/yd^2 (20 g/m^2), and drops off to around 0.15 oz/yd^2 (5 g/m^2) in the winter. Measured by depth, the biomass appears to be constant from 5 to 20 feet (1.5 to 6.1 m) deep, but begins to decrease as depth increases below 20 feet (6.1 m). Chironomids are most likely located in sand-silt sediments and decrease in both finer and coarser sediment-type environments. The chironomid communities within the lower Snake River reservoirs are composed of several different species, thus resulting in chironomids being readily susceptible to predation by rearing salmonid smolts across the duration of the smolt migration seasons during each of the overlapping pupation and emergence episodes of the various chironomid species.

The role of crayfish in resident and predatory fish diets is extensively reported for every year of sampling in both Lower Granite reservoir since 1988 (Bennett, 1988) and in the unimpounded Snake River upriver of Lower Granite reservoir (Nelle, 1999; Petersen et al., 1999), especially for sustaining northern pike minnow and smallmouth bass. Crayfish predominantly inhabit shallow water riprap areas from which they forage riverward for primarily oligochaetes and other soft substrate inhabitants. Crayfish have been found at all depths in the Oxbow reservoir above Hells Canyon (Bennett, 1995), in Lower Granite reservoir during the physical drawdown test in 1992 (Bennett et al., 1995; Curet, 1994), and in the unimpounded Snake River between Lower Granite reservoir and Hells Canyon Dam (Nelle, 1999). To demonstrate the importance of crayfish in sustaining predator productivity in both Lower Granite reservoir and the unimpounded Snake River between Lower Granite reservoir and Hells Canyon Dam, Bennett et al. (1995) observed a vertical migration of smallmouth with the 2 feet (0.6 m) per day receding water during the physical drawdown test of Lower Granite reservoir in March 1992. Crayfish were left desiccated as they searched wetted shelter in the sediment cracks of the 30-foot- (9.1-m-) deep zone that was dewatered for several weeks. When the reservoir refilled in late March and early April, the majority of the smallmouth bass survived and vertically migrated back up to the shallow water zones that had cover via riprap when spring chinook smolts began migrating. Smallmouth bass consumption rates on juvenile salmonids increased in 1992 compared to previous smolt migration years as a consequence of interception by predators that were occupying a littoral zone that was temporarily devoid of crayfish. Crayfish recruited back to the littoral zone within the year, and smallmouth bass consumption rates decreased in 1993 to similar rates estimated for previous and post years of sampling (Bennett et al., 1995; Bennett et al., 1997).

Studies on the Columbia River have shown the importance of benthic invertebrates, particularly *Corophium salmonis*, in diets of juvenile white sturgeon (McCabe et al., 1992a; McCabe et al., 1992b). More extensive research is needed to determine significant links between sturgeon distribution, sturgeon growth, and invertebrate abundance. Sprague et al. (1993) indicated that white sturgeon may be feeding on organisms in the water column rather than exclusively on organisms associated with the substrate. *Corophium* species (river drift organisms) were the predominant prey item eaten by YOY and juvenile white sturgeon in two Columbia River impoundments and the lower Columbia River (Sprague et al., 1993; McCabe et al., 1992a; Muir et al., 1988). *Corophium* species abundance in Lower Granite reservoir appear low (Bennett et al., 1991); however, crayfish were abundant near the upper end of Lower Granite reservoir.

Cochnauer (1981) reported crayfish and chironomid species were dominant food items identified from white sturgeon stomachs in the middle Snake River. This may explain the high density of juvenile white sturgeon in the upper section of Lower Granite reservoir relative to lower areas of the reservoir. Highest densities of crayfish in Lower Granite reservoir, a prey item of white sturgeon greater than 17.7 inches (45 cm) long (Scott and Crossman, 1973), occurred near the upper end of the reservoir, which coincided with the highest densities of juvenile white sturgeon. Bennett et al. (1990) reported high abundance of larval fishes above RM 127.2, which also may contribute to food resources available to white sturgeon. Lepla's (1994) sampling in 1990-1991 show that the upriver portion of Lower Granite reservoir is the most critical portion of the reservoir for juvenile white sturgeon rearing.

Benthic macroinvertebrates that are commonly consumed by salmonids in the lower Snake River and McNary reservoirs also seem to be largely taxa that are commonly associated with hard substrates. Nightingale (1999) reported differences in the macroinvertebrate fauna of hard versus soft substrates in the lower Snake River and McNary reservoirs. Several taxa of aquatic organisms commonly found in the stomachs of juvenile anadromous salmonids in Lower Granite reservoir were from organisms produced on firm substrates (Karchesky, 1996). Hard substrata in the lower Snake River and McNary reservoirs occur along riprap (Nightingale, 1999) and the original river channel. Some of these organisms "drift" in the upstream portion the reservoirs primarily in the seasons of higher flow that increases their availability to rearing and downstream migrating juvenile salmonids and resident fishes.

Chipps et al. (1997) showed that construction of shallow-water habitat with dredged material has increased habitat complexity in Lower Granite reservoir and proper placement has potential as an enhancement technique. Chipps et al. (1997) concluded that islands constructed from dredged material altered the "natural" reservoir habitat by decreasing depth and, therefore, improving rearing habitat for several resident fishes.

3.1.3 Aquatic and Terrestrial Plants

Aquatic plants within the study area include phytoplankton, algae, and various macrophytes. Each of these plant types is an important component to overall flora production within the reservoirs.

Phytoplankton presence in the Snake and Columbia rivers has been typically measured by sampling for monochromatic chlorophyll a. Ledgerwood et al., 2000, reported peaks in concentrations of chlorophyll a primarily in April before peak flows occurred in Lower Granite reservoir and again in the periods of the declining hydrograph from July until approximately October (depending on location of sampling in the reservoir and year). Gilbreath et al. (2000) reported similar patterns of chlorophyll a prevalence for John Day reservoir during the same time periods of 1994 and 1995.

Filamentous green algae was described as part of the diet for several of the fish species in the Little Goose reservoir, but was not prominent in any diet (Bennett et al., 1983). Filamentous green algae can be found attached to rocks, woody debris, and other structures.

Macrophytes are large plants that typically grow in shallow water along the shorelines of lakes or in the slow-moving reaches of rivers. They can be entirely submerged or emergent. Bennett et al. (1995) reported the presence of two species of pondweed in Lower Granite reservoir including *Potamogeton crispus* and *P. filiformis*. Emergent macrophytes are an important element in the food chain because they provide habitat for insects, which, in turn, can be food for fish, and they function as direct food source for many aquatic organisms. They also supply surfaces for fish eggs to incubate as well as protection for fish species during various life stages. These plants are especially important for young fish that hide among plant stems and leaves to escape predators. Macrophytes help stabilize shorelines by reducing erosion and recycling nutrients.

Terrestrial plants growing adjacent to the reservoirs can contribute woody debris, leaf litter, and other organic debris that can be utilized as cover, substrate, and nutrients by invertebrate and vertebrate aquatic fauna if it falls into the water. Terrestrial plants generally do not contribute directly to fish diets. See section 3.2 for further discussion of the terrestrial ecology of the project area.

3.1.4 Fish Predation

The most important fish-eating fish species include smallmouth bass, northern pike minnow, channel catfish, crappies, and yellow perch. Of particular importance, the larger individuals may seasonally forage on juvenile salmonids residing in, or migrating through, the reservoirs. However, other than juvenile fall chinook salmon, fish predation appears to be relatively low in yearling chinook salmon and steelhead (Corps, 1999). The most important single predator on juvenile salmonids is smallmouth bass because of their abundance (Corps, 1999). Predation by northern pike minnow has been substantially reduced in the lower Columbia and Snake Rivers by the Sport Reward Program and scientific sampling funded by BPA (Corps, 1999), both of which remove significant numbers of northern pike minnows.

3.2 TERRESTRIAL RESOURCES

3.2.1 Vegetation

The study area along the Columbia and Snake Rivers passes through steppe and shrub-steppe plant communities (Franklin and Dyrness, 1973; Daubenmire and Daubenmire, 1984). Steppe communities are dominated by bunchgrasses, such as Idaho fescue, bluebunch wheatgrass, and Sandberg's bluegrass, while shrub-steppe communities are co-dominated by sagebrushes, such as big sagebrush. Both the Columbia and Snake Rivers are major migration and dispersal corridors for plants and wildlife and have a high degree of local variation (Franklin and Dyrness, 1973).

Prior to the construction of the dams and impoundments, rich alluvial soils associated with the floodplains allowed the development of quality riparian vegetation along the rivers. Over 50 vegetated islands were present in the Snake River alone with numerous sand and gravel bars common (Technical Appendix M, Corps, 1999).

The construction of the dams and impoundments reduced the native upland and riparian habitats within the study area. Emergent wetland habitat increased significantly after construction of the dams and impoundments due to sedimentation and flooding of backwater areas.

The project reservoirs have influenced the extent and distribution of numerous plant and wildlife communities that have existed within the river corridor for many years. Local plant communities have established under normal reservoir fluctuations and periodic drought. Specifically, riparian, wetland, and shallow-water habitats on the Columbia and Snake Rivers have established under normal, daily reservoir fluctuations of 3 to 5 feet (0.9 to 1.5 m). The following discussion is limited primarily to the major plant and wildlife associations within the project reservoirs, including riparian, wetland, upland, and HMUs.

3.2.1.1 Riparian Communities

The riparian zone includes areas with woody vegetation that are too dry to be considered wetlands, sand and gravel bars, wet meadows, flood-scoured areas, and other stream-related habitats and vegetation. Riparian areas serve as important wildlife habitat and are integral to the function of river aquatic ecosystems, wind shelters for residences, and locations for recreational activities (Corps, 1999).

Currently, approximately 1,804 acres (730.1 hectares) of similar habitat exists in varying proportions along the lower Snake River reservoirs (Corps, 1999). Approximately 2,908 acres (1 176.8 hectares) of riparian communities occur along the McNary reservoir (Corps, 1992).

In general, riparian forests on the lower Snake River are dominated primarily by Russian olive (*Elaeagnus angustifolia*), but also include black cottonwood (*Populus trichocarpa)*, black locust (*Robinia pseudo-acacia)*, hackberry (*Celtis reticulata*), and white alder (*Alnus rhombifolia*). Scrub-shrub vegetation includes coyote willow (*S. argophylla*), other willows (*Salix* spp.), and false indigo (*Amorpha* sp.). Herbaceous plants in this area include dotted smartweed (*Polygonum punctatum*), cocklebur (*Xanthium sp.*), thistle (*Carduus sp.*), and mustard *(Brassica sp.*). A few large sandbars and islands occur along the river that also support plant communities typically dominated by licorice root (*Glycyrrhiza lepidota*), cocklebur, and willows.

Riparian vegetation is abundant along the McNary reservoir in the Columbia River. This is an extremely diverse area consisting of numerous islands, shallow-water and backwater areas, riparian forests, and wetlands. Deciduous riparian trees in this area are some of the largest in the region. In general, deciduous riparian trees associated with the projects are characterized by (in order of abundance) Russian olive, willows, and black cottonwood. Riparian shrubs include willows, dogwood (*Cornus sp.*), and rose (*Rosa sp.*). Riparian herbs include a mixture of various forbs and grasses that occupy sand, mud, and gravel bars in the reservoir areas (Asherin and Claar, 1976; Tabor, 1976).

A number of factors contribute to the lack of extensive riparian areas along the lower Snake River and Columbia River (Corps, 1992; Corps, 1999). The steep shorelines associated with project reservoirs are primarily responsible for limiting development of riparian communities in the study area. Furthermore, extensive grazing (Lewke and Buss, 1977), the expansion of railroads, and the gradual inundation of the river bottom by dams have also limited riparian vegetation to narrow vegetation corridors and backwater areas. The woody plant community that remains in the study area is drought resistant and composed of black locust, Russian olive, and various hybrid cherries (*Prunus sp.*) (Asherin and Claar, 1976).

Since 1976, much of the shoreline has been fenced to limit cattle grazing to selected cattle watering corridors along the lower Snake River. Much of the existing vegetation has rebounded with the removal of cattle grazing. However, cattle watering corridors do still exist.

3.2.1.2 Wetland Communities

Wetlands along the river and inside stream deltas serve a variety of physical and biological functions including wildlife habitat (waterfowl, big game, furbearers, etc.); fish breeding and foraging habitat; nutrient/sediment trapping; flood control; and recreation. The amount of wetlands has increased on the Snake River from less than 10 acres (4.0 hectares) in 1958 to over 350 acres (141.6 hectares) today (Corps, 1999). In the McNary reservoir, there are over 1,010 acres (408.7 hectares) of wetlands (Corps, 1992).

Wetlands along the lower Snake River reservoirs are characterized by emergent plant communities. Cattails (*Typhus latifola*) and bulrush (*Scirpus sp.*) are the predominant wetland plants along the reservoirs.

Wetlands associated with the McNary reservoir are also of the emergent variety. Extensive wetlands occur in the McNary reservoir near the mouths of the Walla Walla, Snake, and Yakima Rivers. Typical native vegetation includes cattails, bulrush, willows, and black cottonwood. Exotic species include purple loosestrife and false indigo.

On the Snake River, numerous small pockets of wetlands and ponds exist in small impoundments behind roads and railroads along the reservoirs and other embayments. Vegetation is dominated by cattails and softstem bulrush, with some rushes and sedges. Purple loosestrife and false indigo are found in these areas. The increase in these types of communities is due to several factors: (1) abundant slack water, which causes sediments carried into reservoirs to accumulate and create good conditions for wetland vegetation development; (2) several embayments and backwaters that allow for wetland development; (3) drawdowns that allowed wetland vegetation to establish; and (4) runoff and seeps from nearby irrigated HMUs (Corps, 1999).

3.2.1.3 The HMUs

The HMUs are lands designated primarily for management as wildlife habitat. These areas provide essential habitat for numerous plants and wildlife of the lower Columbia/Snake River system and have been developed or have established naturally under prolonged periods of normal reservoir conditions. Sixty-two HMUs have been designated along the lower Snake River (Corps, 1999). Approximately 760 acres (307.6 hectares) of irrigated lands are associated with the 11 intensively managed (i.e., irrigated) HMUs on the four lower Snake River projects (Sather-Blair et al., 1991). The largest HMU, Big Flat at 850 acres (344.0 hectares) (Sather-Blair et al., 1991), is located 3 miles (4.8 km) upstream of Ice Harbor Dam. Irrigated HMUs at each of the reservoirs have been planted extensively with trees and shrubs along reservoir shorelines and with herbaceous plants to establish feeding areas for wildlife.

Numerous dryland (non-irrigated) HMUs are located along each of the lower Snake River reservoirs. Dryland HMUs have limited development that may include guzzlers (water-trapping structure for wildlife), quail roosts, and brush piles. The Joso site is a dryland HMU encompassing about 568 acres (229.9 hectares). The center of this HMU is a large gravel quarry that was excavated during the relocation of the railroads prior to the filling of Lower Monumental reservoir. The habitat surrounding the gravel quarry is shrub-steppe. Four guzzlers and two brush piles have been constructed on the HMU.

McNary reservoir has several wildlife management areas. Five HMUs, totaling 4,500 acres (1 821.1 hectares), are managed by the Corps and USFWS. The 500-acre (202.3-hectare) McNary Wildlife Nature Area is located just downstream of McNary Dam and is also managed by the Corps. The 3,600-acre (1 456.9-hectare) McNary National Wildlife Refuge (NWR) is managed by the USFWS near the confluence of the Snake and Columbia Rivers. This refuge has recently been expanded to include the Corps-owned lands (mentioned above) under lease to the USFWS.

3.2.2 Wildlife

The project reservoirs provide essential habitat for numerous birds, reptiles, amphibians, small mammals, bats, and big game animals (Asherin and Claar, 1976, Tabor, 1976). Asherin and Claar (1976) identified 87 species of mammals and 257 species of birds that occur in the vicinity of the lower Snake River and McNary reservoirs. They generally are dependent on tree-shrub riparian habitat associated with the project reservoirs (Lewke and Buss, 1977). In general, riparian and wetland areas support higher population densities and species numbers than dryland shrub-steppe, talus, cliff, and/or grassland habitat, which are also prevalent along the project reservoirs. Habitats associated with the river generally support trees or dense grass-forb cover that provide more structurally complex areas and more abundant forage resources than adjacent uplands.

Inundation of the lower Snake and Mid-Columbia Rivers following dam construction between the early 1950's and 1975 eliminated nearly all of the woody riparian habitat present. Since inundation, the shorelines with adequate hydrology have reestablished a portion of this riparian community. Due to the lack of suitable hydrology and land management practices of the time, the riparian habitat is now highly discontinuous and dominated by exotic species such as Russian olive. Additional riparian habitats have been developed through the establishment of intensive HMUs. Thus, wildlife generally associated with wildlife habitats tends to be concentrated in these HMUs and in the natural vegetation along the major tributaries, such as the Tucannon, Palouse, and Walla Walla Rivers.

The project reservoirs provide food, water, and cover for numerous wildlife species and are especially important in the Clearwater River, lower Snake River, and McNary reservoir where moisture is extremely limited. Wildlife that typically uses riparian and wetland habitat area associated with the project areas can be divided into nine main groups: waterfowl, upland game birds, raptors, small mammals, other non-game birds, big game animals, furbearers, amphibians and reptiles, and listed threatened and endangered species (Asherin and Claar, 1976; Tabor, 1976).

3.2.2.1 Waterfowl

Over 30 species of waterfowl have been documented to occur on the Columbia and Snake Rivers in the project area (Lewke and Buss, 1977: Asherin and Claar, 1976; Rocklage and Ratti, 1998). Resident, breeding waterfowl numbers are generally low except for Canada geese (*Branta canadensis*), mallard (*Anas platyrhynchos*), Barrow's goldeneye (*Bucephala islandica*), and American widgeon (*Anas americana*), which occur throughout the projects. Waterfowl nesting is limited within the lower Snake River reservoirs because of shortage of suitable nesting habitat. Nesting habitat is more readily available adjacent to the McNary reservoir.

Of the four lower Snake River reservoirs, Ice Harbor reservoir typically has the most waterfowl (mainly mallard and Canada geese) during migration and winter with a high count of almost 16,000 mallards in December, 1978 (unpublished aerial waterfowl counts by the USFWS and WDFW). This may be a result of the Ice Harbor reservoir being a waterfowl reserve where waterfowl hunting is prohibited. While waterfowl numbers drop off upstream, the diversity of waterfowl increases (USFWS, 1999a).

The McNary reservoir supports a large population of nesting Canada geese. The 25-plus islands, together with the McNary NWR and HMUs, annually produce up to 600 to 700 goslings and provide habitat for nesting ducks, primarily mallards. Most goose nesting occurs on seven islands, with the greatest numbers of successful goose nests on Badger Island.

Canada goose nesting on the lower Snake River and in McNary reservoirs occurs primarily on reservoir islands and along cliffs. Surveys conducted between 1974 and 1987 in the project vicinity have found that over 80 percent of Canada goose production was supported on Badger, Foundation, and New York Islands, producing 280 nests (Boe, 1988). Island nesting on the lower Snake River produced about 125 nests in 1996 (Corps, 1999).

3.2.2.2 Game Birds

The major game bird species occurring in the study area include ring-necked pheasant, California quail, chukar, and mourning dove of which only the mourning dove is native (Asherin and Claar, 1976; Rocklage and Ratti, 1998). These game birds are relatively common throughout the study area, extending from riverside to the upland areas.

Ring-necked pheasants depend on permanent shrub and tall herbaceous cover that is maintained on irrigated lands in the study area. They are often found on irrigated HMUs foraging on food plots (Corps, 1999).

Chukars use a wide variety of habitats. Oelklaus (1976) found that chukars use Douglas hackberry, smooth sumac, and poison ivy stands along the project area. Shrub and talus areas are important for nesting (USFWS, 1995). Cheatgrass and agricultural grains are important for foraging (Gilbreath and Moreland, 1953; Christensen, 1970).

Of all the game species inhabiting the project area, California quail were most adversely affected by inundation of the dams. Pre-project habitat conditions were ideal for California quail (Sather-Blair et al., 1991) with good interspersion of cropland (food) and riparian vegetation that provided important escape and winter cover. Since completion of the projects, the percentage of project area in food-producing cover types (e.g., agricultural crops) has decreased, and the distances between food and cover have increased.

3.2.2.3 Raptors

Riparian forests and wetlands along the Snake, Columbia, and Clearwater rivers provide perching and nesting opportunities, and concentrated prey (e.g., small mammals, songbirds) (Tabor, 1976; Asherin and Claar, 1976; Asherin and Orme, 1978). In general, cliffs and large trees along riverbanks typically support diverse raptor populations. The McNary and lower Snake River reservoirs provide cliff areas in proximity to the rivers that may provide potential nest and roost sites for bald eagles (*Haliaeetus leucocephalus*), golden eagles (*Aquila chrysaetos*), and prairie falcons (*Falco mexicanus*) (Payne et al., 1975; Asherin and Claar, 1976; Tabor, 1976).

Rocklage and Ratti (1998) documented 17 species of raptors in the study area. Asherin and Claar (1976) found only 13 species within the same area, with one species (burrowing owl) not seen in the previous study. During the summer of 1981, Fleming (1981) found a total of 172 raptor nests of 10 species along the Snake River from Lewiston, Idaho, to Ice Harbor. Although nesting information was not specifically recorded, Rocklage and Ratti (1998) recorded 209 raptors of 12 species present along the lower Snake River during the breeding season. Asherin and Claar (1976) found American kestrel (*Falco sparverius*) and red-tailed hawk (*Buteo jamaicensis*) to be the most common raptors in the lower Snake River area.

Peregrine falcons (*Falco peregrinus)* were recently removed from the endangered species list. There are no reported peregrine falcon nests in or near the dredging or dredged material disposal sites. An active aerie is located along Weissenfels Ridge near the confluence of the Snake River and Tenmile Creek, approximately 8 miles (12.9 km) south of Clarkston (USFWS, 1999a). Peregrine falcons could potentially travel through this area during migrations.

Bald eagles are found in the study area usually during the winter, between November and March. A few bald eagles winter along the McNary reservoir (BPA et al., 1994). Mid-winter bald eagle surveys reported 10 eagles on the lower Snake River (Corps, 1999). One nesting attempt was recorded on the Strawberry Islands, near the mouth of the Snake River in 2000. This nest was unsuccessful. Eagles feed primarily on waterfowl and fish, which are present in the reservoirs. Bald eagles are discussed further in section 3.3.2.1.

3.2.2.4 Non-Game Birds

The project reservoirs provide essential habitat for numerous colonial nesting birds, shorebirds and songbirds (Asherin and Claar, 1976, Tabor, 1976). They generally are dependent on tree-shrub riparian habitat associated with the project reservoirs (Lewke and Buss, 1977). In general, riparian and wetland areas support higher population densities and species numbers than dryland shrub-steppe, talus, cliff, and/or grassland habitat, which are also prevalent along the project reservoirs. Habitats associated with the river generally support trees or dense grass-forb cover that provides more structurally complex areas and more abundant forage resources than adjacent uplands.

There is some evidence that bird species richness along the project area has declined from pre-impoundment conditions. Of 61 total bird species found by Dumas (1950), 12 were not reported by a more recent study (Rocklage and Ratti, 1998). These species include the black-chinned hummingbird, veery, red-eyed vireo, solitary vireo, American redstart, Brewer's blackbird, and fox sparrow. Most of these species are associated with riparian forest habitat (Smith et al., 1997). These species are still seen in and around the lower Snake River by the local chapters of the Audubon Society. The redstart, vireos and brewers blackbird are seen very rarely and may have been migrants in previous studies. It has been documented that conversion of native riparian forest to exotic species such as Russian olive, have reduced species diversity in the region, especially for insectivorous birds (USFWS, 1997).

Rocklage and Ratti (1998) observed a total of 92 bird species during the breeding season within the study area. Within the various habitats along the rivers, the HMUs had higher bird species richness during both the breeding season and the fall than the woody drainages leading into the reservoirs. Their narrow width and their degradation may limit the suitability of the woody drainages for foraging and nesting. Therefore, despite the lack of mature riparian habitat on the HMUs, they still provide important habitat for riparian bird species.

California gulls (*Larus atricilla)*, ring-billed gulls (*L. delawarensis*), Forster's terns (*Sterna forsteri)*, Caspian terns (*S. caspia*), and double crested cormorants (*Phalacrocorax auritus*) nest in large concentrations on the lower Columbia River, particularly on Crescent and Foundation Islands along the McNary reservoir. Pied-billed grebes (*Podilymbus podiceps*) and rail species use many of the backwater areas throughout the project area. Killdeer (*Charadrius vociferus*) and spotted sandpiper (*Actitis macularia*) nest and forage just upslope from the high reservoir line and along the shoreline throughout the project area. In addition, over 1,000 white pelicans (*Pelicanus erythrorhynchos*) typically occur along the Columbia River between Boardman, Oregon, to Vernita Bridge, north of Richland, Washington (Corps, 1992).

3.2.2.5 Small Mammals

Eleven small mammal species have been observed in the study area, with two additional species likely present (Corps, 1999). These species include deer mouse, western harvest mouse, Great Basin pocket mouse, house mouse, long-tailed vole, montane vole, northern pocket gopher, vagrant shrew, Merriam's shrew, bushy-tailed woodrat, and Ord's kangaroo rat (Rocklage and Ratti, 1998; Johnson and Cassidy, 1997; Asherin and Claar, 1976). Deer mice make up the majority of individuals found in the project area. Rocklage and Ratti (1998) found six species, with deer mouse composing 74 percent of total captures. Notably, some evidence suggests that small mammals prefer native riparian habitat to other habitat. Asherin and Claar (1976) found the highest species diversity in their study in the native cattail and shrub willow habitat types.

Six species of bats have been documented in the study area and five more are suspected to occur based on habitat suitability, their range, and their occurrence in the vicinity (Johnson and Cassidy, 1997; Mack et al., 1994; Asherin and Claar, 1976). Documented species include Yuma myotis, western pipistrelle, pallid bat, small-footed myotis, California myotis, and Townsend's big-eared bat (Asherin and Claar, 1976; Johnson and Cassidy, 1997). Other species of bats that may also be present include long-legged myotis; long-eared myotis; fringed myotis; hoary bat, and big brown bat (Johnson and Cassidy, 1997; Asherin and Claar, 1976).

3.2.2.6 Furbearers

Aquatic furbearers occur in each of the project reservoirs and include muskrat (*Ondatra zibethicus),* beaver (*Castor canadensis*), river otter (*Lutra canadensis*), and mink (*Mustela vison*). In general, this group is dependent on riverine areas, embayments, ponds, tributaries, and riparian forests for den sites and foraging areas. Beaver distribution within the project reservoirs is strongly associated with the presence of cottonwood and protected areas. (Asherin and Claar, 1976). Muskrats are particularly abundant in embayments and sloughs where aquatic plants are also abundant. Mink and river otter use the project reservoirs, ponds, sloughs, and backwater areas for foraging and denning. Both the mink and river otter use riprap areas along the banks as den sites (Sather-Blair et al., 1991).

Asherin and Claar (1976) observed four species of terrestrial furbearers: bobcat, coyote, raccoon, and striped skunk and the three species of aquatic furbearers discussed above. They concluded that aquatic furbearer abundance was low along the lower Snake River. Asherin and Claar (1976) also noted that that the aquatic furbearers were more abundant in those study segments with more extensive riparian habitat such as the McNary NWR.

Although it is likely that some of these species were never abundant (Asherin and Claar, 1976), inundation by the reservoirs probably eliminated much of the riparian habitat that was important for foraging and denning for many of the furbearers. In particular, muskrat and mink seem to have declined (WDG, 1984; Corps, 1999). When comparing habitat value for river otter both pre-project, lower Snake River, and conditions today, habitat values meet or exceed those values for pre-project conditions. This is mainly due to the shoreline structure developed by riprap and woody exotic vegetation. It is not clear whether this has translated into higher otter numbers since surveys for otters have not been conducted in recent years.

3.2.2.7 Big Game Mammals

Mule and whitetail deer are the most common big game inhabiting the study area (Tabor, 1976). Mule deer make up about 80 percent of the deer population with the whitetail deer making up the remaining 20 percent. Populations of deer have recovered to pre-impoundment carrying capacity

(Corps, 1990). This increase is at least partly due to the development of habitat in HMUs and the exclusion of livestock from much of the study area (Corps, 1999).

Suitable habitat for deer in the study area mainly serves as wintering range, with the deer making seasonal and daily migrations out of the canyons to forage in the surrounding cultivated land. Deer use a wide variety of habitats including shrub and brush for cover and fawning and grassland for foraging.

Mule deer are found in increasing numbers from the Lower Monumental reservoir upstream to the upper half of the Little Goose reservoir (Tabor, 1976). There is some evidence that greater precipitation and higher habitat diversity along the upper two lower Snake River reservoirs provide more stability for deer populations than habitats downstream and extending into the McNary reservoir (Corps, 1990).

Other species that have been observed along the river but that are considered uncommon include elk, bighorn sheep, black bear, moose, and mountain lion (Corps, 1999).

3.2.2.8 Amphibians and Reptiles

Sixteen species of amphibians and reptiles have been documented in the study area (Asherin and Claar, 1976; Loper and Lohmann, 1998; McKern, 1976). The most commonly occurring species were the Pacific tree frog (*Hyla regilla*), bullfrog (*Rana catesbeiana*), western yellow-bellied racer (*Coluber constrictor mormon*), Great Basin gopher snake (*Pituophis melanoleucus deserticola*), long-toed salamander *(Ambystoma macrodactylum*), western toad (*Bufo boreas*), night snake (*Hypsiglena torquata*), western rattlesnake (*Crotalus viridis*), and painted turtles (*Chrysemys picta*). Other species that may occur within the study area, but were not observed by Asherin and Claar (1976) or Loper and Lohmann (1998) include: the tiger salamander (*Ambystoma tigrinum*), northern leopard frog (*Rana pipiens*), short-horned lizard (*Phrynosoma douglassi*), sagebrush lizard (*Sceloporus occidentalis*), rubber boa (*Charina bottae*), and the ringneck snake (*Diadophis punctatus*).

Of the vegetation types sampled by Asherin and Claar (1976), the ones most closely associated with water had the greatest relative abundance of amphibians. In particular, native willow and emergent wetland habitats have the greatest species diversity. In general Loper and Lohmann (1998) found that species richness and abundance were low at both riparian and upland locations. Some of the reasons may include the relatively young age of the recovering riparian fringe beside the existing reservoirs; the isolation of suitable riparian habitat into discrete patches along the river (i.e., HMUs); and fluctuating water levels in the reservoirs that prevent the consistent occurrence of litter, debris, pools, and vegetation that these species could use for breeding, resting, and forage (Loper and Lohmann, 1998).

3.3 ENDANGERED SPECIES

The ESA establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the preservation of the ecosystems on which they rely. Section 7 of the ESA requires Federal agencies to consult with the USFWS and/or NMFS as necessary to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy critical habitat. It also requires that Federal agencies prepare BA's of the potential effects of major construction actions on listed species.

Several species listed as threatened or endangered under the ESA are potentially found in the lower Snake River reservoirs and McNary reservoir. The following sections describe these species and their use of the study area. Additional information regarding the presence of these species in the study area and the impacts of the proposed dredging and dredged material disposal are found in the BA's (appendix F and appendix G) prepared by the Corps. Full documentation of these consultations is presented in Appendix F (for NMFS) and Appendix G (for USFWS).

3.3.1 Fish

3.3.1.1 Anadromous Fish

The existing anadromous fish species and environmental conditions in the study area that could be affected by the alternatives in this DMMP/EIS are discussed in detail in section 3.1.1.1. However, the NMFS has determined that the effects of the proposed actions will not jeopardize the continued existence of endangered SR sockeye, threatened SRF chinook, threatened SRSS chinook, threatened SRB steelhead, endangered UCRS chinook, endangered UCR steelhead, or threatened MCR steelhead or result in the adverse modification or destruction of their Critical Habitat. The determination of no jeopardy is based upon the current status of the species, the environmental baseline for the action area, and the effects of the proposed actions. Other potentially impacted species such as Pacific lamprey are also discussed in section 3.1.1.1.5.

3.3.1.2 Resident Fish

The only subpopulations of bull trout associated with the four lower Snake River reservoirs spawn and rear in the Tucannon River Basin. Both resident and migratory forms occur there. A detailed discussion on bull trout is presented in section 3.1.1.2.3. Margined Sculpin is a species of concern and is discussed in section 3.1.1.2.5.

3.3.2 Wildlife

There is one listed wildlife species that may occur in the project area (USFWS, 2000), the bald eagle. Washington ground squirrel is currently a candidate species for listing. In addition to the listed species, a discussion of species of concern is presented in section 3.3.4.

3.3.2.1 Bald Eagle - Threatened

Bald eagles are usually associated with a source of permanent water, such as reservoirs, lakes and free-flowing rivers, with abundant fish and nearby sites for perching, roosting, and, in season, nesting. Their primary prey is fish, especially salmon, but they also eat small mammals, various water birds, such as waterfowl, and carrion. In the winter, provided the roosting sites and food are abundant, eagles roost in groups, particularly in conifer stands or along rivers with migrating salmon.

In the western United States, eagles reside along the western coast from southern Alaska through the Pacific Northwest to northern California. In the winter, bald eagles can be found throughout most of the United States west of the Mississippi River. In Washington, bald eagles nest along the Pacific Ocean, Puget Sound, large lakes, and rivers. They winter along rivers that support large runs of anadromous fish, the Puget Sound, and the Pacific Ocean.

During the nesting season (February 1 through August 15), bald eagles use breeding habitat close to rivers, lakes, marshes, or other food sources. Important habitat components include nest trees, perch trees, and available prey. Live, mature trees with deformed tops are often selected for nesting, and nests are often reused year after year. Snags, trees with exposed lateral branches, or trees with dead tops are important for perch-sites while hunting or defending territories. Perches used for foraging are normally close to water where fish, waterfowl, seabirds, and other prey can be captured.

Wintering bald eagles (November 1 through March 15) congregate along rivers, lakes, and streams, where winter runs of salmon provide an abundant prey base. Waterfowl concentrations may also be important winter food sources. In eastern Washington, mixed stands of black locust and black cottonwood provide important roosting and perching habitat.

There are no documented successful bald eagle nests in or around the project area. An unsuccessful nesting attempt occurred on Strawberry Island near the mouth of the Snake River during the 2000 nesting season. This site is adjacent to proposed dredging activity for the approach to Ice Harbor. Bald eagles have also attempted nesting in the Clearwater and Grande Ronde drainages and at the Hanford Reservation north of Richland, Washington. These sites are well over a mile (1.6 km) from the project area. The limited amount of suitable habitat makes additional nesting in the project area unlikely.

Based on data from Corps mid-winter surveys, bald eagles may be present in the project area during the winter, roosting in black locust or black cottonwood trees where available. Mid-winter censuses have been conducted on the lower Snake and Columbia Rivers from McNary (on the Columbia below the confluence with the Snake) to Asotin, Washington, [2 miles (3.2 km) upriver from Clarkston, Washington] annually since 1989. These surveys generally take place in January and are divided into two survey areas. The Western Project survey area extends from McNary to Lower Monumental. The Eastern Project area extends from Lower Monumental to the upper influence of the Lower Granite reservoir, near Asotin, Washington. Surveys were typically conducted in January and were confined to Corps-managed lands along the rivers.

The last 5 years of survey results were examined to determine average annual bald eagle occurrence. In the Western Project area, bald eagle counts ranged from 11 to 19 individual birds annually. Many of the locations are less than 1 mile (1.6 km) from proposed dredging and dredge disposal activities. These include Strawberry Island below Ice Harbor, Sacajawea Park at the Snake and Columbia Rivers confluence, and Big Flat HMU above Ice Harbor. In the Eastern Project area, between three and five individual bald eagles per year have been counted. One or two of these are usually found in the Snake/Clearwater Rivers confluence area, near the proposed Lower Granite dredging and levee-raising activities.

3.3.2.2 Washington Ground Squirrel - Candidate

These squirrels are found in steppe and open shrub-steppe, where they prefer deep, loose soil for digging burrows. One existing colony in Walla Walla County is within the study area, while five additional colonies are located nearby. Use of the Joso site for upland disposal of dredged material has the potential to negatively impact Washington ground squirrels during disposal operations through disturbance of habitat. Most of the ground to be disturbed is within the gravel pit, where soils are less suitable for ground squirrels. Most suitable habitat will remain undisturbed. Restoration of grassland habitat after disposal may benefit ground squirrels.

3.3.3 Plants

One plant species with Federal status may potentially occur in the project area: Ute ladies' tresses. Also, Spalding's silene is proposed to be listed and White Bluffs bladder-pod is a candidate for listing.

3.3.3.1 Ute Ladies' Tresses (*Spiranthes diluvialis*) - Threatened

This orchid is a lowland species, typically occurring beside or near moderate gradient, medium to large streams and rivers in the transition zone between mountains and plains. It is not found in steep mountainous parts of the watershed nor along slow meandering streams out in the flats. The communities where it is often found tend to be typical of riparian habitat in the area. The species tend to occupy graminoid (grasses, rushes, and sedges) dominated openings in shrubby areas. It occasionally occurs in spring-fed wetlands in broad valleys isolated from watercourses. Soil moisture must be at or near the surface throughout the growing season. The species tolerates periodic flooding, but does not occupy constantly inundated areas (USFWS, 1998).

Ute ladies' tresses occur in a variety of settings, including floodplains, moist to wet meadows on floodplains, abandoned meander channels, moist to wet meadows irrigated by freshwater springs, riparian streambanks, borrow pits, upper edges of riverbanks, islands, point bars, and various topographic positions up to 200 feet (61.0 m) horizontally and 0.5 to 4 feet (0.2 to 1.2 m) vertically from the water's edge, but not on steep slopes (USFWS, 1998).

Ute ladies' tresses were discovered in northern Washington (the Okanogan River valley) for the first time in 1997. They were also found in the Snake River Basin in southeastern Idaho in 1996. It is now known to be present in northern Washington, southern Idaho, and nearby parts of Montana. The USFWS has determined that, in the absence of adequate surveys, this species may be expected to occur in suitable habitat throughout Idaho and Washington (USFWS, 1998).

3.3.3.2 Water Howelia (*Howellia aquatilis*) – Threatened

Howelia grows in firm consolidated clay and organic sediments that occur in wetlands associated with ephemeral glacial pothole ponds and former river oxbows (Shelly and Moseley, 1988;

Lesica, 1992). These wetland habitats are filled by spring rains and snowmelt run-off; and depending on temperature and prescription, exhibit some drying during the growing season. This plant's microhabitats include shallow water, and the edges of deep ponds that are partially surrounded by deciduous trees (Shelly and Moseley, 1988; Gamon, 1992).

Only 79 small populations of this aquatic plant were known to exist when the proposed rule to list the species was published (58 FR 19795). Subsequent inventories conducted for howellia in the State of Washington located 28 new sites in Spokane County alone, thus expanding the number of known populations to 107 (Roe and Shelly, 1992; N. Curry, in Litt., 1993; J. Gamon, Washington Natural Heritage Program in litt., 1993; R. Moseley, Idaho Conservation Data Center, in Litt., 1993). Howelia appears to be extirpated from California and Oregon, from Mason and Thurston Counties in Washington, and Kootenai County in Idaho (Jokerst, 1980; Shelly and Moseley, 1988; Oregon Natural Heritage Program, 1991; Gamon, 1992).

Nearly all of the remaining populations of howelia are clustered in two main population centers or metapopulations. Within these areas, individual populations occur primarily in clusters of closely adjacent ponds, although some ponds within the range of these metapopulations are unoccupied. One metapopulation near Spokane, Washington, consists of 46 individual populations in Spokane County, Washington, and one in Latah County, Idaho. A second metapopulation is found in the drainage of the swam river in northwestern Montana (Lake and Missoula Counties, where 59 individual populations are found. In addition to metapopulations, a third site near Vancouver in southwestern Washington (Clark County) contains two populations that are in close proximity of each other (Gamon, 1992).

Water howelia is not documented in Idaho near the study area (Idaho Conservation Data Center, 2000). The study area itself does not exhibit any habitat which could be used by this species.

3.3.3.3 Spalding's Silene - Proposed

Spalding's silene is a plant that has white flowers and is found in virgin Idaho fescue (*Festuca idahoensis*) habitat types in the Palouse region (Washington Natural Heritage Program, 1981). Although not documented within the study area, this species has been found in Whitman and Asotin counties.

3.3.3.4 White Bluffs Bladder-pod - Candidate

A perennial, grayish-pubescent herb of the mustard family that has a well-developed taproot, a dense, many-leaved rosette of gradually reduced leaves, and dense inflorescences of yellow flowers.

This narrow endemic species is restricted to a very small area in Franklin County adjacent to the Columbia River in south-central Washington. It is currently known from an area of a few yards (meters) wide by approximately 10 miles (17 km) long.

The species is restricted to a very small area along the Columbia River in shrub steppe vegetation. The species is restricted to dry, barren, nearly vertical exposures of calcium carbonate paleosol (a "caliche" soil). The substrate is extremely alkaline and highly calcareous. Elevation ranges between 780 and 890 feet. Associated species include big sagebrush, buckwheat milkvetch, slender buckwheat, Snake River cryptantha, and Sandberg's bluegrass.

The range of this species is within the driest region in the state of Washington; the general area receives an average of about 6 inches (15.2 cm) of precipitation per year. As a result, the overall cover of vegetation is extremely low. As noted above, the species is restricted to a highly alkaline substrate that most plants find inhospitable. The species is presumably reliant on periodic exposure of these substrates. (Derived from Washington Rare Vascular Plants Web Page: http://www.wa.gov/dnr/htdocs/fr/nhp/refdesk/fguide/htm/fsp_letu.htm)

3.3.4 Species of Concern

The following discussion is cited from appendix G, Biological Assessment for Non-Anadromous Fish and Terrestrial Species.

3.3.4.1 Wildlife

3.3.4.1.1 Black Tern

Black terns are small terns that eat primarily insects and can occur statewide, in or near wetlands and sloughs. They usually nest in marshy wetlands in June. Black terns are periodically reported by birders in the project area, primarily at the mouth of the Walla Walla River, and are believed to use the area only during migration (Ackerman, 2001). The project is unlikely to impact black terns.

3.3.4.1.2 California Floater

California floaters are mussels found in unpolluted fresh water, except in small creeks. They prefer lakes and slow streams with areas less than 6.6 feet (2 m) deep and sandy bottoms. Adults will also live on mud bottoms. Juveniles are parasitic on gills, fins, and barbels of host fish. The California floater have been located upstream of Hells Canyon Dam (Idaho Dept. of Fish and Game, Conservation Database Center GIS Database). Dorband (1980) indicated that this genus was not found in Lower Granite Reservoir in 1977. It is unlikely this species would occur in the study area.

3.3.4.1.3 Columbia Pebblesnail

Columbia pebblesnails are found in the main channels and free-flowing parts of rivers including the Columbia, Grande Ronde, Salmon, and Snake Rivers. More recent documentation indicates they are present just above the study area on the lower Snake River. They are often common at the edges of rapids or immediately downstream of whitewater areas, and they feed on diatoms and algae. The Columbia pebblesnail have been located upstream of the study area in the Lower Salmon River by Idaho Conservation Database personnel. Dorband (1980) did not list the genus of this species as present in the Lower Granite Reservoir in 1977. Since this species has been found in a direct tributary of the Snake River above Lower Granite Reservoir, it is possible a few individuals could migrate downstream of that point. Water quality would still be a limiting factor, so it would be unlikely to find this species in the impounded areas of the lower Snake River, so should not be found in the study area.

3.3.4.1.4 Columbia Spotted Frog

Columbia spotted frogs are found in warmwater marshes, overflow wetlands, and bogs with non-woody wetland vegetation. They are found scattered across most of eastern Washington although they have not been observed in the study area (Ackerman, 2001; Loper and Lohman, 1998).

3.3.4.1.5 Ferruginous Hawk

These large hawks prefer open plains and brushy open country and avoid forested areas. They nest in trees along streams, bluffs, rock piles, and artificial structures. Ferruginous hawks feed primarily on ground squirrels, rabbits, and other small mammals. They are uncommon along the lower Snake River corridor although some suitable nesting habitat may be present.

3.3.4.1.6 Fringed Myotis, Long-Eared Myotis, Long-Legged Myotis, Pale Townsend's Big-Eared Bat, Small-Footed Myotis, and Yuma Myotis

They commonly forage near or over water and roost in trees and shrubs (riparian areas along the lower Snake River), rock crevices, and buildings. However, the small-footed myotis forages along cliffs, rock outcrops, and dry canyons.

Depending on the size of interstitial spaces, bats may use riprap areas for roosting or hibernating (Anderson, 2001).

3.3.4.1.7 Harlequin Duck

Harlequin ducks generally rely on fast, turbulent mountain streams as breeding habitat. They may be present in the study area in August and September (following the nesting season) although sightings are rare. They winter in coastal areas and, thus, would not likely be present during the project work window of December 1 through March 31.

3.3.4.1.8 Little Willow Flycatcher

The little willow flycatcher uses open brushy areas, especially scrub-shrub wetlands comprised of willows. Willow flycatchers are seen along riparian drainages in or near the study area during spring and early summer.

3.3.4.1.9 Loggerhead Shrike

Loggerhead shrikes are robin-sized birds that feed mainly on insects, small birds, and mammals. They would be seen in the area during the summer breeding season. Preferred habitat includes shrub-steppe and any semi-open area with shrubs, fences, powerlines, or small trees for perches.

Loggerhead shrikes are currently seen on the Hanford Reservation and adjacent areas during the summer. Most of the study area is outside of this native shrub-steppe habitat.

3.3.4.1.10 Mountain Quail

Mountain quail are uncommon birds that prefer shrubby/forested areas and are found at lower elevations in the Blue Mountains. Mountain Quail have been recorded in the mountainous areas of northwestern Idaho by the Idaho Consevation Database personnel. The study area is primarily degraded shrub-steppe which starts at the foothills of the Idaho mountains and goes into the heart of the Pasco Basin. There is no suitable habitat for this species within the study area.

3.3.4.1.11 Northern Goshawk

Northern goshawks are large hawks that prefer mature and old-growth forests for nesting and would not nest in the study area. Observations of goshawks would likely be during migration and winter. They are aerial hunters, flying between trees and under canopy in search of grouse, smaller birds, and other prey. The northern goshawk is primarily a migrant in the area which has been seen regularly in and around the study area by local chapters of the Audubon Society.

3.3.4.1.12 Northern Sagebrush Lizard

Northern sagebrush lizards are primarily shrub-steppe dwellers, but also use bouldered regions and forested slopes. They are typically ground lizards and rarely climb into shrubs. They prefer fine gravel soils, but are also found on sandy or rocky soil. They need rock crevices, mammal holes, and similar cover for refuge. Northern sagebrush lizards are currently seen on the Hanford Reservation and adjacent areas during the summer. Most of the study area is outside of this native shrub-steppe habitat.

3.3.4.1.13 Olive-Sided Flycatcher

Olive-sided flycatchers are birds that seem to prefer mixed and broken forests with wooded streams and some wetland. Their diet consists entirely of flying insects that they search for from high snags and perches. They nest high in conifer trees. Olive-sided flycatchers are seen along riparian drainages in or near the study area during spring and early summer.

3.3.4.1.14 Western Burrowing Owl

These owls are generally found in open, broken, or flat areas, including shrub-steppe and agricultural areas. They are seen regularly in the Tri-Cities, Hanford, and Yakima Range areas (Ackerman, 2001). Opportunistic feeders, they prey primarily on insects and small mammals, but also on birds, fish, and amphibians when available. They use ground squirrel or other mammal burrows for shelter and nesting.

Artificial burrows were created at the Joso HMU in the early 1980's. No use by burrowing owls has been documented although no formal monitoring plan has been implemented.

3.3.4.2 Plants

3.3.4.2.1 Northwest Raspberry

This is a Snake River endemic that is found in the Snake River canyon and adjacent tributaries. It occurs along drainage bottoms and somewhat moist areas on the adjacent slopes along small tributaries to the Snake River, such as Nisqually John Canyon. It is known from less than two dozen sites, with some of the historic sites inundated with the construction of Lower Granite (Clegg, 1973). Whether it has become established along the current reservoir shorelines is unknown; however, it has become established on at least four of the intensive HMUs (Phillips, 1993).

3.3.4.2.2 Jessica's Aster

This tall perennial species has blue flowers and can be found in association with the northwest raspberry. It is found along streambanks and open places in the Palouse region and is currently known from only nine populations in Whitman County (Washington Natural Heritage Program, 1981). None of these populations are found within the study area.

3.3.4.2.3 Broad-Fruit Mariposa

This very showy species has purple flowers and is found along the borders of seasonally wet meadows (Washington Natural Heritage Program, 1981). Although there is no documented presence within the study area, it has been found in Garfield and Whitman counties.

3.3.4.2.4 McFarlane's Four O'Clock

McFarlane's four o'clock is known to occur in three geographically isolated units occupying approximately 163 acres (65.0 hectares) in Idaho and Oregon. The Snake River unit occupies approximately 25 acres (10.1 hectares) along 6 miles (9.7 km) of Hells Canyon on the banks and canyonland slopes above the river. This plant is found on steep (50 percent) sandy slopes underlain by talus in canyonland corridors where the climate is regionally warm and dry with precipitation occurring mostly in a winter-to-spring period (Robinson, 1996).

There are no reported occurrences of McFarlane's four o'clock in the project vicinity (Robinson, 1996). This project is not expected to impact this species.

3.3.4.2.5 Washington Polemonium

A member of the phlox family, this species has white or creamy flowers and has a characteristic skunk smell. Its habitat includes moist bottomlands and has been found in Whitman County. This species has not been documented in the study area. The species is tied to wet meadow conditions which could be found in the area, so the species may be found if habitat conditions are suitable.

3.4 RECREATION

The lower Snake and Columbia Rivers provide an important recreational resource for the region. There are numerous recreational facilities lining the shores of the lower Snake River reservoirs and McNary reservoir on the Columbia River. Recreational facilities and facility visitation are described in the following sections.

3.4.1 Recreation Facilities and Activities

There are 68 designated recreation sites located on the shores and adjacent areas of the Columbia and Snake Rivers between McNary on the Columbia River and the upstream end of the Lower Granite reservoir on the Snake River. These facilities include wildlife refuges, local and state parks, and marinas, and are managed and operated by the Corps, the USFWS, and local and state recreation agencies. Table 3-1 summarizes the recreation facilities and primary uses. All the facilities are on Corps property.

Table 3-1. Recreation Facilities in the Lower Snake River and McNary Reservoirs.

Reservoir	Day-Use	Boating	Marina	Camping	State
Lower Granite					
Blyton Landing	X	X		X	WA
Chief Looking Glass Park	X	X			WA
Chief Timothy State Park	X	X		X	WA
Chief Timothy Habitat Management Unit	X				WA
Clearwater Park	X				ID
Greenbelt Ramp	X	X			WA
Gateway Golf Center	X				WA
Gateway Park	X				WA
Granite Lake RV Park				X	WA
Hells Canyon Resort		X	X		WA
Hells Gate State Park	X	X	X	X	ID
Lewiston Levee Parkway	X				ID
Lower Granite Dam	X				WA
Nisqually John Landing	X	X		X	WA
North Lewiston Ramp	X	X			ID
Offield Landing	X	X			WA
Southway Ramp	X	X			ID
Swallows Park	X	X			WA
Wawawai County Park	X			X	WA
Wawawai Landing	X	X		X	WA
Little Goose					
Boyer Park and Marina	X	X	X	X	WA
Central Ferry State Park	X	X		X	WA
Illia Dunes	X				WA
Illia Landing	X	X		X	WA
Little Goose Dam	X				WA
Little Goose Landing	X	X		X	WA
Willow Landing	X	X		X	WA

Table 3-1. Recreation Facilities in the Lower Snake River and McNary Reservoirs (continued).

Reservoir	Day-Use	Boating	Marina	Camping	State
Lower Monumental					
Ayer Boat Basin	X			X	WA
Devils Bench	X	X		X	WA
Lower Monumental Dam	X	X			WA
Lyons Ferry Marina	X	X	X	X	WA
Lyons Ferry State Park	X	X		X	WA
Riparia Recreation Area	X			X	WA
Texas Rapids Recreation Area	X	X		X	WA
Ice Harbor					
Big Flat Recreation Area	X	X		X	WA
Charbonneau Recreation Area	X	X	X	X	WA
Fishhook Park	X	X		X	WA
Hollebeke Park	X				WA
Ice Harbor Dam Recreation Area	X	X			WA
Levey Park	X	X			WA
Lost Island	X				WA
Matthews Recreational Area	X	X		X	WA
Windust Park	X	X		X	WA
McNary					
Chiawana Park and Road 54 Park	X	X			WA
Columbia Park	X	X		X	WA
Hat Rock State Park	X	X			OR
Hood Park	X	X		X	WA
Howard Amon Park	X	X			WA
Hover Park	X				WA
Leslie R. Groves Park	X	X			WA
Locust Grove/Martindale	X				WA
Madame Dorion Memorial Park	X			X	WA
McNary Beach Park	X				OR
McNary Dam Visitor Center	X	X			OR/WA
McNary National Wildlife Refuge	X				WA
McNary Yacht Club		X	X		OR
Oregon Boat Launch	X	X			OR
Pacific Salmon Visitor Information Center	X				OR
Pasco Boat Basin	X	X	X		WA
Peninsula Habitat Management Unit	X				WA
Sacajawea State Park	X	X			WA
Sand Station	X			X	OR
Spillway Park	X				OR
Two Rivers Habitat Management Unit	X				WA
Two Rivers Park	X	X			WA
Walla Walla Yacht Club		X	X		WA
Wallula Habitat Management Unit	X				WA
Warehouse Beach	X				OR
Washington Boat Launch	X	X			WA
West Park	X				OR
Wye Park	X	X			WA
Source: www.nww.usace.army.mil/html/offices/op/rec/					

Recreational activities take place throughout year, with the highest activity levels during the fair-weather periods of late spring, summer, and early autumn. Due to the setting of recreational facilities, most recreation is related to the water resources presented by the Snake and Columbia Rivers. Boating, swimming, and fishing are common activities, as are camping and day-use activities such as picnicking, hiking, and wildlife observation. Water-dependent activities, such as fishing and boating, take place during the same months that dredging is planned (December through February), however at generally lower activity levels than in spring and summer months, although steelhead fishing activities are highest in the autumn months. Similarly, the riverfront parks in Lewiston are used year-round and could be potentially affected by the alternatives that include raising levees.

3.4.2 Facility Use/Visitation Patterns

As noted in section 3.4.1, recreational facilities in the study area are used for a variety of activities throughout the year. Table 3-2 summarizes annual visitation to all facilities within each reservoir. Visitation reflects both the number of facilities, recreational opportunities, and proximity to large groups of potential users. For instance, because of their proximity to the Tri-Cities (Richland, Pasco, and Kennewick, Washington) area and the number of facilities they offer, the McNary and Ice Harbor reservoirs' recreation facilities have significantly higher levels of visitation than those in the more remote Lower Monumental reservoir.

Regarding the riverfront parks in Clarkston and Lewiston that could be potentially affected by the alternatives including raising the levees, in Fiscal Year 1998 (FY 98) (October 1997 through September 1998) visitation patterns were as follows:

- Swallows Park in Clarkston: 682,200 visitor hours
- Lewiston Levee Park: 329,100 visitor hours
- Chief Looking Glass in Asotin: 69,800 visitor hours

These parks see heavy day use throughout the summer except on very hot days, when the usage is generally in the morning and late evening. Peak usage for all these areas is summer. Spring, fall, and winter receive light to moderate use that is generally weather-dependent (Wiedmeier, 1999). Lewiston Levee Park, for example, features a multi-use trail that runs along the levee, as well as picnic tables and other day use facilities. A levee raise could directly modify the west Lewiston levee.

Table 3-2. Recreation Facility Visitation Lower Snake River Reservoirs, FY 95 - FY 97

Reservoir	FY 95		FY 96		FY 97	
	Visitor Hrs	Visits	Visitor Hrs	Visits	Visitor Hrs	Visits
McNary	11,469,800	4,609,200	11,019,300	4,300,900	10,772,055	4,281,893
Ice Harbor	5,234,800	467,100	5,074,600	473,700	4,650,860	433,843
Lower Monumental	722,300	165,700	815,300	177,900	835,696	172,538
Little Goose	1,436,900	202,100	1,798,400	278,000	1,650,568	245,569
Lower Granite	2,319,800	861,500	3,010,800	1,033,500	3,082,700	1,047,094

Source: U.S. Army Corps of Engineers, Walla Walla District. McNary Visitation Report 1995 - 1997

3.5 CULTURAL RESOURCES

Cultural resources in the DMMP study area (lower Snake River and McNary reservoirs) are a rich source of information about prehistoric and historic human use and occupation of this area dating back over 10,000 years. Cultural resources can generally be placed into one of the following three categories: prehistoric, historic, and traditional cultural properties (TCP). The information provided in this section is primarily derived from the System Operational Review Final Environmental Impact Statement (SOR FEIS) (BPA et. al., 1995) and the current information collected in the development of the Lower Snake River Juvenile Salmon Migration FR/EIS. For further information see the Feasibility Study main report and Appendix N, Cultural Resources, as these documents are incorporated by reference.

3.5.1 Cultural Resource Definition

Cultural resources are the material remains of past human life or activities. They can consist of objects, buildings, structures, sites, or districts (a group of closely associated sites). For the DMMP study, the project area or Area of Potential Effect (APE) consists of the four Lower Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) and McNary Dams/reservoirs and associated project lands along with those areas affected by proposed dredging and disposal activities. Most of the cultural resources within the APE are prehistoric archaeological sites. Archaeological sites are typically open campsites, housepit villages, rockshelters, rock art (petroglyphs/pictographs), lithic (stone) quarries and workshops, burial grounds and cemeteries, and isolated rock cairns, pits, and alignments. Historic sites are also located in the APE and represent Euro-American activities. These include the remains of farms, towns, trading posts, mining sites, military forts, burial sites, abandoned settlements, and transportation and industrial facilities.

The third cultural resources category is TCP. A TCP is the beliefs, practices, lifeways, arts, crafts, and social institutions of any community that has been passed down through the generations, usually orally or through practice. It can be embodied in buildings, structures, sites, landscapes, and individual objects or groups of buildings, structures, or sites. A TCP often pertains to cultural sites, natural features, and resources important in traditional social and religious practices that tend to preserve cultural identity. It encompasses such things as distinctive shapes in the natural landscape, named features in local geography, natural habitats for important subsistence or medicinal plants, traditional usual and accustomed fisheries, sacred religious sites, and places of spiritual renewal.

While the preceding discussion provides one description of cultural resources, there are other views of what constitutes cultural resources. The academic and legal definitions tend to focus on tangible evidence such as sites and artifacts and for this study, the definition of cultural resources contained in Federal law and regulation will be followed. However, for Native American people, these definitions are too narrow. They view their entire heritage, including beliefs, traditions, customs, and spiritual relationship to the earth and natural resources, as sacred cultural resources. This broader definition/view of cultural resources by Native Americans is acknowledged and a sincere effort will be made to listen to and understand the Tribal position in this regard.

3.5.2 Cultural Resource Significance

Federal agencies' cultural resources responsibilities are defined in a series of laws and regulations that have been promulgated over the years. The most comprehensive and far reaching of these is the National Historic Preservation Act of 1966 (NHPA), as amended (16 U.S.C. 470). The NHPA, together with its implementing regulations (36 Code of Federal Regulations, Part 800), lays out a process for agencies to follow for historic properties on any proposed Federal undertaking. This process calls for an agency to identify the APE, identify if historic properties are present and, if so, assess their significance and identify and coordinate with interested parties. The significance or non-significance of an historic property is based on a set of defined criteria. If determined significant, an historic property is then eligible for listing in the National Register of Historic Places (NRHP). It is only significant historic properties that a Federal agency is required to address under the NHPA. Except under rare circumstances, an historic property must be at least 50 years old to be eligible for nomination to the NRHP. Under Section 106 of the NHPA, it states that a Federal agency shall take into account the effect of its undertakings on historic properties included in or eligible for inclusion in the NRHP. It also says that the agency shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on its undertaking. As part of its required Section 106 consultation/coordination process, the Corps also routinely works with appropriate State Historic Preservation Offices (SHPO), Native American Indian tribes, and other interested parties in managing historic properties found in the APE. (NOTE: The NHPA refers to cultural resources as *historic properties*. For purposes of this document and for other than this section (i.e., 3.5.2), the term cultural resources will be used.)

3.5.3 Culture History

Culture history describes the known sequence of cultural transformations from the end of the last ice age to the present. Because the DMMP APE covers several distinct cultural sequence areas, a broader culture history description is presented here that describes general trends across the Columbia River Basin that are applicable to the APE.

3.5.3.1 Prehistory

Paleoindian people lived more than 10,000 years before present (B.P.), during the rapidly warming terminal Pleistocene period. Where conditions were favorable, they exploited large mammals such as mammoth, mastodon, camel, and horse, which became extinct during or shortly after this period. Paleoindians also hunted Pleistocene forms of species such as bison, mountain sheep, and deer, which were larger than their modern descendants (Butler, 1986). Thrusting spears with large, fluted projectile points were the main weapon technology.

Early Period (6,000 to 10,000 years B.P.) sites can be identified by the presence of characteristic stone projectile point styles called Windust and Cascade (Leonhardy and Rice, 1970). Early Period social units (bands) may have inhabited very large territories at low density, traveling within them to exploit seasonally or locally abundant resources, the most important being large ungulates (Ames, 1988). Prehistoric people also exploited very favorable fishing sites but only seasonally during this period. Peak salmon runs made salmon harvest at these sites very efficient at certain limited times. Population density was relatively low during this period, and people relied on residential mobility rather than intensive food production and storage to overcome seasonal food scarcity.

The Middle Period (2,000 to 6,000 B.P.) was accompanied by a continental warming and drying trend that peaked sometime between 8,000 and 4,000 years ago (Aikens, 1993) and influenced the distribution of vegetation zones. The modern climatic pattern was established by approximately 4,000 years ago. At or near the beginning of this period, the atlatl, or spear thrower and dart, replaced the thrusting spear as the dominant weapon technology.

The Late Period begins about 2,000 years ago with the introduction of the bow and arrow, as indicated by small, stemmed projectile points (Aikens, 1993). Population densities continued to grow throughout the Late Period, fostering an intensification of food production that included the historically observed pattern of food storage, particularly of dried salmon, roots, and berries for winter consumption.

The seasonal economic cycle of the native inhabitants of the study area is well known. They lived in winter villages near major rivers or on the lower reaches of major tributaries, subsisting on food stores during the winter, supplemented by hunting and fishing. They inhabited large, multifamily lodges covered with tule mats.

In the early spring, people harvested Indian celeries (lomatiums and other species) and fished spawning runs of suckers in the major rivers. Later, they roamed upland further from the winter villages to collect bitterroot and lomatiums for long-term storage. In May, they took up posts on the main rivers at favorable fishing sites for the spring chinook runs. The runs peaked for a few days, then floods in late May made fishing much more difficult in the larger rivers. The people then headed for the mountains to escape the summer heat, to harvest and dry large quantities of huckleberries, and to hunt deer and other game.

As low summer flows in the rivers made fishing easier, the people returned to harvest the salmon runs that occurred between July and October. The most important of these was the fall chinook run in September, which produced large quantities of stores for winter food. Up to one-third of the people’s annual diet may have consisted of salmon. Food plants may have supplied an additional 50 percent of their annual food supply, with game and huckleberries supplying much of the remaining amount (Hunn, 1990).

3.5.3.2 Historic Period

European and American cultural influence began in the early 1700's when European trade items were transported into the Mid-Columbia and Snake River Basins. The first contact between Euro-Americans and Native Americans in the region occurred in 1805 with the arrival of the Lewis and Clark Corps of Discovery. The Lewis and Clark Corps of Discovery followed the course of the lower Snake River, traveling through the homelands of the Nez Perce, Palus, Cayuse, and Walla Walla tribes/bands (Coues, 1893). The Lewis and Clark expedition was followed by other expeditions that further explored the region and established trading operations.

Missionaries arrived in the 1830's, soon to be followed in the 1840's by increasing numbers of settlers coming west.

In 1855, treaties establishing area reservations were signed between the United States and many of the Plateau Culture Area tribes/bands. Gold was discovered in Idaho in the 1860's, leading to a rush of settlers into the area. Further settlement was based on extensive dryland wheat farming. This was the era of the steamboat. Between 1855 and 1880, conflicts arose between non-Native American settlers and local tribes, resulting in several wars. Tribes and bands were required to relinquish part of their homelands. Through treaty negotiations, many tribes and bands legally retained certain pre-existing rights that allow them to fish at usual and accustomed areas and to hunt, gather, and graze livestock on open and unclaimed lands.

The 1880's brought construction of railroads and continued settlement. The 1900's have seen the damming of the rivers, expansion of urban developed areas and agricultural lands, increased recreation, navigation of the rivers, the development of major irrigation projects, and continued growth in the region.

3.5.4 Existing Cultural Resources Environment

There are approximately 600 known archaeological sites within the APE, many of which are partially or completely inundated. The known sites are both prehistoric and historic and range in age from the earliest period of human occupation to recent times. Identified prehistoric sites include villages, fishing sites, burials, rock art (petroglyphs and pictographs), storage pits, and temporary camps. Historic sites include homesteads, mining sites, forts, towns, farmsteads, and trading posts.

Four archaeological districts (Tri-Cities, Lower Snake River, Windust Caves, and Palouse Canyon) and four sites (45FR5, 45FR50, 45FR272, and 10NP151) are listed in the NRHP. 45FR50 is also a designated National Historic Landmark. In addition to these NRHP sites and districts, two other sites have been determined NRHP eligible – 45FR283 and 45WT78/79. (NOTE: Cultural resources determined NRHP eligible are afforded the same level of consideration and protection as sites listed on the NRHP.) Many other cultural resources within the APE are potentially eligible for NRHP nomination, but have not been thoroughly evaluated or nominated.

In summary, the NRHP and NRHP eligible sites and districts in the APE include:

McNary Dam, Lake Wallula
Tri-Cities Archaeological District (listed)
Lower Snake River Archaeological District (listed)
45FR5 (listed)
45FR283 (determined eligible)

Ice Harbor Dam, Lake Sacajawea
Windust Cave Archaeological District (listed)
45FR272 (listed)

Lower Monumental Dam, Lake West
Palouse Canyon Archaeological District (listed)
45FR50 (listed, National Historic Landmark)

Little Goose Dam, Lake Bryan
No sites currently listed or determined eligible

Lower Granite Dam, Lower Granite Lake
10 NP 151 (listed)
45WT78/79 (determined eligible)

Most scientific information generated about cultural resources found in the APE is the result of archaeological studies associated with the construction of Federal dams in the study area. Comprehensive archaeological surveys have been done for all the reservoirs. Evaluation of recommended sites in McNary, Ice Harbor, and Little Goose reservoirs were completed by the end of 2001. Evaluation of recommended sites in Lower Monumental and Lower Granite reservoirs will be completed by the end of 2002.

3.6 SOCIOECONOMICS

The socioeconomic effects of implementing a long-term plan for maintaining the navigation channel in the lower Snake River and McNary reservoirs would be seen primarily within the communities along the river system that are, in some way, involved with commercial river navigation. Broader economic effects stem from the movement of commodities outside the study area. Levee raises and road modifications in the Lewiston/Asotin area would be expected to produce localized socioeconomic effects through the construction activities it would entail.

The socioeconomic factors of population, employment, income, and environmental justice communities for the study area are presented in the sections below.

3.6.1 Population

The populations of the counties in the planning study area are shown in table 3-3.

The estimated 1998 population of all the counties in the study is 405,995. This represents a 14.6 percent increase from the 1990 population, with only Garfield County, Washington, experiencing a small decrease in population. The study area is generally rural in nature with the Tri-Cities area, near the confluence of the Snake and Columbia Rivers, and the Lewiston-Clarkston area, near the confluence of the Clearwater and Snake Rivers, being the main population centers in the study area.

Study area counties have shown generally higher annual growth rates in the 1990's than in the 1980's or, in the case of some counties, lowered rates of population decline. In the 1980's, the region's growth rate lagged behind the overall growth rates of the states of Washington, Idaho, and Oregon (17.77 percent, 6.65 percent, and 7.95 percent, respectively), due in large part to the rapid growth of the more heavily populated urban areas in these states during the same time periods.

Table 3-3. Study Area Population by County.

County	State	Est. 1998 Population	1990 Population	1980 Population
Asotin	WA	21,264	17,605	16,823
Benton	WA	136,250	112,560	109,444
Columbia	WA	4,156	4,024	4,057
Franklin	WA	46,459	37,473	35,025
Garfield	WA	2,330	2,248	2,468
Nez Perce	ID	36,852	33,754	33,220
Umatilla	OR	65,495	59,249	58,861
Walla Walla	WA	53,702	48,439	47,435
Whitman	WA	39,487	38,775	40,103
Source: U.S. Department of Commerce, Bureau of the Census				

3.6.2 Employment and Income

Regional employment, as projected by the U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, is summarized in table 3-4.

Table 3-4. Study Area 1997 Employment by County.

County	State	Jobs By Sector	
		Non-Farm	Farm
Asotin	WA	7,028	232
Benton	WA	71,414	4,657
Columbia	WA	1,935	306
Franklin	WA	21,492	4,213
Garfield	WA	1,021	293
Nez Perce	ID	25,741	464
Umatilla	OR	31,751	3,156
Walla Walla	WA	27,543	2,590
Whitman	WA	19,367	1,590
Source: U.S. Department of Commerce, Bureau of Economic Analysis			

Within the study area, total county non-agricultural employment was highest in Benton County, Washington, which is the most populous and highly urbanized county in the study area. Correspondingly, non-agricultural employment totals were lowest in rural counties with low populations (Columbia and Garfield counties in Washington).

Table 3-5 presents income data for the study area counties. Per capita incomes in the study area counties are generally consistent with or higher than statewide per capita incomes for their respective states. Estimated income-based 1995 poverty rates within the study area counties range from a low of 8.7 percent in Benton County, Washington, to a high of 17.0 percent in Umatilla County, Oregon.

Table 3-5. Study Area Income by County.

County	State	1993 Per Capita Income
Asotin	WA	17,503
Benton	WA	21,037
Columbia	WA	23,017
Franklin	WA	17,234
Garfield	WA	22,495
Nez Perce	ID	18,834
Umatilla	OR	16,368
Walla Walla	WA	17,180
Whitman	WA	16,021
Source: U.S. Department of Commerce, Bureau of Economic Analysis		

3.6.3 Environmental Justice Communities

As outlined in Executive Order 12898, federal agencies must evaluate environmental justice (EJ) issues related to any project proposed for implementation. This evaluation includes identification of minority and low-income populations in the project area, identification of any negative project impacts that would disproportionately affect these low-income or minority groups, and proposed mitigation to offset the projected negative impacts.

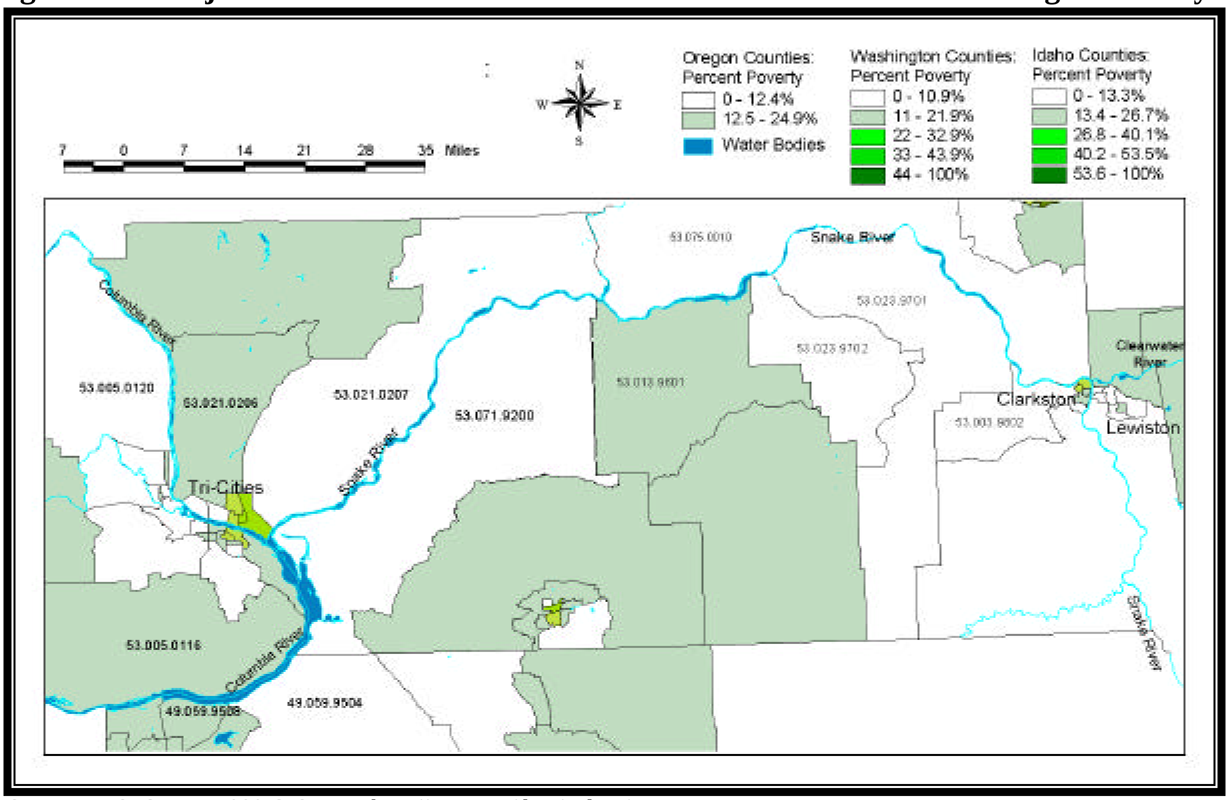
3.6.3.1 Geographic Identification of EJ Communities

The Project Area for the DMMP environmental justice analysis was defined as all the census tracts adjacent to the lower Snake River and McNary reservoir where the proposed project activities would occur. The most recent complete demographic data sets available were reviewed for this analysis. Data from the U.S. Bureau of Census 2000 decennial census on the racial demographics of each tract and Census 1990 data on the percent of inhabitants living in poverty for each tract were analyzed to determine the locations of communities sensitive to environmental justice issues. Poverty data from the 1990 Census were determined to be appropriate for this analysis due to the fact that county-wide poverty levels either dropped or stayed the same in the project area between 1990 and 1997 (American Factfinder 2002). Given the large area potentially affected by the DMMP alternatives, Census tract-level data were determined to be the appropriate level of data for review. Census tracts are geographic subdivisions of Counties, generally with between 1,000 and 8,000 people, with an optimum size of 4,000 people.

The percent minority inhabitants and percent of inhabitants living in poverty in each tract were compared to the state average for each tract's respective state. Tracts with above average percent minority or percent poverty were identified as locations with potential environmental justice populations.

As seen in figure 3-2, most of the land adjacent to the project area is below average in terms of the number of residents living in poverty. The exceptions are tract 9601 in Columbia County, WA, tracts 0201, 0204, and 0206 in Franklin County, WA, tracts 9803 and 9806 in Asotin County, WA, tracts 011001, 0113, 011501, and 0116 in Benton County, WA, tract 9508 in Umatilla County, OR, and tract 990398 in Nez Perce County, ID. The number of inhabitants living in poverty in each Census tract as of 1990 is shown in table 3-6.

Figure 3-2. Project Area 1990 Census Tract Data: Percent Inhabitants Living in Poverty



Source: U.S. Census 1990 GIS Data, http://esri.com/data/online/tiger

As shown in figure 3-3, the central and eastern regions of the project area are below average in terms of minority inhabitants. The tracts at the west end of the project area, however, are home to significant minority populations. Specifically, tracts 020100, 020400, 020502, 020601, 020602, and 020700 in Franklin County, WA, tracts 010901, 011600, and 012000 in Benton County, WA, tract 920000 in Walla Walla County, WA, and tract 950800 in Umatilla County, OR have populations composed of an above average percentage of minorities.

Table 3-6. Percent Poverty of Project Area Census Tracts 1990

Census Tract	County and State	Percent Poverty	State Average Percent Poverty	Above Average?
9802	Asotin, WA	10.5%	10.9%	no
9803	Asotin, WA	31.2%	10.9%	yes
9806	Asotin, WA	17.7%	10.9%	yes
0101	Benton, WA	2.4%	10.9%	no
0105	Benton, WA	9.7%	10.9%	no
0106	Benton, WA	10.3%	10.9%	no
010802	Benton, WA	2.4%	10.9%	no
010901	Benton, WA	10.3%	10.9%	no
011001	Benton, WA	11.4%	10.9%	yes
0113	Benton, WA	22.1%	10.9%	yes
011501	Benton, WA	14.3%	10.9%	yes
0116	Benton, WA	15.6%	10.9%	yes
0120	Benton, WA	0.0%	10.9%	no
9601	Columbia, WA	11.8%	10.9%	yes
0201	Franklin, WA	43.0%	10.9%	yes
0204	Franklin, WA	30.1%	10.9%	yes
020501	Franklin, WA	6.3%	10.9%	no
020502	Franklin, WA	5.4%	10.9%	no
0206	Franklin, WA	13.0%	10.9%	yes
0207	Franklin, WA	10.0%	10.9%	no
9701	Garfield, WA	9.9%	10.9%	no
9702	Garfield, WA	10.3%	10.9%	no
9903	Nez Perce, ID	23.7%	13.3%	yes
9904	Nez Perce, ID	12.5%	13.3%	no
9905	Nez Perce, ID	2.9%	13.3%	no
9907	Nez Perce, ID	11.4%	13.3%	no
9504	Umatilla, OR	8.8%	12.4%	no
9508	Umatilla, OR	18.6%	12.4%	yes
9200	Walla Walla, WA	6.8%	10.9%	no
0010	Whitman, WA	10.7%	10.9%	no

Source: U.S. Census 1990 GIS Data, http://esri.com/data/online/tiger

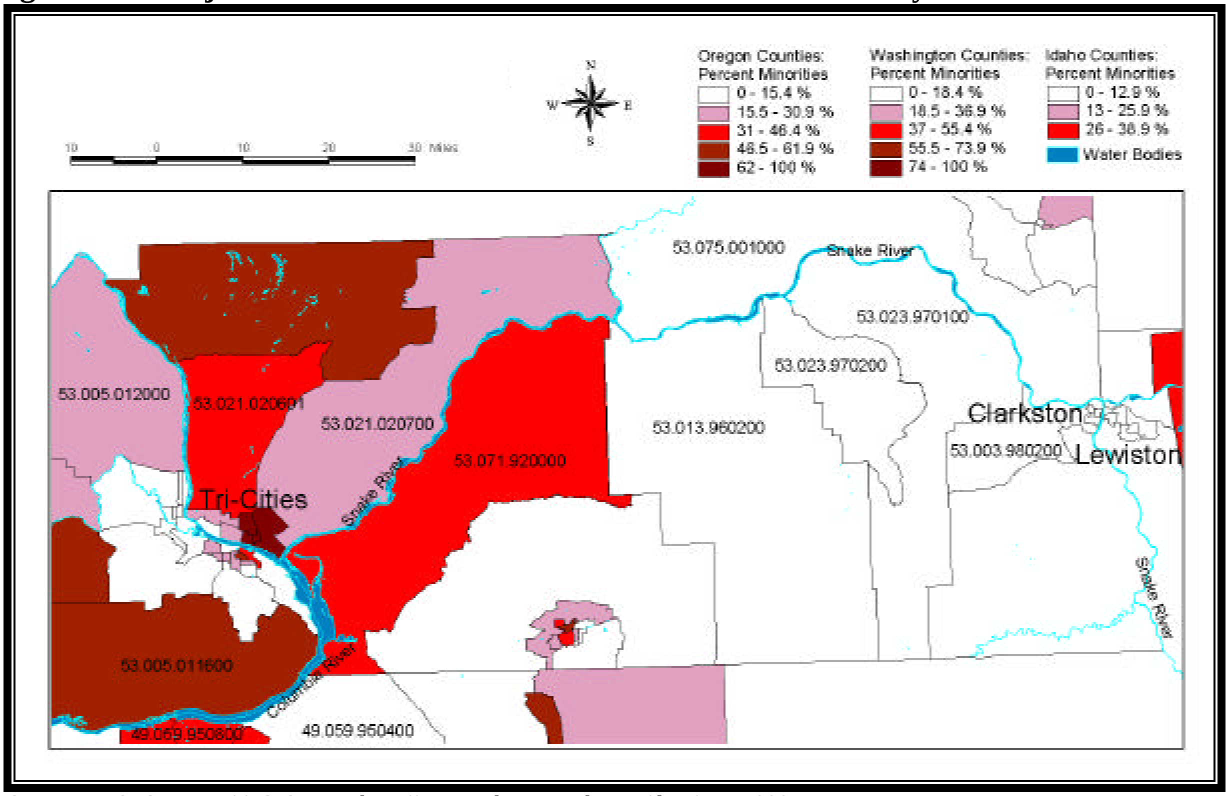
The percentage of minority inhabitants living in each project area census tract as of the year 2000 is shown in table 3-7.

3.6.3.2 Economic and Cultural Identification of EJ communities

The nature of the project requires discussion of other environmental justice communities that may be affected by the proposed project but which are not apparent from the geographic identification performed above. As described in the Lower Snake River Juvenile Salmon Migration Feasibility Study EIS (FR/EIS), these groups include Native American tribes that depend on the cultural and aquatic resources in the Snake River, and Hispanic farm workers whose jobs depend on the irrigation and freight transport systems supported by the Snake River.

The Corps' public involvement process is an important factor in assessing project impacts relative to environmental justice concerns. Section 6 of the DMMP/EIS describes the public involvement process, including specific consultations with Tribes in the region. Input received through the public involvement and tribal consultation processes have been considered in the analysis of environmental justice.

Figure 3-3. Project Area 2000 Census Tract Data: Percent Minority Inhabitants



Source: U.S. Census 200 GIS Data, http://geographynetwork.com/data/tiger2000

Table 3-7. Percent Minorities in Project Area Census Tracts 2000

Census Tract	County and State	Percent Minority	State Average Percent Minority	Above Average?
980200	Asotin, WA	1.7%	21.1%	No
980300	Asotin, WA	4.6%	21.1%	No
980600	Asotin, WA	3.6%	21.1%	No
012000	Benton, WA	36.1%	21.1%	Yes
010100	Benton, WA	8.4%	21.1%	No
010600	Benton, WA	10.3%	21.1%	No
010804	Benton, WA	11.8%	21.1%	No
010901	Benton, WA	22.1%	21.1%	Yes
011001	Benton, WA	17.8%	21.1%	No
011501	Benton, WA	13.4%	21.1%	No
011600	Benton, WA	61.6%	21.1%	Yes
960200	Columbia, WA	8.8%	21.1%	No
020700	Franklin, WA	25.1%	21.1%	Yes
020601	Franklin, WA	46.2%	21.1%	Yes
020602	Franklin, WA	28.1%	21.1%	Yes
020501	Franklin, WA	11.0%	21.1%	No
020502	Franklin, WA	29.3%	21.1%	Yes
020400	Franklin, WA	100.0%	21.1%	Yes
020100	Franklin, WA	100.0%	21.1%	Yes
970100	Garfield, WA	3.6%	21.1%	No
970200	Garfield, WA	3.3%	21.1%	No
990300	Nez Perce, ID	6.9%	12.0%	No
990400	Nez Perce, ID	4.2%	12.0%	No
990500	Nez Perce, ID	3.8%	12.0%	No
990700	Nez Perce, ID	2.7%	12.0%	No
950400	Umatilla, OR	12.7%	15.4%	No
950800	Umatilla, OR	43.6%	15.4%	Yes
920000	Walla Walla, WA	40.2%	21.1%	Yes
001000	Whitman, WA	2.7%	21.1%	No
Source: U.S. Census 200 GIS Data, http://geographynetwork.com/data/tiger2000				

3.7 TRANSPORTATION

The proposed navigation maintenance dredging on the Columbia and Snake Rivers and restoration of flow conveyance in the Lower Granite reservoir would maintain the integrity of the integrated barge, rail, and highway transportation system serving the study area. The proposal could result in limited short-term affects to barge, rail, and highway service in the area during the construction of various project features; however, the overall long-term impacts would be beneficial to transportation services in the area. This section describes the transportation network and provides the basis for assessing the impacts.

3.7.1 River Navigation

Navigation on the Columbia and Snake Rivers has historically provided an important route of access into and from the interior Columbia and Snake River basins. Commercial traffic operates on the Columbia River from its mouth through the Tri-Cities area in Washington. On the Snake River, commercial traffic uses the waterway from its confluence with the Columbia River at Pasco, Washington, to Lewiston, Idaho. The Federal government, through the Corps, operates and maintains the congressionally authorized navigation channels and locks throughout the navigable waterway of the Columbia and Snake Rivers.

The navigation channel, from the confluence of the Snake River with the Columbia River to Lewiston, is authorized to a depth of 14 feet (4.3 m) and a width of 250 feet (76.2 m). There are navigational locks at four dams on the lower Snake River: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The confluence of the Snake and Columbia Rivers is in the McNary reservoir. A comprehensive inventory of port facilities on the Columbia and Snake Rivers above McNary is presented table 3-8.

Port facilities at Clarkston and Lewiston have histories of siltation, which occurs because of the changes in river flow as the Snake River and Clearwater River enter the reservoir formed behind Lower Granite. River current velocity decreases as it enters the reservoir, dropping large amounts of sediment. Maintaining water depths has been most critical on the south side of the river at Clarkston and, to a lesser extent, at Lewiston. Facilities on the north bank downstream of the Clearwater-Snake Rivers confluence have reported few problems.

On the McNary reservoir, eddies and other conditions cause marginal water depths at some facilities, especially downstream of Clover Island. These depths have continued to cause docking problems for grain and short-term storage elevators in the Tri-Cities area. Other facilities with marginal water conditions present are located at Burbank and Wallula.

The Columbia and Snake Rivers waterway serves an enormous area that covers much of the western United States. Agriculture dominates the regional industries associated with waterborne commerce. Trade revolves around grains (primarily wheat, alfalfa, corn, grass seed, fruits, and vegetables) with wheat being the largest export item. Other regional industries that use water transportation include aluminum, pulp and paper, petroleum, logs, lumber, and beef. Products shipped on the shallow draft channel are comprised mainly of wheat, grain, wood products, logs, petroleum, chemicals, and other agricultural products. Containerized commodities are also transported via the waterway. Containers are typically loaded at Lewiston and Pasco with approximately 97 percent of these shipments destined for Portland and the remainder going to Vancouver, Washington. Petroleum and fertilizer products have historically made up the bulk of upriver barge shipments on the waterway (Corps, 1995). The forecast of barge shipments over the Columbia and Snake Rivers waterway above McNary is presented in table 3-9. Typically, a "barge shipment" is comprised of one four-barge raft and a tow, which can transport 14,000 tons (12 709.2 metric tons) of grain or other bulk commodities.

Table 3-8. Inventory of Commercial Facilities on the Columbia and Snake River Reservoirs Above McNary Dam

Facility Name	River Mile	Owner	Use
Lower Granite Reservoir			
Tidewater Terminal Co.	135.5	Tidewater Terminal Co.	Containers, petroleum products, liquid fertilizer, and salt
Port of Whitman County, Site H Wharf	135.6	Port Whitman County	Logs and general cargo
Potlatch Corp Dock	135.7	Potlatch Corp	Ship wood chips
Mountain Fir Lumber Co., Wilma Dock	136.0	Longview Fibre Co.	Ship wood chips
Stegner Grain Terminal Dock	136.5	Port of Whitman County	Grain shipment
Port of Whitman County Docks	137.0	Port of Whitman County	Logs, general cargo
Port of Clarkston Dock	137.8	Port of Clarkston	Containers, logs, heavy lift
Clarkston Grain Terminal Dock	138.4	United Grain Corp	Grain shipment
Mountain Fir Lumber Co. Lewiston Div Dock (Clearwater River)	0.5	Longview Fibre Co.	Ship wood chips and hog fuel
Port of Lewiston Container Terminal	1.1	Port of Lewiston	Containers, cargo, lumber, paper
Continental Grain Co., Lewiston Dock	1.3	Continental Grain Co.	Grain shipment
Lewis-Clark Terminal Association Dock	1.4	Lewis-Clark Terminal Association, Inc.	Grain shipment
Little Goose Reservoir			
Pomeroy Grain Growers Dock	83.0	Port of Garfield	Grain shipment
Columbia County Grain Growers	83.5	Port of Whitman County	Grain shipment
Central Ferry Elevator			
Central Ferry Terminal	83.7	Central Ferry Terminal Association	Grain shipment
McGregor Terminal	N/A	McGregor Company	Ammonia shipment
Almota Elevator Co. Dock	103.6	Almota Elevator Co.	Grain shipment
Port of Altoma Dock, S&R Grain	103.7	Port of Whitman	Grain, receive liquid fertilizer
McNary Reservoir			
Port of Umatilla Cargo Dock	292.5	Port of Umatilla	Containers, wood chips, heavy lift
Pendleton Grain Growers	292.7	Pendleton Grain Growers	Grain shipment
Tidewater Barge Lines	292.8	Tidewater Barge Lines	Petroleum products, liquid fertilizer, fueling vehicles
Walla Walla Grain Growers	311.6	Walla Walla Grain Growers	Grain Shipment
Port of Walla Walla at Boise Cascade Wallula Plant	314.5	Port of Walla Walla.	Wood pulp shipment
Phillips Pacific Chemical Co.	321.6	Phillips Pacific Chemical Co.	Shipment of liquid fertilizer
Chevron Chemical Co.	322.6	Chevron Chemical Co.	Not used
Unocal Chemicals	323.6	Unocal Chemicals Division	Ammonia and urea
Northern Pacific Grain Growers	328.0	Northern Pacific Grain Growers	Grain shipment
Port of Benton/Barge Slip	343.1	Port of Benton	Cargo, heavy lift
Port of Benton	342.7	Port of Benton	General cargo
Port of Pasco Marine Terminal	328.2	Port of Pasco	Grain, receive petroleum products

Table 3-8. Inventory of Commercial Facilities on the Columbia and Snake River Reservoirs Above McNary Dam (continued).

Facility Name	River Mile	Owner	Use
Pasco Container Terminal/Barge Slip	326.8	Port of Pasco	Container, heavy lift, barges
Port of Walla Walla Dock	1.7	Port of Walla Walla	Not used
Connell Grain Growers	1.8	Port of Walla Walla	Grain shipments
Cargill Burbank Grain Elevator Dock	2.0	Port of Walla Walla	Grain shipments
Chevron Pipe Line Co, East Pasco Terminal	2.2	Chevron USA, Inc.	Petroleum products
Tidewater Terminal Co. Mooring Docks	2.7	Tidewater Terminal Co.	Mooring vessels, handling supplies
Tidewater Terminal Co.	2.9	Tidewater Terminal Co.	Petroleum products
Tidewater Terminal Co. Molasses Dock	3.0	Tidewater Terminal Co.	Molasses, liquid fertilizer
Ice Harbor Reservoir			
Walla Walla Grain Growers, Shefler Dock	29.0	Walla Walla Grain Growers	Grain shipment
Louis Dreyfus Windust Station Dock	38.5	Louis Dreyfus Corp.	Grain shipment
Lower Monumental Reservoir			
Columbia County Grain Growers Lyons Ferry Dock	61.1	Columbia County Grain Growers, Inc.	Grain shipment
Source: Columbia River System Operation Review FEIS, November 1995.			

3.7.2 Railroads

Washington, Oregon, Idaho, and Montana are served by the Burlington Northern and Santa Fe Railroad (BNSF), the Union Pacific Railroad (UPRR), and several short-line operations. Among the latter, the Camas Prairie Railroad serves Idaho and Washington, the Blue Mountain Railroad serves Washington, and the Montana Rail Link serves Idaho and Montana.

In Washington, the BNSF and UPRR have an agreement to jointly manage the main line track from Seattle to Portland. From Vancouver, Washington, the BNSF line runs along the northern side of the Columbia River through the Tri-Cities to Spokane. It continues north to Sandpoint, Idaho, then runs southeast to Missoula, Montana, and on into the Midwest. The BNSF has crossings into Oregon at Portland, Wishram, and Wallula. The UPRR runs along the southern side of the Columbia River from Portland to Hinkle, Oregon, then runs south to Boise and on into the Midwest. Both the BNSF and the UPRR provide extensive trackage in all four states.

The Camas Prairie Railroad is a joint venture operated cooperatively by the BNSF and UPRR. Camas Prairie tracks connect Revling and Kamiah in Idaho through Lewiston to Riparia on Lower Monumental reservoir in Washington. The Camas Prairie tracks cross the Clearwater River near the west Lewiston levee and run down the lower Snake River canyon along the north shore of Lower Granite, Little Goose, and Lower Monumental reservoirs. Montana Rail Link provides service from Sandpoint, Idaho, to Garrison, Montana. (Corps, 1992)

Table 3-9. Projected Commodity Growth for Shipments Above McNary (1,000 tons).

	1996	2000	2004	2010	2014	2020	2024	2030	2040	2050	2060	2070	2074
Wheat and Barley	4,363	4,641	5,038	5,036	5,035	5,289	5,458	6,092	6,092	6,092	6,092	6,092	6,092
Other Food and Farm	91	104	104	104	104	104	104	104	104	104	104	104	104
Petroleum	1,709	1,569	1,569	1,569	1,569	1,569	1,569	1,569	1,569	1,569	1,569	1,569	1,569
All Others	7	2	2	2	2	2	2	2	2	2	2	2	2
Empty Containers	16	16	16	16	16	16	16	16	16	16	16	16	16
Metals	6	4	4	4	4	4	4	4	4	4	4	4	4
Chemicals	199	241	262	262	262	275	284	317	317	317	317	317	317
Wood Products	28	69	69	69	69	69	69	69	69	69	69	69	69
Wood Chips and Logs	528	581	581	581	581	581	581	581	581	581	581	581	581
TOTAL	6,947	7,228	7,646	7,644	7,643	7,910	8,088	8,755	8,755	8,755	8,755	8,755	8,755
Source: Corps, 1995													

3.7.3 Highway/Roadway

The highway network serving the study area includes interstate, Federal, state, and county highways. Table 3-10 lists the key highways and roadways in the study area.

Table 3-10. Key Highways and Roadways.

Highway/Roadway	Segment/Location
Primary Highways	
Interstate 84	U.S. 97 (Biggs) to Pendleton
Interstate 82	I-84 to U.S. 395 (Pasco)
U.S. 395/730	I-84 to U.S. 12
U.S. 12	U.S. 395 (Pasco, WA) to Lewis Co., ID
U.S. 95	Lewis and Adams Co., ID
OR 11	I-84 to WA State Line
WA 14	U.S. 97 (Maryhill) to I-82 (Plymouth)
WA 124	U.S. 12 (near Pasco) to U.S. 12 (Waitsburg)
WA 125	WA 125 to OR State Line
WA 193	U.S. 12 to Port of Wilma
Secondary Highways	
U.S. 395	U.S. 12 (Pasco) to WA 260 (near Mesa)
WA 260	U.S. 395 to WA 261
WA 261	WA 260 to U.S. 12
WA 127	U.S. 12 to Central Ferry
WA 129	U.S. 12 to OR State Line
Alternate Routes North from the Snake River	
U.S. 195	U.S. 12 to WA 26
WA 26	U.S. 195 to U.S. 395
WA 260	WA 261 to WA 26
Source: Columbia River Flow Measures Options Analysis/EIS, January 1992.	

Roads that have the greatest potential to be impacted by the proposed levee raise alternatives in the Lewiston, Idaho, and Asotin and Clarkston, Washington, areas are:

- U.S. Highway 12 as it parallels the Snake River below the mouth of the Clearwater River.
- Whitman County Road 900 north of the Snake River below the mouth of the Clearwater River.
- Washington Highway 129 between Clarkston and Asotin.
- Snake River Road upstream of Asotin.
- Snake River Avenue on the east bank of the Snake River upstream from the mouth of the Clearwater River.

The higher proposed levee raise alternative would impact the greatest number of roads within the Lewiston/Clarkston area and require more significant modifications. Conversely, the lower proposed levee raise alternative would have a limited impact to a small number of roads in the area. See appendix E for details.

3.8 GEOLOGY AND SOILS

Existing Environment

The Clearwater and Snake Rivers drain portions of southeastern Washington and southwestern Idaho. The Snake River, in turn, drains to the Columbia River. The Columbia's watershed includes eastern and central Washington, north-central Oregon, and portions of Idaho and the Canadian provinces of British Columbia and Alberta. The physiographic provinces within the area of consideration include the Columbia Basalt Plain, the Rocky Mountains, and the Blue Mountains (Baker et al., 1987; Galster et al., 1989). The Clearwater River originates in Idaho and flows west through the Columbia Basalt Plain where it is joined by the Snake River. The lower Snake River flows north along the eastern margin of the Blue Mountains, then turns west as it flows through the Columbia Basalt Plain. Along much of the Columbia Basalt Plain and the Blue Mountains, these two rivers flow within canyons that are several hundred to over 2,000 feet (610 m) deep.

The bedrock geology of the Columbia Basalt Plain consists primarily of thick successions of basaltic lavas. Numerous basaltic formations are distinguished within these lavas, and they are generally known as the Columbia River Basalt Group (CRBG) (Galster and Sager, 1989). The original extrusion of these basalts blocked rivers and impounded lakes. Therefore, several areas have fluvial and lacustrine sedimentary rock intercalcated between the basalt flows. The Blue Mountains have a core of volcanic and sedimentary rocks. To the north, these core rocks are covered by the CRBG, which, in turn, has been upwarped slightly by the Blue Mountains. To the east, the Snake River flows along the flank of the Blue Mountains where the CRBG does not obscure the underlying rocks.

During the Quaternary period (2 million years ago to present), repeated advances of the Lake Pend Oreille lobe of the Cordilleran ice sheet dammed the Clark Fork River and impounded glacial Lake Missoula. This lake released catastrophic floods numerous times during the late Pleistocene Epoch (1.7 to 2 million years ago), scouring much of the surface of the Columbia Basalt Plain. In the vicinity of Grand Coulee Dam, another glacier lobe dammed the Columbia River creating glacial Lake Columbia (Hansen, 1989). The glacial Lake Missoula floods entered and overtopped this lake. A similar flood emerged from pluvial Lake Bonneville (now Great Salt Lake) and flowed down the Snake River (Malde, 1968).

These floods eroded the river valleys and produced large deposits of river sediments (Baker et al., 1987). These river deposits occur as scattered terraces along the river valleys. The flood erosion also produced steep slopes that have undergone some retreat, producing steep, coarse-grain talus slopes along the bedrock cliffs. Post-glacial river incision has reworked some of the older river deposits producing lower elevation and younger alluvial terraces that are scattered along the rivers. Since impoundment, some smaller rivers have deposited alluvial fans where they enter the reservoirs; others are completely drowned, forming small embayments. All the Pleistocene and contemporary river and alluvial fan deposits consist of gravels and sands with minor amounts of silt and clay. The proposed upland disposal site at Joso has historically been used for sand and gravel mining.

During the Pleistocene and into the post-glacial period, winds eroded exposed fine-grain sediments. These silt-size sediments, known as loess, have been deposited over large areas. These deposits are most common on the upland surfaces of the Columbia Basalt Plain in a region known as the Palouse (Busacca et al., 1985). These materials occur only to a minor extent around the perimeter of the region's reservoirs. At Ice Harbor, there is a large wind-derived sand deposit (Miklancic, 1989a), and small areas of sand dunes exist along some reservoirs.

Sedimentation within the reservoirs is dominated by river influx and wave-eroded materials. The heavier sediments (gravels and sands) can no longer be transported beyond the length of each reservoir. Lighter sediments (silts and clays) move through spillways, fishways, and powerhouses. River erosion is concentrated within a narrow band between high- and low-reservoir levels along the upper reservoir shorelines. Based on historic dredging within the study area, it is estimated that the river sediments that may be dredged are approximately 85 percent sand, gravel, and cobbles, and approximately 15 percent silts.

The Joso site, a potential upland disposal site, includes soils from the following soil groups: Basalt Rock, Magallon, and Quincy Fine Sand. The Joso site includes a thin strip of Basalt Rock formations located along the shoreline of the Snake River. Along this area, basalt rock cover is exposed 25 to 90 percent and slopes range from 30 to 60 percent. The soil between exposures ranges in thickness from a few inches to 1 foot (a few centimeters to 30.5 cm). The area contains numerous loose, angular, basalt stones and cobbles. The inner portion of the Joso site contains large areas of Magallon soils. These areas are described as very rocky, very fine sandy loam with 0 to 30 percent slope. The areas are well drained and somewhat excessively drained soils that have developed from alluvium over glacial outwash. The areas have low shrink-swell potential. Both soil groups have a low to medium potential for erosion, but erosion is minimal as long as there is vegetative cover.

3.9 WATER QUALITY/WATER RESOURCES

This section describes the existing water quality, wetland, and floodplain conditions of the affected environment. Significant human-caused changes have occurred to some water quality, wetland, and floodplain parameters over the past century in the Clearwater, Snake, and Columbia River systems. These changes range from a shift in temperature characteristics to introduction of nutrients and exotic radionuclides (IDHW, 1982; Pruter and Alverson, 1972; Vigg and Watkins, 1991). Other impacts include inundation of existing wetland and river delta areas and the subsequent redevelopment of these resources at the new reservoir levels.

Because of the distinctive nature of their general water quality, each of these river systems is discussed separately following the discussion of water quality criteria. The primary emphasis is on the key water quality parameters of turbidity, dissolved oxygen, temperature, pH, and chemicals of concern. Chemicals of concern are substances such as metals, organometallic and organic compounds, chlorinated hydrocarbons, phthalates, phenols, and pesticides that, based on their concentrations, may pose a potential risk to human or ecological health in the aquatic environment. Special emphasis was placed on examination of sediment nutrient loads and their effects to the water column if re-suspended. Of particular interest is the deleterious effect from elutriated ammonia to be detailed in subsequent paragraphs of this section. Reviews of existing water quality and sediment data and previous environmental documentation were used to assess the affected environment and project environmental effects as they relate to water quality and water resources. For some chemicals of concern, such as metals, limited water quality data were available; these limitations are acknowledged in this discussion. Written summaries of recent water quality and tabular summaries of recent sediment quality data are provided in appendix H, Water Quality/Water Resources. Summary tables of the historical water and sediment quality data for the proposed dredging and disposal sites are included in appendix H. See also the Feasibility Study, Appendix C as that information is incorporated by reference.

Since there are no uniform freshwater sediment quality criteria that provide a definitive numerical standard for evaluation of dredged material, the Corps is developing a Mid-Columbia and Lower Snake River Region Sediment Testing Framework. In the interim, the Dredged Material Evaluation Framework: Lower Columbia River Management Area will be used by the Corps to evaluate the potential water quality impacts of dredging and dredged material management and the suitability of dredged material for in-water disposal. The specific procedures in the Lower Columbia Framework will be used and evaluated for their applicability for adoption as part of the Mid-Columbia and Lower Snake River framework.

3.9.1 Water Quality Criteria and Standards

The EPA and the states of Idaho, Oregon, and Washington have established surface water criteria or standards for the Snake and Columbia River Basins. Relevant references include the EPA National Quality Criteria for Water or "Gold Book" criteria (EPA, 1986), Washington Water Quality Criteria, the 1999 Update of Ambient Water Quality Criteria for Ammonia (EPA, 1999), Water Quality Standards And Wastewater Treatment Requirements: Idaho Administrative Procedures Act (IDAPA) 58.01.02, and Oregon Water Quality Criteria. Water quality standards for Oregon, Idaho, and Washington are summarized in table 3-11.

All three states have established a policy of antidegradation and beneficial uses for their surface waters, which precludes the discharge or introduction of toxic or hazardous materials (e.g., the EPA's 126 priority pollutants) or deleterious contaminants. Since the codes, rules, and regulations for these state standards are voluminous, only highlights of the standards are presented in this document--specifically, turbidity, dissolved oxygen, temperature, and pH are discussed below in sections 3.9.1.2 through 3.9.1.6. Specific water quality conditions in the lower Snake, Clearwater, and Columbia Rivers are presented in sections 3.9.1.8 through 3.9.1.10.

3.9.1.1 Beneficial Use Criteria

In Idaho, beneficial use is defined as domestic water supply (DWS), industrial water supply, and agricultural water supply; cold-water and warm-water biota; salmonid spawning; primary and secondary contact recreation; wildlife habitats; and aesthetics. All except warm-water biota have been designated as beneficial uses for this portion of the Clearwater River, and the Snake River downstream of Brownlee reservoir.

Table 3-11. Water Quality Standards in Oregon, Idaho, and Washington

Parameters	Oregon	Idaho	Washington
Temperature	= 68 °F (20 °C): No increase, single source = 67 °F (19.7 °C): Increase < 0.5 °F (0.28 °C), single source < 66 °F (19 °C): Increase < 2 °F (1.1 °C), all sources	Maximum instantaneous temp: 72 °F (22 °C) [1] Daily average: < 66 °F (19 °C) Maximum instantaneous temp: 55 °F (13 °C) [2] Daily average: < 48 °F (9 °C)	Temp: = 68 °F (20 °C) Temp: < 34 (T [1] + 9) °C
Dissolved Oxygen	= 90 percent saturation	= 6.0 mg/L, 30-day mean = 4.7 mg/L, 7-day mean = 3.5 mg/L L, minimum = 6.0 mg/L or 90 percent saturation (salmonids spawning)	= 8 mg/L
Total Dissolved Gas	= 110 percent saturation [4 6]	= 110 percent	< 110 percent [4] < 120 percent, during salmon migration [6]
	= 105 percent saturation [5]		
Turbidity	= 10 percent increase	= 5 nephelometric turbidity unit (NTU) increase [7] < 10 NTU increase [8] < 50 NTU [9] < 10 NTU [10]	= 5 NTU increase [7] < 10 NTU increase [8]
pH	6.5 - 8.5	6.5 – 9.0	6.5 - 8.5
Fecal coliform	100 organisms/100 mL [11]	100 organisms/100 mL [11]	100 organisms/100 mL [11]

1/ Standards for the Snake River; Clearwater River confluence (RM 139) to Asotin, WA (RM 147).
2/ Standards for the Clearwater River; mouth (RM 0) to Potlatch River confluence (RM 15). This reach is designated as a "Special Resource Water."
3/ T = Background Temperature.
4/ Except when stream flow exceeds 10-year, 7-day average flood frequency.
5/ In hatchery-receiving waters and when depth is < 2 feet (0.6 m).
6/ Waivers to 120 percent in tailrace and 115 percent in forebay of downstream dam, with 125 percent maximum for 1 to 2 hours during voluntary spills.
7/ If background is ≤ 50 NTU.
8/ If background instantaneous measure is > 50 NTU.
9/ Instantaneous, outside mixing zone.
10/ 10 Consecutive days.
11/ Geometric Mean.

Source: Developed by Normandeau/Corps

Idaho regulations also contain criteria to establish Special Resource Waters. The criteria for Special Resource Waters are:

a. Water of outstanding high quality, exceeding criteria for primary contact recreation and cold-water biota;

b. The water possesses an outstanding aesthetic and recreation quality;

c. Intensive protection the water is of paramount interest to the people of Idaho;

d. The water is of unique ecological significance;

e. Intensive protection of the water is necessary to maintain an existing, but jeopardized use;

f. And, the water is part of a natural Scenic River, national park, state park, or of major importance to the same.

g. The Feasibility Study's water quality evaluation is incorporated by reference.

The State of Washington has a four-level water quality classification system that ranges from AA (extraordinary) to C (fair). The State of Washington has classified the Columbia River from Grand Coulee Dam downstream to the Pacific Ocean, and the Snake River as Class A (excellent). Beneficial uses are water supply (domestic, industrial, agricultural); stock watering; fish and shellfish rearing, spawning, and harvesting; wildlife habitat; recreation (primary contact); and commerce and navigation (WAC Chapter 173-201A, 11/18/97).

Oregon defines the study area portions of the Columbia River as beneficial for public and private domestic supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, hydropower, and commercial navigation and transport (Oregon State Water Quality Standards as of November 2001).

3.9.1.2 Turbidity

Idaho and Washington specify that turbidity shall neither exceed 5 nephelometric turbidity units (NTU's) over background levels when the background level is 50 NTU's or less nor have more than a 10 percent increase when background is more than 50 NTU's. In Idaho, this applies to small public water intakes and the increase is not to exceed 25 NTU's. For protection of aquatic life, Idaho Department of Environmental Quality (Idaho DEQ) specifies that instantaneous turbidity increases shall not be greater than 50 NTU's above background or greater than 25 NTU's above background for more than 10 consecutive days. Oregon Department of Environmental Quality (Oregon DEQ) simply specifies the 10 percent increase criterion (BNA, 1991).

3.9.1.3 Dissolved Oxygen

Dissolved oxygen standards vary for each state. Idaho DEQ has specific criteria below existing dams. From June 15 to October 15, these criteria are set at 6.0 parts per million (ppm) [6.0 milligrams per liter (mg/L)] (30-day mean), 4.7 ppm (4.7 mg/L) (7-day mean minimum), 3.5 ppm (3.5 mg/L) (instantaneous minimum), and 6 ppm (6 mg/L) or 90 percent of saturation (whichever is greater) for salmonid spawning uses. Oregon DEQ specifies for cool-water aquatic life that dissolved oxygen concentrations shall not fall below 6.5 ppm (6.5 mg/L) as a minimum monthly mean or 5.0 ppm (5.0 mg/L) as a 7-day minimum mean, and shall not fall below 4.0 ppm (4.0 mg/L) at any time. For Washington Class A waters, dissolved oxygen concentrations shall exceed 8.0 ppm (8.0 mg/L). Washington Department of Ecology has listed the lower Snake River impaired by low dissolved oxygen under the provisions and pursuant to Section 303(d) of the Clean Water Act.

3.9.1.4 Temperature

Each state has different thermal criteria. Idaho DEQ specifies the criteria in relation to specific use categories. Idaho DEQ’s maximum instantaneous temperature standard for the Snake and Clearwater rivers is 72 °F (22 °C). The most restrictive use criterion is for salmonid spawning, with maximum water temperatures set at 55 °F (13 °C) with daily averages no greater than 48.2 °F (9 °C) for the Clearwater River from RM 0 - RM 15.

Oregon DEQ set their temperature standard for the Columbia River in 1994. The current standard allows no water temperature increases in the Columbia River, outside of an assigned mixing zone, when the stream water temperature is at or above 68 °F (20 °C). When the river is 67.5 °F (19.7 °C) or less, the Oregon state standard dictates that no more than a 0.5 °F (0.28 °C) increase is allowed due to a single-source discharge. No more than a 2 °F (1.1 °C) increase is allowed by all sources when the stream is 66 °F (19 °C) or less.

In Washington State, for most Class A waters, no increase over 64 °F (18 °C) due to human activity is allowed. However, for specific Class A water classifications such as the lower Columbia and Snake Rivers, higher temperatures of 68 °F (20 °C) are allowed. In the lower Columbia River and the Snake River above the confluence with the Clearwater River (RM 139.3), no increase over 0.54 F (0.3 °C) caused by human activity can occur from a single source, or no increases over 2 °F (1.1 °C) from all activities when the stream is over 68 °F (20 °C). In the Snake River below the confluence with the Clearwater River, the 2 °F (1.1 °C) restriction is dropped in favor of no temperature increase exceeding t = 34/(T+9) °C where t = change in temperature and T = background temperature.

3.9.1.5 Total Maximum Daily Loads

Region 10 EPA will develop total maximum daily loads (TMDLs) for thermal loading for the Pacific Northwest (Oregon, Washington, and Idaho). The TMDLs will be completed in 2002 according to the planned schedule. The EPA has the lead on this regional project due to the scope of the work, size of the basin, and the tremendous technical resources needed to complete the tasks. The Tribes, States, and Canada will be in consultation with the EPA and will be cooperating agencies in the effort to complete this task on schedule.

3.9.1.6 pH

Standards for pH vary among states, use classifications, and river system reaches. The Washington state standard pH levels range between 6.5 and 8.5 pH, which are the pH units required for the protection of aquatic life and beneficial/domestic use. Oregon state standard pH levels range between 7.0 and 8.5 for Columbia RMs 247 through 309. Umatilla and Walla Walla Basin streams range from 6.5 to 9.0.

The water quality criteria presented in this document were compiled from the following sources:

- National Recommended Water Quality Criteria (EPA, 1998b)
- 1999 Update of Ambient Water Quality Criteria for Ammonia (EPA, 1999)
- Oregon Water Quality Criteria (ODEQ, 1998)
- Washington State Water Quality Standards for Surface Waters (Ecology, 1997b)
- Quality Criteria for Water (EPA, 1986)
- United Nations Agricultural Water Quality Goals (NAS and NAE, 1972)

3.9.1.7 Background

Water quality conditions in the lower Snake, Clearwater, and Columbia River are presented in the following sections. Detailed data for the proposed dredging and disposal locations are presented in appendix H.

For future water quality sampling and analysis associated with the proposed dredging and dredged material disposal, the Corps plans to analyze for the parameters summarized in table 3-12 at a minimum. The tests and analysis methods used would be reevaluated after completion of the Mid-Columbia and Lower Snake Region Sediment Testing Framework. Some additional water quality analysis for organic chemicals may be recommended by the Testing Framework as it develops.

3.9.1.8 Lower Snake River Water Quality

Within the study area, the water quality of the Snake River varies depending upon the location. A Corps study (Corps, 1999) recorded water quality data for 12 sampling stations along the lower Snake River, 1 sampling station along the Clearwater River near Lewiston, and 2 sampling stations on the Columbia River between McNary Dam and the confluence of the Snake and Columbia Rivers.

Table 3-12. Test Description and Method.

Test Description	Test Method
Metals in water by ICP (Parameters are sampled as directed by the current of the Regional Testing Framework for the NWW management units	EPA 6020
Calcium and Magnesium by ICP	EPA 6020
Hardness by Titration	EPA 130.2
Ammonia Nitrogen	EPA 350.1
Nitrate/Nitrite Nitrogen	EPA 353.2
Total Nitrogen TN	EPA 350.1
Total Phosphorus	EPA 365.4
Sulfate	EPA 375.2
Chloride	EPA 9251
Fluoride	EPA 340.3
Silica	EPA 370.1
Sodium and Potassium	EPA 7010
TVS	EPA 160.1
Orthophosphate	EPA 365.4
Source: U.S. Army Corps of Engineers, Walla Walla District	

3.9.1.8.1 Turbidity

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted through the water sample. Turbidity in water is caused by a colloidal or suspended matter composition of very fine organic and inorganic matter, clays, microorganisms, and plankton. The standard unit of measurement is the nephelometric turbidity unit (NTU), which references the type of instrument calibrated to measure the property. Correlation of turbidity with total suspended solids (TSS) is problematic due to differences in size, shape, and refractive indexes affecting the light scattering of a suspension. The cause and effect relationship to the aquatic environment is directly related to suspended matter blocking light. Although turbidity is not directly related to the amount of TSS, it can be used as an index of the amount of TSS in the water column (i.e., the higher the turbidity, the greater the amount of TSS).

Turbidity is often confused with the particle mass density measurement TSS. Suspended particle or sediment load is composed of fine particles consisting primarily of inorganic materials of sufficient size and mass to settle quickly when kinetic energy (flow) decreases enough for the mass of the particle to fall out of suspension. The literature suggests there are direct correlations between suspended sediment load and fish feeding. Lloyd (1985) lists several studies spanning three decades where increased sediment load results in decreases of salmonid feeding. Noggle (1978) looked at the physiological effects to gill tissue in salmon exposed to high loads of suspended sediment. Most of the conclusions were that the fish only had damaged gills when extreme quantities of sediment were suspended in test waters. He also concluded that feeding was most affected in the moderate and lower levels of suspended particles and turbidity.

The use of mixing zones in monitoring and enforcement of TSS and turbidity standards seeks to accommodate the temporal suspension effects of larger size particles. While a consistent relationship between turbidity measurements and TSS concentration may not exist, the impacts caused by high levels of the suspended particles can be predicted by turbidity, which is easily measured. The practicality of rapid measurement of suspended sediment quantity by drying at constant temperature followed by precision weighing is difficult at best. The ease and accuracy for which turbidity can be measured in the field has prompted many regulators to develop turbidity criteria instead of suspended sediment criteria.

Turbidity was lowest at the confluence of the Snake and Clearwater Rivers and increased farther downstream in the Snake River. Median turbidity values ranged from 2 to 4 NTU's in the Snake River (Corps, 1999). It shall be noted that, during the sampling for this study, periods of heavy runoff or heavy storm non-point source water discharge were not analyzed for physical parameters such as turbidity. In some instances, samples were not analyzed due to safety constraints required when operating small watercraft.

3.9.1.8.2 Dissolved Oxygen

Dissolved oxygen values throughout the Snake River ranged from 6.4 to 13.3 ppm (6.4 to 13.3 mg/L) above Idaho’s 6.0 ppm (6.0 mg/L) minimum standard (Corps, 1999). Trend analysis suggests the dissolved oxygen concentrations are linked to flow and temperature effects. In the spring, fall, and winter months, the dissolved oxygen concentration is generally within the Idaho and Oregon water quality standards. In the summer months where there is reduced flow and increased temperature, low dissolved oxygen is found in the slack water areas of the dam forebay and sloughs. By Washington State Standard for Class A water, dissolved oxygen is a significantly limited water quality parameter. Washington State, in accordance to the provisions set by Section 303(d) of the Clean Water Act, lists the Snake River as limited for dissolved oxygen.

Differences in dissolved oxygen concentrations were small between surface waters and waters near sediments for most of the year. Differences were less than 1 ppm (1 mg/L) between top and bottom waters in deep-water reservoirs according to the Corps (1999) study. Although the general dissolved oxygen trend of the five reservoirs is similar to the previous discussion, there were exceptions recorded in the beginning of September in the Lower Granite and Little Goose reservoirs where differences were measured at 2.5, 3.8, and 5.6 ppm (2.5, 3.8, and 5.6 mg/L) at three separate sampling sites (Corps, 1999).

3.9.1.8.3 Water Temperature

Water temperature in the study area varies by time of year and location. Generally, water temperature is lower in the winter months of January and February, increases slowly during spring runoff (March - May), increases more rapidly in late spring until mid-summer (June - early August), plateaus through mid-September, then decreases steadily through January (table 3-13). For example, at the Lower Granite tailrace in water year 2000 (October 1999 to September 2000), the average monthly water temperatures in January and February were 39.0 and 39.4 °F (3.9 and 4.1 °C) with a maximum daily temperature of 41.4 °F (5.2 °C) and a minimum daily temperature of 37.2 °F (2.9 °C). Conversely, average monthly temperatures in July through September in 2000 were 66.0, 64.9, and 65.1 °F (18.9, 18.3 and 18.4 °C), respectively. The maximum daily value for this period was 68.0 °F (20.0 °C) and the lowest was 61.9 °F (16.6 °C). Water temperatures in the Ice Harbor tailrace were comparable to Lower Granite; however, Ice Harbor was warmer on average throughout the year (table 3-14). Because temperatures were similar at the farthest extents of the study area, data for the other Snake River reservoirs were assumed to follow similar trends. Average daily variation refers to the difference between maximum and minimum temperatures on a daily basis and averaged for the month designated.

Table 3-13. Lower Granite Tailrace Temperature Data for Water Year 2000.

	Monthly Average	Daily Max.	Daily Min.	Average Daily Variation
October	58.3 °F (14.6 °C)	63.3 °F (17.4 °C)	53.2 °F (11.8 °C)	0.4 °F (0.2 °C)
November	50.2 °F (10.1 °C)	53.2 °F (11.8 °C)	46.0 °F (7.8 °C)	0.4 °F (0.2 °C)
December	42.6 °F (5.9 °C)	46.0 °F (7.8 °C)	40.6 °F (4.8 °C)	0.4 °F (0.2 °C)
January	39.0 °F (3.9 °C)	40.1 °F (4.5 °C)	37.9 °F (3.3 °C)	0.2 °F (0.1 °C)
February	39.4 °F (4.1 °C)	41.4 °F (5.2 °C)	37.2 °F (2.9 °C)	0.4 °F (0.2 °C)
March	43.7 °F (6.5 °C)	47.3 °F (8.5 °C)	41.4 °F (5.2 °C)	0.4 °F (0.2 °C)
April	49.3 °F (9.6 °C)	52.3 °F (11.3 °C)	46.2 °F (7.9 °C)	0.7 °F (0.4 °C)
May	53.6 °F (12.0 °C)	57.0 °F (13.9 °C)	50.7 °F (10.4 °C)	0.5 °F (0.3 °C)
June	59.7 °F (15.4 °C)	66.0 °F (18.9 °C)	53.6 °F (12.0 °C)	0.9 °F (0.5 °C)
July	66.0 °F (18.9 °C)	68.0 °F (20.0 °C)	63.9 °F (17.7 °C)	0.9 °F (0.5 °C)
August	64.9 °F (18.3 °C)	67.3 °F (19.6 °C)	61.9 °F (16.6 °C)	1.4 °F (0.8 °C)
September	65.1 °F (18.4 °C)	67.5 °F (19.7 °C)	62.1 °F (16.7 °C)	0.7 °F (0.4 °C)
Source: Corps Northwest Division CROMES database (Walla Walla TDGMS)				

Table 3-14. Ice Harbor Tailrace Temperature Data for Water Year 2000.

	Monthly Average	Daily Max.	Daily Min.	Average Daily Variation
October	61.5 °F (16.4 °C)	66.7 °F (19.3 °C)	56.1 °F (13.4 °C)	3.2 °F (1.8 °C)
November	54.0 °F (12.2 °C)	58.6 °F (14.8 °C)	49.5 °F (9.7 °C)	2.7 °F (1.5 °C)
December	47.3 °F (8.5 °C)	51.6 °F (10.9 °C)	41.7 °F (5.4 °C)	3.2 °F (1.8 °C)
January	40.3 °F (4.6 °C)	44.6 °F (7.0 °C)	37.9 °F (3.3 °C)	1.8 °F (1.0 °C)
February	39.7 °F (4.3 °C)	42.8 °F (6.0 °C)	38.1 °F (3.4 °C)	1.4 °F (0.8 °C)
March	44.8 °F (7.1 °C)	49.3 °F (9.6 °C)	40.6 °F (4.8 °C)	2.9 °F (1.6 °C)
April	51.3 °F (10.7 °C)	54.1 °F (12.3 °C)	45.7 °F (7.6 °C)	2.7 °F (1.5 °C)
May	56.3 °F (13.5 °C)	63.3 °F (17.4 °C)	52.0 °F (11.1 °C)	3.1 °F (1.7 °C)
June	61.7 °F (16.5 °C)	67.5 °F (19.7 °C)	57.0 °F (13.9 °C)	3.2 °F (1.8 °C)
July	69.4 °F (20.8 °C)	72.9 °F (22.7 °C)	63.3 °F (17.4 °C)	3.6 °F (2.0 °C)
August	69.1 °F (20.6 °C)	72.9 °F (22.7 °C)	63.3 °F (17.4 °C)	6.8 °F (3.8 °C)
September	67.1 °F (19.5 °C)	71.2 °F (21.8 °C)	62.8 °F (17.1 °C)	3.8 °F (2.1 °C)
Source: Corps Northwest Division CROMES database (Walla Walla TDGMS)				

Temperatures measured at the USGS gage at Anatone (Snake RM 167.2) give some indication of the Snake River water temperature in the Lewiston area. These temperatures range from an average maximum of about 37.4 °F (3 °C) in February to about 72.5 °F (22.5 °C) in mid-July (Corps, 1999). In addition, in water year 2000, the lowest daily maximum temperature of 41.0 °F (5 °C) and lowest daily minimum of 36.5 °F (2.5 °C) were both recorded in January. Conversely, the highest maximum temperature of 75.7 °F (24.3 °C) and highest minimum temperature of 66.6 °F (19.2 °C) occurred in August (table 3-15). Although the Anatone station reflects the warm water from the Snake River above the confluence, it does not show the cooling influence that Dworshak releases have on the Lower Granite reservoir.

Table 3-15. Snake River at Anatone, Temperature Data for Water Year 2000.

	Monthly Average	Daily Max	Daily Min	Average Daily Variation
October		63.5 °F (17.5 °C)	52.7 °F (11.5 °C)	1.4 °F (0.8 °C)
November		53.6 °F (12.0 °C)	43.7 °F (6.5 °C)	0.9 °F (0.5 °C)
December		46.4 °F (8.0 °C)	38.3 °F (3.5 °C)	0.9 °F (0.5 °C)
January		41.0 °F (5.0 °C)	36.5 °F (2.5 °C)	0.7 °F (0.4 °C)
February		43.7 °F (6.5 °C)	37.4 °F (3.0 °C)	0.9 °F (0.5 °C)
March	46.0 °F (7.8 °C)	48.6 °F (9.2 °C)	43.7 °F (6.5 °C)	1.6 °F (0.9 °C)
April	51.4 °F (10.8 °C)	55.4 °F (13.0 °C)	46.9 °F (8.3 °C)	1.8 °F (1.0 °C)
May	55.8 °F (13.2 °C)	60.3 °F (15.7 °C)	52.2 °F (11.2 °C)	1.8 °F (1.0 °C)
June	62.2 °F (16.8 °C)	73.0 °F (22.7 °C)	53.8 °F (12.1 °C)	2.2 °F (1.2 °C)
July	73.0 °F (22.7 °C)	74.8 °F (23.8 °C)	64.6 °F (18.1 °C)	2.2 °F (1.2 °C)
August	71.1 °F (21.7 °C)	75.7 °F (24.3 °C)	66.6 °F (19.2 °C)	3.4 °F (1.9 °C)
September	66.2 °F (19.0 °C)	74.7 °F (23.7 °C)	55.2 °F (12.9 °C)	3.2 °F (1.8 °C)
Source: Corps Northwest Division CROMES database (Walla Walla TDGMS)				

3.9.1.8.4 pH

Values measured in the upper reaches of the lower Snake River averaged slightly above 8 pH units. The average pH for the lower portion of the lower Snake River was slightly lower than 8 pH units (Corps, 1999). On a significant number of occasions, the pH exceeded 8.0 and was at 8.5 or higher. The lower Snake River is consistently observed under a variety of conditions to maintain alkaline conditions between 7.8 and 8.6 for a significant number of days throughout the year. Natural geological conditions and artificial conditioning of the soil realistically contribute to the raised pH. The effects of higher pH exacerbate the ammonia problems encountered in most of the sediment management areas. This is further explained in the nutrients section covering un-ionized ammonia.

3.9.1.8.5 Nutrients

Most of the studies dealing with sediment quality referenced in this document describe the sediment as very rich in nitrogenous compounds. The dominant species of nitrogen in the sediment is ammonia. In the water, nitrite/nitrate (NO_2 + NO_3) is the dominant species of nitrogen if the water is well oxygenated and the proportion of nitrite is small. Nitrite is an intermediate oxidation state of nitrogen, which can be in the form of nitrate, nitrite, or ionized (NH_4) and un-ionized ammonia (NH_3) depending on oxidation state.

The Snake River sediments are very rich with nutrients and contain high amounts of ammonia [60 to 80 ppm (60 to 80 mg/L) average] but it is not fully understood how the nitrogen cycle works in the Snake River reservoirs. The lower Snake River had average water nitrite/nitrate levels from 0.13 to 0.35 ppm (0.13 to 0.35 mg/L). The water ammonia levels were near instrument detection limits in some cases or below detection limit [0.007 ppm (0.007 mg/L) N as NH_3]. This suggests the ammonia is probably bound to the sediments. Unless it is exposed, the small amount of ammonia that is naturally released is generally oxidized quickly.

Ammonium (NH_4+) is the ionized form of ammonia and is generally only toxic in very high concentrations. It is the un-ionized portion of ammonia (NH_3) that is toxic to aquatic life (Downing and Merkens, 1955). Un-ionized ammonia is more toxic because it is a neutral molecule and, thus, has the ability to diffuse across the epithelial membranes of aquatic organisms far more readily than a charged ion. In nature, ammonia is a byproduct of the organism's biological processes and must be excreted. High external un-ionized ammonia concentrations reduce or reverse diffusive gradient and cause the buildup of ammonia in gill tissue of fish (EPA, 1999). Research on various forms of aquatic life indicates that un-ionized ammonia toxicity positively correlated to temperature (Nimmo et al., 1989) and pH (Tabata, 1962; Armstrong, 1978), especially in hard water (Johnson, 1995).

There is a potential for both acute (short-term exposure) and chronic (long-term exposure) effects from un-ionized ammonia in the Snake River (Corps, 1999). The Snake River has relatively hard water based on the concentration of calcium carbonate and magnesium carbonate. Depending on the temperature, flow pattern, pH, and hardness, there could be toxic effects to aquatic life. Performance of the work during the coldest months would help to minimize potential effects of ammonia. Close water quality monitoring would ensure that any increases are short in duration and do not meet acute conditions.

During dredging, specific ion probes would be used to monitor ammonia concentration in the plume downstream of the dredging areas and downstream of the disposal areas. Monitoring would include a detailed analysis of ammonia in the sediment and water prior to dredging. If nitrogen in the sediments is fairly high [more than 35 ppm (35 mg/L)], elutriate testing would be necessary prior to initiation of the dredging activity.

The dominant species of phosphorus is total phosphorus (TP) (Corps, 1999). The TP values in the lower Snake River ranged from 0.036 to 0.067 ppm (0.036 to 0.067 mg/L) TP as phosphate. The ortho-phosphate (ortho-P) in the lower Snake River ranged from 0.013 to 0.023 ppm (0.013 to 0.023 mg/L) ortho-P as phosphate. Phosphate is essential for plant growth and, when it is present with other nutrients in abundance, it leads to substantial increases in algae growth. When this occurs, deleterious effects from nuisance blooms of blue-green algae increase. Nuisance blooms of blue-green algae in the Snake River are generally described as large mats of floating biological material with bubbles in it.

The lower Snake River water quality has degraded significantly by increased nutrient loading since 1974 (Greene, 1995). Greene (1995) determined growth potentials in 1995 Snake River samples were so large that test algae could not reach nitrogen or phosphorus limitation without the assistance of EDTA (Ethylendiamine tetraacetic acid disodium salt). No samples have been analyzed during spring runoff periods of times of high flow. It is possible that a majority of the phosphorus loading occurs during this time. River concentration of phosphorus in the sediment ranges from 34 to 38 ppm. Very little is understood about the phosphorus budget of the reservoirs. Small releases of phosphorus should not pose a problem. During dredging, water and sediment samples for phosphorus would be analyzed to determine potential for environmental harm.

3.9.1.8.6 Salinity/Conductivity

Salinity is the amount of dissolved material in water. For comparison purposes, fresh water is approximately 4 to 8 percent of the salt ionic strength of seawater. Fresh water concentration of dissolved ions is generally between 100 to 200 ppm (100 to 200 mg/L). The ionic composition of fresh waters is dominated by dilute solutions of compounds, particularly bicarbonates, sulfates, and chlorides, which are dissolved as water percolates through soil, flows down a channel, or is otherwise in contact with naturally occurring geologic deposits. Other factors such as the release of pollutants, storm water runoff, and windblown dusts can increase salinity of a body of water. Because the entire dredging and disposal action occurs in fresh water only, this section and later sections discuss salinity by its qualitative scale of measurement referred to as specific conductivity. Because it is not the appropriate unit of measure for the quantitative measurement of salinity, conductivity cannot be a direct relationship to salinity in fresh water. Conductivity measures the ability of a compound in an aqueous solution to exhibit electrical current conductance.

In 1997, the average conductivity in the lower Snake River from RM 6 to RM 129 ranged from 68 microhms to 363 microhms. Re-suspension of sediments can put more of the major dissolved ions into solution and can cause an increase in salinity. Freshwater biota not accustomed to changes in dissolved salt concentration could be negatively impacted by such changes because they lack the capacity to osmoregulate in even small increases of salinity. Identification of baseline salinity and estimation of potential change is difficult in the absence of adequate data. The Corps plans to collect quantitative data on salinity changes to assess the potential for negative impacts to freshwater biota.

3.9.1.8.7 Water Quality Chemicals of Concern

Although water quality sampling for conventional parameters, such as pH and temperature, has been conducted within numerous areas of the lower Snake River, recent sampling data for water quality chemicals of concern are not available. However, sampling of sediments for chemicals of concern has been undertaken and is discussed in Section 3.9.2.4. Elutriate testing (mixing sediments with water to measure containments can potentially affect water quality) is used to determine potential impacts of sediments on water quality. The only available water quality data on potential chemicals of concern for the proposed dredging areas is from the Water Quality Report, Lower Granite Lock and Dam Snake River, Washington - Idaho, which was published in 1973 and summarized data collected between 1969 and 1971 before Lower Granite was built. The metals copper and iron were found in three water quality sampling stations. At Snake RM 135, the average copper concentration was 0.12 ppm (0.12 mg/L) and the average iron concentration was 0.08 ppm (0.08 mg/L).

3.9.1.9 Columbia River Water Quality

The entire Columbia River Basin encompasses a 259,000-square-mile (670 807-km^2) area. There is no authoritative description of overall water quality conditions in the basin, in part, because two nations and six states share the basin. Each state has unique water quality standards, management programs, and monitoring programs. The following paragraphs discuss the Columbia River between the Snake River confluence and McNary.

3.9.1.9.1 Turbidity

Median turbidity values ranged from 2 to 3 NTUs in the Columbia River between the confluence of the Snake and Columbia Rivers and McNary (Corps, 1999), well below Washington's 25-NTU background action limit.

3.9.1.9.2 Dissolved Oxygen

Dissolved oxygen data is not available for the proposed dredging and disposal areas in the Columbia River. Water quality sampling in the Snake River portion of McNary reservoir, just upstream of the confluence with the Columbia River (where dredging is proposed) recorded dissolved oxygen concentrations ranging from 9.0 to 12.4 ppm (9.0 to 12.4 mg/L).

3.9.1.9.3 Water Temperature

Water temperature in the McNary tailrace for water year 2000 follows the same pattern exhibited by the Snake River reservoirs and varies by time of year and location. Generally, water temperature is lower in the winter months of January and February, increases slowly during spring runoff (March - May), increases more rapidly in late spring until mid summer (June - early August), plateaus through mid-September, then decreases steadily through January (table 3-16). The average monthly temperatures in January and February were 40.1 and 38.8 °F (4.5 and 3.8 °C), respectively. The average monthly temperatures in July and August were 66.2 and 69.3 °F (19 and 20.7 °C), respectively.

3.9.1.9.4 pH

The median pH value along the Columbia River between the Snake River confluence and McNary was 8.2 pH units (Corps, 1999). As was discussed in the nutrients section, the higher the pH, the greater the potential for ammonia to exist in the un-ionized state. This would directly impact fish and dredging windows and would contribute to the growing problem of sediment management in McNary reservoir.

Table 3-16. McNary Tailrace Water Temperature Data for Water Year 2000.

	Monthly Average	Daily Max.	Daily Min.	Average Daily Variation
October	59.0 °F (15.0 °C)	62.1 °F (16.7 °C)	54.3 °F (12.4 °C)	0.4 °F (0.2 °C)
November	52.3 °F (11.3 °C)	54.3 °F (12.4 °C)	48.9 °F (9.4 °C)	0.4 °F (0.2 °C)
December	45.7 °F (7.6 °C)	48.9 °F (9.4 °C)	42.6 °F (5.9 °C)	0.2 °F (0.1 °C)
January	40.1 °F (4.5 °C)	42.4 °F (5.8 °C)	37.9 °F (3.3 °C)	0.5 °F (0.3 °C)
February	38.8 °F (3.8 °C)	39.9 °F (4.4 °C)	37.9 °F (3.3 °C)	0.4 °F (0.2 °C)
March	42.3 °F (5.7 °C)	45.5 °F (7.5 °C)	39.4 °F (4.1 °C)	0.7 °F (0.4 °C)
April	48.7 °F (9.3 °C)	51.4 °F (10.8 °C)	44.8 °F (7.1 °C)	1.1 °F (0.6 °C)
May	54.7 °F (12.6 °C)	58.5 °F (14.7 °C)	50.4 °F (10.2 °C)	1.1 °F (0.6 °C)
June	60.4 °F (15.8 °C)	64.8 °F (18.2 °C)	56.5 °F (13.6 °C)	1.3 °F (0.7 °C)
July	66.2 °F (19.0 °C)	69.3 °F (20.7 °C)	63.7 °F (17.6 °C)	0.9 °F (0.5 °C)
August	69.3 °F (20.7 °C)	70.9 °F (21.6 °C)	67.6 °F (19.8 °C)	0.9 °F (0.5 °C)
September	65.7 °F (18.7 °C)	69.1 °F (20.6 °C)	62.1 °F (16.7 °C)	1.1 °F (0.6 °C)
Source: Corps, 2001				

3.9.1.9.5 Nutrients

Currently, there is no information available on nutrients for McNary reservoir. Monitoring would be done during and after dredging in the area to be dredged and, if any concerns arise, they will be addressed at that time.

3.9.1.9.6 Salinity/Conductivity

Currently, there is no information available on salinity or conductivity for McNary reservoir. Monitoring would be done during and after dredging in the area to be dredged and, if any concerns arise, they will be addressed at that time.

3.9.1.9.7 Water Quality Chemicals of Concern

Water quality sampling data for potential chemicals of concern are not available for the areas of the Columbia River where dredging and disposal are proposed. Additional sampling and analysis will be completed prior to dredging consistent with the Dredged Material Evaluation Framework.

3.9.1.10 Clearwater River Water Quality

Data for the Clearwater River system are limited, although studies are being conducted that may provide useful information. The Corps study (1999) had one sampling station on the Clearwater River that was within the study area. The Corps and USGS also conduct water quality monitoring on the Clearwater River.

3.9.1.10.1 Turbidity

Turbidity in the Clearwater River had a median value of 2 NTU's (Corps, 1999).

3.9.1.10.2 Dissolved Oxygen

Dissolved oxygen values in the Clearwater River ranged from 8.8 to 12.1 ppm (8.8 to 12.1 mg/L) (Corps, 1999).

3.9.1.10.3 Water Temperature

Temperatures measured at the USGS gage at Spalding (Clearwater RM 11.6) give some indication of the Clearwater River water temperature in the Lewiston area. In water year 2000, the lowest daily maximum temperatures of 41.9 °F (5.5 °C) and the lowest daily minimum temperature of 35.6 °F (2.0 °C) were recorded in January. Conversely, the highest maximum temperature of 67.3 °F (19.6 °C) occurred in June and highest minimum temperature of 53.6 °F (12.0 °C) occurred in July (table 3-17).

Table 3-17. Clearwater River at Spalding, Temperature Data for Water Year 2000.

	Monthly Average	Daily Max.	Daily Min.	Average Daily Variation
October		55.4 °F (13.0 °C)	45.5 °F (7.5 °C)	3.6 °F (2.0 °C)
November		50.9 °F (10.5 °C)	40.1 °F (4.5 °C)	2.0 °F (1.1 °C)
December		43.7 °F (6.5 °C)	36.5 °F (2.5 °C)	1.1 °F (0.6 °C)
January		41.9 °F (5.5 °C)	35.6 °F (2.0 °C)	2.0 °F (1.1 °C)
February		43.7 °F (6.5 °C)	37.4 °F (3.0 °C)	2.0 °F (1.1 °C)
March	44.6 °F (7.0 °C)	48.6 °F (9.2 °C)	41.2 °F (5.1 °C)	3.4 °F (1.9 °C)
April	46.4 °F (8.0 °C)	50.5 °F (10.3 °C)	43.3 °F (6.3 °C)	2.5 °F (1.4 °C)
May	50.5 °F (10.3 °C)	56.8 °F (13.8 °C)	45.7 °F (7.6 °C)	2.3 °F (1.3 °C)
June	57.6 °F (14.2 °C)	67.3 °F (19.6 °C)	49.3 °F (9.6 °C)	3.1 °F (1.7 °C)
July	57.2 °F (14.0 °C)	62.6 °F (17.0 °C)	53.6 °F (12.0 °C)	4.5 °F (2.5 °C)
August	55.0 °F (12.8 °C)	62.1 °F (16.7 °C)	50.7 °F (10.4 °C)	4.9 °F (2.7 °C)
September	57.7 °F (14.3 °C)	64.9 °F (18.3 °C)	50.5 °F (10.3 °C)	4.1 °F (2.3 °C)
Source: Corps Northwest Division CROMES database (Walla Walla TDGMS)				

3.9.1.10.4 pH

The median value for pH in the Clearwater River was 7.7 pH units (Corps, 1999).

3.9.1.10.5 Nutrients

Phosphorus is a key metabolic nutrient. Nitrogen is an important plant nutrient. Ionic concentrations of these nutrients are evaluated because elevated concentrations can indicate overenrichment and pollution of natural waters. Ortho-P values ranged from 0.001 to 0.006 ppm (0.001 to 0.006 mg/L) and TP ranged from 0.006 to 0.017 ppm (0.006 to 0.017 mg/L). The nitrate/nitrite ranged from 0.02 to 0.05 ppm (0.02 to 0.05 mg/L). Total ammonia nitrogen was below detection limits most of the time. Total nitrogen ranged from 0.07 to 0.14 ppm (0.07 to 0.17 mg/L). This indicates the water that flows from the Clearwater River to the Snake River does not contribute to the nutrient loading of the Snake River. Significant portions of the waters that flow in the lower Clearwater River come from Dworshak reservoir, which is a deep reservoir characteristically low in nutrients.

3.9.1.10.6 Salinity/Conductivity

Currently, there is no information on salinity or conductivity for the portion of the Clearwater River included in the study area. Conductance ranged from 15 to 49 µS/cm.

3.9.1.10.7 Water Quality Chemicals of Concern

The only available water quality data on potential chemicals of concern for the proposed dredging areas in the Clearwater River is from the Water Quality Report, Lower Granite Lock and Dam Snake River, Washington – Idaho, which was published in 1973 and summarized data collected between 1969 and 1971 before Lower Granite was built. It should be noted that these data are of very limited utility in describing the water quality conditions of the Clearwater River. At Clearwater RM 2.3, copper concentrations were 0.08 ppm (0.08 mg/L) and iron concentrations were 0.21 ppm (0.21 mg/L).

3.9.2 Sediment Quality

The Snake River carries large quantity sediment loads probably due in large part to soil erosion from agricultural and forestry practices. The Snake River flows through an area dominated by agricultural use and the sediments tend to be highly enriched with organic nitrogen compounds and other nutrients. The sediments have small amounts of herbicides and pesticides, low levels of dioxin, and few heavy metals.

The Corps sampled more than 85 sites in McNary, Ice Harbor, Little Goose, Lower Monumental, and Lower Granite reservoirs for the Lower Snake River Juvenile Salmon Migration Feasibility Study. The data availability for each site is highly dependent upon the local dredging requirements, contaminants of concern, and fiscal year funding issues. The past parameters for sediment sampling included the following:

- Glyphosates
- Herbicides
- Elutriate herbicides
- Manganese
- Metals
- Ambient metals
- Organic pesticides
- Particle size
- Elutriate pesticides
- Pesticides
- Petroleum products
- Nutrient
- Elutriate nutrients

Available sediment data from the proposed dredging and disposal locations are summarized in appendix H. These tables are excerpted from the Corps' sediment database. Figures with the sediment sample location sites are also shown in appendix H. The list of individual compounds to be tested is reviewed at least every 3 years. Individual compounds are included or dropped from the list based on their use in the area.

3.9.2.1 Sediment Quality Criteria and Standards

There are no uniform freshwater sediment quality criteria that provide a definitive numerical standard. The EPA and some states and Tribes are currently in the process of developing standards. However, to date, there have been several research and guidance documents that provide "screening" or recommended values for constituents found in sediment. These values are to be used as a benchmark or to indicate a potential concern. The sources that provide some of the numerical levels of guidance are as follows:

- Washington Department of Ecology. 1997. Creation and Analysis of Freshwater Sediment Quality Values in Washington (Publication No. 97-323a). (Ecology, 1997a)

- U.S. Army Corps of Engineers. 1998. Dredged Material Evaluation Framework: Lower Columbia River Management Area. (Corps, 1998)

- U.S. Environmental Protection Agency. 1997. National Sediment Quality Survey. Appendix D. (Publication No. 832-R-97-006). (EPA, 1997)

- U.S. Environmental Protection Agency. 1993. Technical Basis for Deriving Sediment Quality Criteria for Non-ionic Organic Contaminants for Protection of Benthic Organisms (Publication No. 822-R-93-011). (EPA, 1993)

- U.S. Environmental Protection Agency. 1991. Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual (Publication No. 503/8-91/001). (EPA, 1991)

The marine standards found in the EPA Ocean Testing Manual and the Corps Dredged Material Evaluation Framework were used in the past to screen freshwater sediment. Use of this criterion is of limited value to determine safety levels in fresh water and should only be used when developing consensus-based measures.

These minimum screening criteria are recommended in the Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Inland Testing Manual (ITM), an EPA/Corps guidance document. The protocols in the manual are intended solely as uniform guidance for testing of dredged material in fresh water. It is still the requirement of the permitted dredging entity to assess and document the potential for contaminant-related impacts associated with dredged material disposal. The manual does not alter the statutory and regulatory Combined Federal Code requirements for permitting decisions under Section 404 of the Clean Water Act. Under the Clean Water Act regulations, the testing is conducted in order to assist the permitting authority in making factual determinations regarding the effect of the discharge on the aquatic ecosystem and in the determination whether the discharge will comply with the 404(b)(1) guidelines.

The 404(b)(1) guidelines provide the substantive environmental criteria used in evaluating proposed discharges of dredged or fill material into waters of the United States. Fundamental to these guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem unless it can be demonstrated that such a discharge would not have an adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.

The ITM does not provide quantitative guidance on interpreting the ecological meaning of such effects (e.g., the ecological consequences of a given tissue concentration of a bio-accumulated contaminant or the consequences of that body burden to the animal). Dredged material bioassays (toxicity and bioaccumulation tests) are subject to interpretation and are not precise predictors of environmental effects. Rather, the manual considers statistically significant increases above certain levels compared to the reference sediment as potentially undesirable. Because a statistically significant difference is not a quantitative prediction that an ecologically important impact would occur in the field, this document discusses some of the additional factors to be weighed in evaluating potential ecological impact. The site-specific information and procedures found in the ITM are more likely to result in environmentally sound evaluations than is reliance on statistical significance alone.

Given the limitations of existing framework documents noted above, the Corps is developing a Mid-Columbia and Lower Snake Region Sediment Testing Framework. An outline for this framework is presented in appendix J. The regional framework will not be completed prior to initiation of the proposed dredging and dredged material management activities documented in this DMMP/EIS. In the interim, the Dredged Material Evaluation Framework: Lower Columbia River Management Area will be used by the Corps to evaluate the suitability of dredged material for in-water disposal. The procedures in the Lower Columbia Framework will be used and evaluated for their applicability for adoption in the Mid-Columbia and Lower Snake Region Framework.

3.9.2.2 Grain Size

The Corps took sediment samples from the Snake/Clearwater Rivers confluence dredging areas in September 1997 and from port facilities in McNary reservoir in 1998 for grain size analysis. The results recorded grain sizes ranging from 3.9 to 5.7 micrometers (µm) (Battelle, 1992). Most sediment samples taken for previous dredging operations have contained between 85 and 90 percent sand with 10 to 15 percent silt and fines. These samples are indicative of material that might be dredged from the main navigation channel. Composition of dredged materials from the port areas, close to streambanks, and in boat basins is expected to contain up to 50 percent silt and fines. This would be consistent with the results found in 1996 along the shoreline at the Port of Lewiston. See table 3-18 for grain size distribution throughout the Snake River. Grain sizes in table 3-18 are presented in American Society for Testing and Materials (ASTM) E11-70 standard sieve units. These units correspond inversely to particle size. For example, sieve size of less than five would indicate particle size of greater than 4.0 mm; sieve size of greater than 230 would indicate very fine materials, less than 0.063 mm in diameter. Dredging at the navigation lock approaches is expected to be comprised of predominantly river cobbles and rock.

Table 3-18. Percent of Sample by Grain Size (ASTM Standard Sieve).

Reservoir	<5S	5S	5S–10S	10S-20S	20S-40S	40S-60S	60S-140S	140S-200S	200S-230S	>230S
Ice Harbor	2	0	0	1	18	18	23	0	33	5
Lower Monumental	3	1	1	1	3	7	13	0	70	1
Little Goose	2	1	4	3	10	12	16	0	50	3
Lower Granite	0	0	1	2	7	17	20	1	50	2
McNary	0	0	3.97	0.48	1.2	3.81	15.74	7.69	8.36	58.95
Source: U.S. Army Corps of Engineers, Walla Walla District										

Dredging the navigation channel downstream of the dams should have little effect on water quality since the material to be removed is expected to be river cobbles with some larger rocks with very small quantities of fines. In-water placement of this material is expected to have little impact, but could create a small local turbidity plume (Battelle, 1992).

3.9.2.3 Sediment Chemicals of Concern

Sediment core samples have been taken along the lower Snake River . Appendix H shows the sediment sampling site locations that are in dredging and disposal areas. The samples were analyzed for sediment quality and ambient elutriate quality. Summary tables of the sediment quality data for the dredging and disposal areas are also located in appendix H. The results are discussed below.

Sediment samples were tested for the following organic compound groups: chlorinated herbicides, dioxins, glyphosate herbicide, organochlorine pesticides, organophosphorus pesticides, semi-volatile compounds, and total petroleum hydrocarbons. Each of the samples was analyzed for a suite of 18 metals (inorganic). The metals analyzed included arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, vanadium, and zinc. For each of the sediment samples, an ambient elutriate was prepared and analyzed for organophosphorus pesticides, organochlorine pesticides, and metals. Samples were also tested for nutrient concentrations.

Selection of potential chemicals of concern was conducted through an initial screening comparison between the collected data with their respective water quality and sediment quality values. The purpose of the screening process was to identify chemicals of potential concern that exceed their minimum water or quality values. The overall process involved comparing the maximum detected concentration for each chemical in each matrix (or one-half the maximum detection limit for chemicals not detected in any sample) with the minimum appropriate and applicable water or sediment quality criteria. Chemicals present in concentrations exceeding the respective criteria were then considered for further evaluation. (See section 3.9.2.4, below.) This is a very conservative screen because maximum concentrations under existing conditions would likely overestimate actual exposure concentrations. Nevertheless, this process would be expected to screen out most compounds and focus the evaluation on relatively few chemicals of potential concern.

Sediment core samples were also taken from port facilities in McNary reservoir. These samples were analyzed for the same metals as the Snake River except for arsenic. No ambient elutriate analysis was conducted for these samples.

3.9.2.4 Sediment Quality

Based on screening comparisons of chemicals in sediments with their respective sediment quality criteria, only nutrients, manganese, total dichlorodiphenyltrichloroethane (DDT) (which is calculated from the sum of 4,4-DDT, 4,4-DDD, and 4,4-DDE), and dioxin TEQ (toxic equivalency quotient) exceeded their minimum sediment quality criteria and are considered chemicals of concern (Corps, 1999). Concentrations of all other individual chemicals (or one-half of the detection limit for chemicals not detected) were below their respective criteria.

Sediment samples were taken from seven sites along the dredging locations of the Lower Granite reservoir and the Little Goose reservoir. These seven samples were tested for ammonia and nitrate. At these sampling sites, the maximum level of ammonia was 110 milligrams per kilogram (mg/kg) and the average ammonia level was 81 mg/kg. The average nitrate level was 0.5 mg/kg and the maximum level measured was 0.8 mg/kg.

The sediment analysis for McNary detected low levels of all the tested metals except for mercury. No mercury was detected in sediments during this 1973 study in Oregon. Most existing sediment quality data is based upon sampling of near-shore areas of the lower Snake River Reservoirs, where dredging is not likely to take place. Samples from proposed dredging sites have not exceeded screening criteria.

3.9.2.5 Ambient Elutriate

The ambient elutriate analysis is designed to estimate the amount of chemical sorbed to sediment that may desorb into the water column. As such, it represents the hypothetical water concentration around the sediment particles, with the conservative assumptions of steady state and undiluted conditions.

In the Corps 1997 sampling (Corps, 1999), the organic chemical ethyl parathion was detected near its detection limit in only one of 98 samples. Because of the low frequency of detection and the relatively low concentration in the one sample in which it was detected, ethyl parathion is not recommended as a chemical of concern.

However, total DDT is recommended as a chemical of concern. DDT is highly toxic to fish and invertebrates. The primary reason for this concern is not its toxicity, but rather its bioaccumulation and persistence in the environment. Researchers have demonstrated the bioaccumulation factor to be between 12,000 and 40,000 times the amounts in the environment (Dustman and Stickel, 1969). J. B. Diamond et al. (1968) discovered that soil residues applied at 1 pound per acre had very little decrease 9 years after the application and estimate the DDT residues persist for 30 years or more.

During testing for the Lower Snake River Feasibility Study in 1997, organochlorine pesticide residues were detected in the sediments of all four lower Snake River reservoirs (Corps, 1999, Appendix C). The predominant compound detected was DDE, which ranged in average maximum concentration of 6.48 ppb in the Lower Granite reach. Both DDT and DDD were detected with an average of 1.62 and 2.07 ppb, respectively. None of these compounds were discovered in the elutriate tests taken in 1997. However, since 1997, EPA has revised the criteria (EPA, 1999). The revised standards are now more restrictive, lowering allowable thresholds for DDT concentrations in water. The detection limits associated with the testing methods employed in 1997 were not low enough to determine if DDT was present at the maximum concentration currently recommended by EPA. Consequently, the Corps has not determined if the 1997 elutriate test results would exceed current EPA criteria recommended for water quality standards for DDT or its derivatives. The Corps plans to evaluate the issue further to determine what, if any, additional testing and analysis may be needed.

In June 2000, the Corps sampled for dioxin at 24 designated dredging sites from the confluence of the Snake and Clearwater Rivers downstream for several miles in Lower Granite reservoir. Chlorinated furans and dioxin congeners have been detected in the past in these areas (1991, 1996, and 1998). These are products originating from industrial activity in the Lewiston-Clarkston area. Results showed that there were no concentrations of 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD) which is considered a very potent carcinogen. Less toxic dioxin and furan congeners were found at seven sites at low concentration levels. The Agency for Toxic Substances and Disease Registry guidelines for evaluating dioxin address TEQ's. A dioxin concentration in soils of 50 parts per trillion dioxin TEQ's is the screening level for determining public health actions. Of the seven sites with dioxins in the 2000 study, the highest dioxin concentration was 0.6 part per trillion of TEQ's. In 1997, the Corps sampled four sites from Lower Granite reservoir for dioxin. Dioxin congeners were detected in two of four sample sites. No 2,3,7,8 TCDD was found.

In the Corps June 2000 study, 20 metals were analyzed in sediments at 33 sites. All metal concentrations were below standards listed for the compounds in Washington State's Department of Ecology (June 1999). Mercury was below detection levels (less than 0.002 part per million) in all areas. The maximum copper concentration was 44.3 parts per million, which was below copper marine sediment quality standards (screening limits) of 390 parts per million.

Inorganic substances are ubiquitous in water and can occur at natural background concentrations that are below the most conservative criteria. Consequently, the inorganic chemicals that exceeded their respective water quality criteria were further evaluated by comparisons with background levels for the Snake River.

Table 3-19 compares the elutriate results with the background values.

Table 3-19. Elutriate Results With Background Values

Pollutant	Elutriate Average (ppm or mg/L)	Background Average (ppm or mg/L)
Arsenic	0.0024	0.0047
Copper	0.0135	0.0422
Manganese	0.945	0.050
Mercury	0.00044	0.00053
Source: U.S. Geological Survey		

These comparisons suggest that manganese is the only inorganic chemical in the ambient elutriate analysis that exceeds concentrations that are upstream of the proposed dredging areas in the lower Snake River.

Sediment ambient elutriate samples were taken from nine sites along the dredging locations of the Lower Granite reservoir and the Little Goose reservoir. These nine samples were tested for ammonia and nitrate. At these sampling sites, the maximum level of ammonia was 12.80 ppm (12.80 mg/L) and the average ammonia level was 4.67 ppm (4.67 mg/L). The average nitrate level was 0.31 ppm (0.31 mg/L) and the maximum level measured was 0.47 ppm (0.47 mg/L).

3.9.2.6 Contaminated Sediments

Sediments containing levels of contamination that would require handling as solid or hazardous wastes preclude placement of dredged sediments either in-water or by proposed upland disposal methods. Dredged sediment with high levels of contamination require disposal in a solid or hazardous waste landfill.

Sediments identified as hazardous are required to meet the guidance set forth in RCRA. The guidance outlined in the ITM is used to determine whether dredged sediments are considered hazardous. This guidance is discussed in section 3.9.2.1.

Review of sediment sampling results from the Lower Snake River Feasibility Study indicated five chemicals of concern in ambient elutriate at contaminant levels that exceed water quality criteria. Based on available data, it is unlikely that those sediments contain concentrations of constituents that would necessitate their handling as hazardous waste in accordance with RCRA. The Corps' sediment sampling and analysis, consistent with the dredged material evaluation framework and conducted prior to dredging an area, would indicate the presence of contaminated sediments that could potentially require special handling.

There could be a possibility of radioactive materials being present in the reservoir sediments within McNary reservoir because of the location of the Hanford Nuclear Reservation at the upstream end of the reservoir. Any radioactive material within the reservoir would most likely have been introduced in the 1940's, 1950's, or early 1960's. As the reservoir behind McNary was filled in 1953, any radioactive material present could have started impacting accumulated sediment at that time. This early introduction into the reservoir system would most likely result sin the radioactive material being located in the lower sediment strata, which would be unlikely to be affected by any proposed dredging activities.

The U.S. Department of Energy (USDOE) and Washington State Department of Health have evaluated sediments in the Columbia River for radiological contaminant characteristics. Radionuclide concentrations in Columbia River sediments have been sampled annually by the USDOE since 1995. Sampling was done at Priest Rapids, McNary, and Ice Harbor dams as well as in the Hanford Reach. Parameters measured were: cobalt-60; strontium-90; cesium-137; and plutonium-239/240. Radionuclide concentrations in Columbia River sediments were relatively constant for 1995 through 2000 (DOE 2001). Washington State Department of Health evaluated potential radiation doses and attendant risks for the maximum concentrations of radionuclides observed in the Columbia River. Their report concluded:

> "The maximum radiation doses to the maximally exposed individuals comes from the deeply buried sediments of McNary Dam. The maximum annual average dose over a 75 year lifetime is 1.6 (millirem) mrem. This dose requires that the deep sediments be dredged to the surface…In all cases the calculated doses are low and less than 1% of natural background. In fact, the risks from these doses are less than the risks associated with existing federal standards for radionuclides in drinking water and air emissions (Wells, 1994)."

No specific federal or state freshwater sediment criteria are available to assess the sediment quality of the Columbia River with respect to radiological parameters (DOE 2001).

3.9.3 Wetlands

Wetlands were identified using spatial data provided through the NWI, field reconnaissance, aerial photo interpretation, and information provided in previous studies. Previous studies were used to provide a general description of wetland types and approximate acreage throughout the geographic study area. The NWI data (gathered between 1983 and 1990) was compiled from aerial photo interpretation and is not necessarily inclusive of all wetlands within a given area. Field reconnaissance was performed to field verify NWI data and assess additional wetlands on the sites proposed for upland disposal of dredged material. Site visits were also conducted in the areas potentially affected by the proposed nominal 3-foot (0.9-m) levee raise and associated roadway modifications. Field approximations of size and type of wetlands were based on indicative characteristics such as vegetation and water.

There are approximately 1,010 acres (408.7 hectares) of emergent wetlands located in and along McNary reservoir. The wetlands are predominately located at the confluence of the Walla Walla and Snake Rivers and the Yakima and Columbia Rivers (Corps, 1992). The lower Snake River reservoirs are also characterized by emergent wetland vegetation at the edge of the water surface and in backwater areas. Wetland acreage in these reservoirs is estimated as: Lower Granite [18 acres (7.3 hectares)], Little Goose [84 acres (34.0 hectares)], Lower Monumental [65 acres (26.3 hectares)], and Ice Harbor [186 acres (75.3 hectares)] (Corps, 1999). These wetland locations and structure are typically influenced by reservoir elevation, which is not anticipated to change under any of the alternative scenarios considered in this DMMP/EIS.

For the Joso site, NWI mapping indicates that there is approximately 0.2 acre (0.08 hectare) of palustrine shrub wetlands located on a northeast inlet area. This wetland was verified by field reconnaissance. Plant composition of this wetland includes Russian olive (*Elaeagnus angustifolia),* false indigo (*Amorpha fruticosa*), cattail (*typha* spp.), wild onion (*Allium douglasii*), and teasel (*Dipsacacea* spp).

Two other wetlands, not indicated on NWI, were also identified on the Joso site. These are located along the southwest edge of the parcel in two shallow inlets. Both wetlands have vegetative characteristics indicative of palustrine submerged and emergent wetlands. The first wetland is approximately 0.1 acre (0.04 hectare), and the second wetland to the north is estimated at 0.8 acre (0.32 hectare). Some of the rushes and sedges also showed signs of foraging animals and a pair of great blue heron were observed at the northern wetland during the field visit. Vegetation at these two locations is diverse and native plants dominated the sites. The dominating plant material observed included pondweed (*Potamogeton* spp.), hornwort (*Ceratophyllum* spp.), tule (*Scirpus tabernaemontani*), dock (*Rumex crispus* and *salicifolius*), American brooklime (*Veronica anagallis- aquatica*), false loosestrife (*Ludwigia palustris*), cattails (*Typha* spp.), Harding grass (*Phalaris* spp.), and rushes (*Juncus* spp.).

Wetlands may be present at other sites that may be considered for beneficial uses of dredged material. The Corps would survey potential beneficial use sites to assess wetland resources.

3.9.4 Floodplain Areas

The 100-year floodplain designation is commonly used to represent area where there is a 1 percent probability of inundation by flooding once each year. Restrictions are often placed on activities within a floodplain. The Corps policy for any development is that fill placed within the 100-year floodplain must be balanced by removing fill so that the net impact to flood storage is zero.

The 100-year floodplain for the study area reservoirs would vary depending on surrounding topography and hydrologic conditions. The existing levees in the Lewiston area are designed to guard against the SPF, which is greater in discharge than the 100-year flood event. Although sedimentation has reduced the flow conveyance in the vicinity of the confluence of the Clearwater and Snake Rivers, the levees do provide protection from a 100-year flood event beyond the year 2020.

The proposed levee raises are designed to provide enhanced flow conveyance. The proposed upland disposal location at Joso was evaluated to determine if any proposed dredged material placement is within the floodplain. Portions of the Joso site are within the 100-year floodplain. However, the proposed disposal area is not located within the floodplain area. Proposed temporary storage areas for dredged material at the site are partially within the 100-year floodplain. The proposed woody riparian habitat creation site at Chief Timothy HMU is within the 100-year floodplain. Specific floodplain areas that may be associated with other potential beneficial uses of dredged material were not evaluated. However, the process of determining beneficial uses and disposal areas would identify and evaluate floodplain areas early in the process.

3.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

3.10.1 Dredged Material

Sediments proposed for dredging have been tested for HTRW. The latest sediment sampling and analysis for hazardous materials, substances, chemicals, and wastes was completed in September 1998. Reviews of sediment sampling results indicate it is unlikely that sediments contain concentrations of constituents that would necessitate their handling as HTRW in accordance with RCRA. Additional information on contaminants in the sediments is discussed in section 3.9.2.6.

3.10.2 Upland Disposal Site

The potential or actual presence of HTRW within the study area can influence whether and how the proposed action would be implemented. To assess the presence of HTRW in and around the proposed upland disposal site (Joso), a Phase 1 Environmental Site Assessment was conducted in accordance with the requirements of the ASTM Standard Practice for Environmental Site Assessments: Phase 1 Environmental Assessment Process E 1527. This site assessment included a title search; reviews of Federal, state, and local environmental records and databases (such as the Superfund National Priority List of sites, underground storage tank site lists, and spill reports); review of historical records; site reconnaissance; and interviews with landowners, lessees/tenants, and local agency officials.

The Joso site is owned by the Corps and is managed as an HMU. The site has historically been used for rock and gravel mining operations. Large portions of the site were excavated and the pits have been left open. Review of environmental and historical records indicated no HTRW concerns requiring further investigation at the site (HDR, 1999a). Site reconnaissance revealed the presence of an area where past tire burning and asphalt dumping has occurred. Remnants of these activities that remain at the site are rusted belts from the tires (approximately 30 tires) and weathered asphalt (HDR, 1999b).

3.11 AIR QUALITY

The DMMP/EIS study area encompasses the Snake and Columbia Rivers and includes Lewiston County in Idaho; Walla Walla, Franklin, Columbia, Whitman, Garfield, and Asotin Counties in Washington; and Umatilla County in Oregon. This section discusses general air quality conditions and regulating agencies throughout the study area. As discussed in section 2, the Corps would continue maintenance activities in Lake Wallula behind McNary on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River. Lower Granite is the most upstream of the four lower Snake River dams and provides navigation to Lewiston, Idaho, and Clarkston, Washington. Because the majority of proposed dredging and construction activities would occur in the Lewiston-Clarkston area and the Lower Granite reservoir, this section will focus on that area.

3.11.1 Meteorology

Within the study area of Northeastern Oregon, Southeastern Washington, and Northwestern Idaho, the climate is typically arid with relatively minimal cloud cover, and elevations range from approximately 300 to 750 feet above sea level. Looking at several cities within the study area from Oregon to Idaho, average annual rainfall ranges from 7 to 13 inches (17.8 to 33.0 cm). Average temperatures range from 35 to 37 °F (1.7 to 2.8 °C) in the winter, and 71 to 74 °F (21.7 to 23.3 °C) in the summer (Western Regional Climate Center, 2000). The prevailing wind direction in the study area is southwesterly. Storm activity in the summer and fall leads to strong wind gusts making the arid study area prone to wind erosion and dust storms.

3.11.2 Fugitive Dust Emissions

Activities associated with DMMP/EIS implementation have the potential to generate windblown particulate matter (PM) (fugitive dust), particularly during levee construction, material transport, and in-water and upland disposal. Health concerns associated with suspended particles focus on those particles small enough to reach the lungs when inhaled. Children, the elderly, and those with respiratory diseases can be affected most. Few particles larger than 10 microns in diameter reach the lungs (a micron is equal to one-millionth of a meter.) In 1997, EPA added two new $PM_{2.5}$ standards, set at 15 micrograms per cubic meter ($\mu g/m^3$) and 65 $\mu g/m^3$, respectively, for the annual and 24-hour standards. In addition, the form of the 24-hour standard for PM_{10} (about one-seventh the diameter of a human hair) was changed. These standards have been challenged in court and the case is pending before the U.S. Supreme Court. The EPA is beginning to collect data on $PM_{2.5}$ concentrations. Beginning in 2002, based on 3 years of monitoring data, EPA could designate areas that do not meet the new $PM_{2.5}$ standards as non-attainment areas.

Fugitive (i.e., uncontrolled) dust releases are generally the largest source of PM_{10} emissions during construction activities. Emissions depend on wind conditions, soil type, soil moisture content, and total area of soil disturbance. Dust emissions could be generated by wind blowing over exposed soil surfaces during levee construction, grading and scraping activities, and the spreading and compacting of soil at the upland disposal areas. Both upland and in-water disposal could also be a source of dust as dredged material dries and is transported and distributed. The movement of construction equipment and support vehicles around the proposed project sites could also generate dust. However, impacts of fugitive dusts can be greatly abated using standard construction practices such as wetting exposed soil, watering haul roads, and placement of soil amendments to fix fine particles.

3.11.3 Equipment Exhaust Emissions

Heavy equipment used for dredging, material transport, and disposal would include cranes, tug boats (e.g., for pulling/pushing barges), tractors, and heavy trucks. These are generally powered by diesel engines that emit low quantities of hydrocarbon and carbon monoxide emissions. Diesel engines do produce larger quantities of particulates and nitrogen oxides than gasoline engines. Use of diesel-powered equipment is a common component of existing and proposed dredging/

maintenance activities and equipment use is not specifically regulated (Ecology, 1999). Thus, this discussion focuses primarily on fugitive dust emissions. It is reasonable to expect transportation-related emissions will continue to decline as fuel efficiencies improve and national emission standards become effective.

3.11.4 National Ambient Air Quality Standards (NAAQS)

The states of Washington, Oregon, and Idaho have adopted the NAAQS listed in table 3-20. The NAAQS include primary standards, designed to protect public health, and secondary standards, designed to protect public welfare from effects such as air pollution damage to property and vegetation.

Pursuant to the Clean Air Act, the EPA has developed regional or local classifications for each Federal criteria pollutant. An area is classified as in "attainment" if pollutant concentrations meet the NAAQS. Areas where concentrations exceed the NAAQS for that pollutant are designated as “non-attainment.” Areas that have not received sufficient analysis for certain criteria pollutants are designated as "unclassified" for those particular pollutants.

Table 3-20. National Ambient Air Quality Standards.

Pollutant	Averaging Time	National Standards
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.03 ppm
	24-Hour Primary*	0.14 ppm
	3-Hour Secondary*	0.50 ppm
Particulate matter (PM_{10})	Annual Arithmetic Mean: Primary and Secondary	50 $\mu g/m^3$
	24-Hour:** Primary and Secondary	150 $\mu g/m^3$
Particulate matter ($PM_{2.5}$)	Annual Arithmetic Mean: Primary and Secondary	15 $\mu g/m^3$
	24-Hour:** Primary and Secondary	65 $\mu g/m^3$
Carbon Monoxide (CO)	One Hour*	35 ppm
	8 Hour*	9 ppm
Ozone (O_3)	One Hour***	0.12 ppm
	8 Hour***	0.08 ppm
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.053 ppm
Lead (Pb)	3-Month Arithmetic Mean	1.5 $\mu g/m^3$

* *Not to be exceeded more than once per year.*
** *Statistically estimated number of days with exceedences, not to be more than one per year.*
*** *Not more than one expected exceedence per year on a 3-year average.*
ppm *Parts of pollutant per million parts of air [by volume at 77 °F (25 °C)].*
$\mu g/m^3$ *Micrograms of pollutant per cubic meter of air.*

Source: U.S. Environmental Protection Agency

3.11.5 Washington Air Quality Standards

The study area in Washington State includes Benton, Walla Walla, Franklin, Columbia, Whitman, Garfield, and Asotin Counties. Air quality in all these counties except Benton County is regulated by the Washington Department of Ecology (Ecology) Eastern Regional Office located in Spokane. Benton County is regulated by Ecology's Benton County Clean Air Authority located in Richland. The Washington study area is primarily designated unclassifiable for criteria pollutants. The City of Wallula in Walla Walla County is designated as a PM_{10} non-attainment area. The EPA's Natural Events Policy, adopted in 1996, excludes exceedences due to dust storms from evaluating attainment status for an area. In 1998, Ecology developed controls for the area for any human activities, including construction, that contribute to exceedences. These controls include the following:

- Use phased development to keep the disturbed area to a minimum.
- Schedule thorough and consistent watering that does not run off the site.
- Use wind fencing.
- Restrict traffic on the site.
- Reduce vehicle speed.
- Cover any trucks transporting dirt.
- Plan schedules so control measures are available throughout the project.

The City of Kennewick, Washington, has also been of concern to the Benton Clean Air Authority for similar windblown dust issues. The Benton Clean Air Authority adopted an Urban Fugitive Dust Policy in 1996 that outlines requirements (appendix B of the Policy), similar to ones above, for construction activities and hauling material.

Activities associated with dredging, transport, and disposal would be designed to comply with regulations defined in Washington Administrative Code (WAC) 173-400-040 general standards for maximum emissions, subsections 1 - Visible emissions, 2 - Fallout, 3 - Fugitive emissions, 5 - Emissions detrimental to persons or property, and 8 - Fugitive dust sources.

Localized diesel emissions may increase during dredging, transport, and disposal, but should have little impact on ambient air quality. Emissions from these activities proposed in this DMMP/EIS are currently not regulated by Ecology (1999), and there are no plans to regulate such emissions in the future.

3.11.6 Idaho Air Quality Standards

Air quality in Nez Perce County and the City of Lewiston is managed by the Idaho DEQ, Lewiston Regional Office. Lewiston is also part of the Eastern Washington-Northern Idaho Air Quality

Control Region. Because the Lewis Clark Valley airshed crosses city, county, and state boundaries, the Lewis Clark Valley Air Quality Advisory Commission was formed in 1989 to address carbon monoxide and PM_{10} issues. The commission includes authorities from Washington and Idaho, as well as Asotin County and the cities of Asotin, Lewiston, and Clarkston.

Rules for Control of Air Pollution in Idaho are given in IDAPA, DEQ, 58.01.01. Fugitive dust control requirements for the State of Idaho are given in IDAPA 58.01.01, Sections 650 and 651, and require that all reasonable precautions be taken to prevent the generation of airborne particulate matter (fugitive dust). Reasonable precautions would include, but are not limited to, the following:

- Use of water or chemicals during construction or demolition activities.
- Application of dust suppressants (water, oil, suitable chemicals) where practical.
- Covering of trucks when practical when transporting material likely to emit dust.

Localized diesel emissions may increase during dredging, transport, and disposal. Emissions from the activities proposed in this DMMP/EIS are currently not regulated by the Idaho DEQ and there are no plans by the state to regulate such emissions in the future.

3.11.7 Oregon Air Quality Standards

The study area in eastern Oregon is located within Umatilla County and is managed by the Oregon DEQ Eastern Region. The nearest Eastern Region office is located in Hermiston. Air quality requirements are defined in the Oregon Statute Title 36, Chapter 468A and do not specifically address fugitive dust control, but similar diesel and fugitive dust control measures as outlined above would be followed throughout the study area. General air pollution control requirements most likely applicable to the study area are given in Chapter 468A, Sections 468A.005 - 468A.085.

Localized diesel emissions may increase during dredging, transport, and disposal. Emissions from the activities proposed in this DMMP/EIS are currently not regulated by ODEQ and there are no plans by the state to regulate such emissions in the future.

3.12 NOISE

The DMMP/EIS study area encompasses the Snake and Columbia Rivers and includes Nez Perce County in Idaho; Walla Walla, Franklin, Benton, Columbia, Whitman, Garfield, and Asotin Counties in Washington; and Umatilla County in Oregon. This document focuses on general noise conditions throughout the study area and specifically addresses Lewiston, Idaho, and Clarkston, Washington. As discussed in section 2 of this document, the Corps would continue maintenance activities in Lake Wallula behind McNary on the Columbia River and the reservoirs behind Ice Harbor, Lower Monumental, Little Goose, and Lower Granite on the lower Snake River. Because the majority of proposed dredging and construction activities would occur in the Lewiston-Clarkston area and the Lower Granite reservoir, this section will focus on that area.

For the purpose of analysis, it is assumed dredging activities near Lewiston and Clarkston would occur 24 hours per day from December 15 through March 1. Transport and disposal near populated areas would occur during daytime hours (i.e., 7 a.m. to 10 p.m.).

3.12.1 Background Information on Noise

Sound travels through the air as waves of minute air pressure fluctuations caused by some type of vibration. In general, sound waves travel away from the noise source as an expanding spherical surface. As a result, the energy contained in a sound wave is spread over an increasing area as it travels away from the source. This results in a decrease in loudness at greater distances from the noise source.

The human ear does not respond equally to all sound frequencies. Therefore, when considering the effects of noise on people, it is necessary to consider the frequency response of the human ear. The frequency weighting most often used to evaluate environmental noise is A-weighting, which reduces the measured sound pressure level for low-frequency sounds while slightly increasing the measured pressure level for some high-frequency sounds. Noise levels referenced in this evaluation are reported in "A-weighted decibels" or dBA.

3.12.2 Existing Noise Levels

The study area in Washington, Idaho, and Oregon is primarily rural with relatively few noise sources. Sources include isolated industrial facilities, train and boat operation, and distant highway noise. Because the area is rural and sparsely populated, background noise levels at locations distant from traveled roadways are likely to be between 30 and 40 dBA under calm wind conditions. Noise levels within the cities of Lewiston and Clarkston are typical of those found in urbanized areas and vary by location and time of day. Table 3-21 shows typical noise sources and associated noise levels. Noise levels in proximity to roadways range from 60 to 70 dBA along arterials and freeways and are affected primarily by traffic volumes and speed. Residential noise levels are likely near 50 dBA and maybe quieter during evening and nighttime hours.

3.12.3 Washington Noise Control Standards

Chapter 173-60 WAC specifies noise limits that restrict both the level and duration of noise measured at any given point within a receiving property. The maximum permissible environmental noise levels depend on the Environmental Designation for Noise Abatement (EDNA) of the property containing the noise source and the land use of the property receiving that noise.

For the purpose of this evaluation, dredged material disposal is considered either maintenance of an essential utility service or a temporary construction activity. Thus, noise would be exempt from regulation between 7 a.m. and 10 p.m. per WAC 173-60-050(1)(e) and (3)(a). Noise from watercraft (i.e., tugboats and barges) generated during material transport would be exempt from regulation per WAC 173-60-050(4)(j) at all times.

Table 3-21. Weighted Sound Levels and Human Response.

Sound Source	dBA*	Response Criteria
Carrier deck jet operation	140	Limit amplified speech
	130	Painfully loud
Jet takeoff (200 feet)	120	Threshold of feeling and pain
Discotheque		Maximum vocal effort
Auto horn (3 feet)		
Riveting machine	110	
Jet takeoff (2,000 feet)		
Shout (0.5 foot)	100	Very annoying
New York subway station		
Heavy truck (50 feet)	90	Hearing damage (8 hours)
Pneumatic drill (50 feet)		
Passenger train (100 feet)	80	Annoying
Helicopter (in-flight, 500 feet)		
Freight train (50 feet)		
Freeway traffic (50 feet)	70	Telephone use difficult
		Intrusive
Air conditioning unit (20 feet)	60	
Light auto traffic (50 feet)		
	50	Quiet
Living room		
Bedroom	40	
Library		
Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

*Typical A-weighted sound levels taken with a sound-level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

Source: U.S. Council on Environmental Quality, 1970.

Noise within Asotin County, Washington, is regulated by Ordinance 97-30. Ordinance 97-30 is designed primarily to control nuisance noises and does not pertain directly to dredging or related activities proposed as part of the DMMP/EIS. County staff indicated that dredging activities similar in scope to that proposed under the DMMP/EIS have occurred in the Clarkston area in the past. Dredging activities were not in violation of Ordinance 97-30. County staff indicated that a letter to the county commissioners providing notice of future dredging activities would be adequate to ensure continued compliance with Ordinance 97-30 (Riggers, 1999). Asotin County noise ordinances and/or control measures would be applicable to proposed dredging and construction activities in the vicinity of Clarkston.

3.12.4 Idaho Noise Control Standards

The portion of the study area in Idaho is located in and around the City of Lewiston. Noise within the City of Lewiston is regulated under Article II. Noise Control and Regulation, Sections 24-37 through 24-43 of the Lewiston Code. Dredging and transport of dredged material would be considered a repair and/or maintenance of an essential utility; thus, activities would be exempt from regulation. A sound level variance permit would not be required (Ayers 1999).

Sounds associated with levee construction would be temporary and would occur during daytime hours. Typical construction noise would also be exempt from regulation.

3.12.5 Oregon Noise Control Standards

A small portion of the study area is located in Umatilla County, Oregon. The Oregon DEQ coordinates a state-wide program of noise control and state-wide noise control regulations are listed under the Oregon Administrative Rules, Division 35 Noise Control Regulations. Project activities within Umatilla County would require the notification of County officials and compliance to local noise ordinances. Typical temporary construction noise is usually exempt during weekday daytime hours.

3.13 AESTHETICS

3.13.1 Visual Resources

The lower Snake River system and the Columbia River upstream of McNary are located in an arid region with surrounding open and agricultural landscapes interspersed with urban, suburban, and industrial land uses. The study area is predominantly rural in character. The river passes through and is adjacent to the Blue Mountains and Columbia Basalt Plain physiographic provinces. As the Snake River approaches the Tri-Cities area, the land surrounding the river is comprised of low hills with steppe vegetation. Moving upstream, the valley walls become steeper, forming a canyon with sidewalls ranging from 200 to 2,000 feet (61.0 to 609.6 m) high. The steep buttes and walls surrounding the river are the dominant features of this landscape (figure 3-4). Throughout much of the study area, roadways (e.g., U.S. Highway 12) and railroad facilities are adjacent to the reservoirs. Levees have been constructed in several areas, notably in Lewiston-Clarkston and the Tri-Cities areas.

The river provides a water feature in an arid landscape with often dramatic, steep surrounding hillsides and canyons, making it an important aesthetic resource in the study area. Many of the recreational facilities that have been developed along the lower Snake River (see section 3.4) take advantage of the scenic qualities of this landscape, as well as water-based recreation such as boating and fishing. In the urbanized areas of the Tri-Cities and Lewiston-Clarkston, extensive riverfront parkland has been developed and is heavily used.

The proposed upland dredged material disposal site at Joso is an open terrace area with limited development in areas surrounding it (see figure 3-4). An abandoned quarry area is located near the center of the site, and roadway and railroad facilities are located adjacent to the site.

3.13.2 Viewers and Viewing Patterns

People viewing the aesthetic resources of the project area include highway travelers, recreational users of the river and surrounding lands, and local residents. The aesthetic values of the river and surrounding landscapes vary based on the viewers' perspectives and values. Highway travelers tend to view the resources as they are traveling on roadways through the study area, such as along U.S. Highway 12, which parallels the Snake River over several stretches of its alignment; as such, these travelers tend to view the resources at a distance, generally from an automobile and generally at high rates of speed. Recreational users, such as boaters, campers, swimmers, and fishermen, tend to view the resources for longer periods of time due to the fact that they are involved in recreational activities that are dependent on the river setting. Local residents tend to view the resources as they go about their daily business in the vicinity of the river as well as when they use the river and surrounding lands for recreational purposes (Corps, 1992).

Existing levees vary in height and run for approximately 8.6 miles (13.8 km) along the shorelines of the Snake and Clearwater Rivers. The levees in Lewiston and Clarkston provide a visual as well as recreational resource, with landscaping, walking paths, and points that provide views of the river (from the top of the levee). The levees do obscure views of the river from various locations in Lewiston.

Throughout the study area, viewing patterns would vary seasonally in a manner similar to recreational uses of the river and surrounding lands, with more activities during the warm and sunny periods in late spring, summer, and early fall.

3.14 NATIVE AMERICAN TRIBES AND COMMUNITIES

3.14.1 Summary

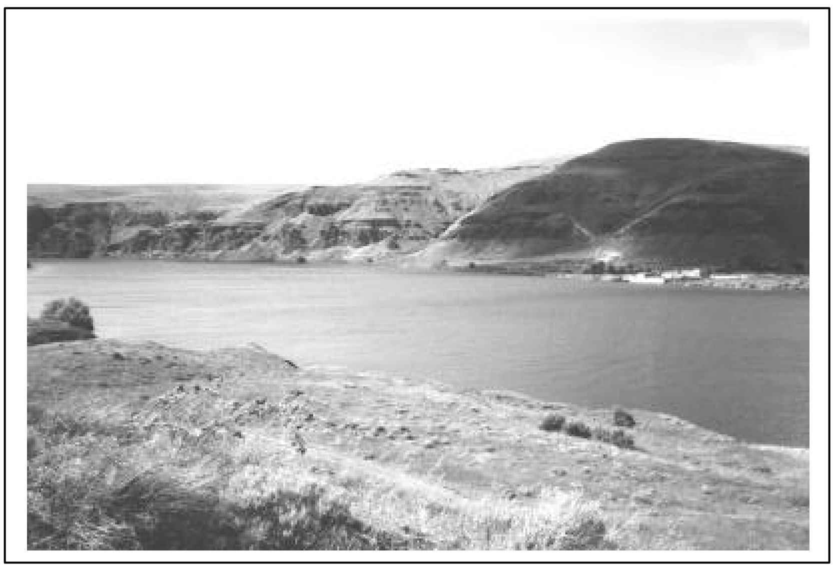
The United States has long recognized the dependent sovereign status of Indian tribes. Principles outlined in the United States Constitution and treaties, as well as those established by Federal laws, regulations, and executive orders, continue to guide the nation's policy toward Indian nations.

The Corps conducts its government-to-government relationships with Federally recognized Indian tribes as a part of its obligations, just as it does with states, counties, and local governments. The relationship the Federal government maintains with tribes is unique and necessarily involves consultation with tribal governments. The Corps is responsible for assessing the impacts of agency activities, considering tribal interests, and assuring that tribal interests are considered in conjunction with Federal activities and undertakings.

The Corps recognizes that tribal governments are sovereigns located within and dependent upon the United States. Yet tribes have rights to set their own priorities, to develop and manage tribal resources, and to be consulted in Federal decisions and activities having the potential to affect tribal rights. The Corps has a responsibility to help fulfill the United States government's responsibilities toward tribes when considering actions that may affect tribal rights, resources, and assets. The Corps is committed to carrying out Federal activities in a manner that is consistent with the United States' legal obligations toward tribes.

Figure 3-4. Aesthetics of the Study Area.

Mouth of Alpowa Creek, downstream of Chief Timothy State Park, Lower Granite Reservoir



Shoreline of Lower Monumental Reservoir at the Joso Site.

3.14.2 Introduction

The Federal government has a unique relationship with American Indian peoples and Federally recognized tribal governments. Principles outlined in the United States Constitution and treaties, historic executive orders, and mandates established in Federal laws, regulations, and modern executive orders, continue to guide our national policy towards American Indian nations.

Prior to the formation of Federally recognized tribes, the indigenous peoples of the McNary and lower Snake River region lived in villages comprised of several extended families. Groups of villages known as bands were bound together culturally and collectively shared a homeland. The names of bands were typically taken from those of major villages. Through formal treaties and executive orders initiated by the United States government, groups of native bands were given Federal recognition as American Indian tribes. In the mid-1800's, the tribes ceded their homelands to the United States through treaties ratified by Congress. As domestic dependent nations, Indian tribes exercise inherent sovereign powers over their members and territory. American Indian tribes are defined as "any Indian band, nation, village or community" the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. Thus, the word tribe denotes Federal recognition of an American Indian government.

The modern tribes with cultural heritage pertaining to McNary and the lower Snake River are comprised of numerous communities associated with the Umatilla, Yakama, Nez Perce, and Colville reservations, and families associated with the Wanapum community at Priest Rapids, Washington. Tribal members are both Americans and tribal citizens who may receive representation from Federal, state, county, and local governments. The unique manner in which tribal governments represent their members is perhaps the most sensitive to their immediate economic and cultural needs and values. The potential effects of the DMMP may directly relate to tribal economies and cultural practices and indirectly to people's health, social well-being, quality of life, and values for the natural and cultural environment associated with the lower Snake and Mid-Columbia Rivers.

Affected tribes and American Indian communities maintain cultural values in both natural and cultural resources managed by the Corps in McNary and the lower Snake River. Numerous aquatic, plant, and wildlife species retain cultural significance to tribes (e.g., salmonids, Pacific lamprey, sturgeon, whitefish, sculpin, deer, grouse, eagles, coyotes, bear, wolves, biscuitroot, Indian carrots, chokecherries, and tules). Values for the water, land, life forms, and places continue to be the source of Indian community concerns, as well as tribal governments' desires to protect their legal rights. Such values are lodged in both traditional lifeways and modern socioeconomic needs, which influence and impact tribes.

Changes to tribes' cultural identities and limitations imposed on traditional practices are ongoing. For example, the fisheries on and adjoining McNary and the lower Snake River system have been significantly altered over the past one and a half centuries in terms of access and habitat quality. Tribes that desire to take treaty fish such as Pacific lamprey (largely a ceremonial and subsistence activity) find their fishermen displaced from local fishing stations. Tribes such as the Yakama, Nez Perce, and Umatilla currently catch lamprey from tributaries of the lower Columbia River.

Federally recognized tribes have the right to set their own priorities and develop and manage tribal resources within the Federal government framework. Tribal interests and rights are viewed by tribes and traditional communities with the spatial context of tribal ceded lands, traditional native homelands, and places traditionally used by native peoples. Places where tribes have rights to harvest resources may include fishing grounds and stations, root and berry fields, and hunting grounds. Of particular concern to tribes are the potential impacts from water resource management on anadromous fish runs and associated aquatic habitats, and tribal rights to fish for ceremonial, subsistence, and commercial needs.

Additional Information, incorporated by reference, on Native Americans can be found in the Feasibility Study and Appendix Q, Tribal Coordination and Consultation. In assessing effects of the DMMP's proposed courses of action on tribes, the following factors may be considered: 1) water quality and aquatic habitats; 2) accessibility to culturally and religiously significant places and resources; 3) viability and harvestability of culturally significant species; and 4) quality of habitat places that would impact treaty rights to hunt, fish, gather, and graze livestock. Short- and long-term effects on these factors are expected to differ.

3.14.3 Issues and Concerns

Potential effects of the DMMP could result in impacts to tribal communities within the study area. Given that the DMMP is largely associated with in-water activities in the McNary and four lower Snake River reservoirs, tribes are concerned with affects to their treaty rights and interests associated with the study areas' aquatic ecosystem. [See the Aquatic Resources and Biological Assessment appendices (F, G, and K) for a detailed description of the study area's aquatic ecosystem. These appendices also provide information on the condition of species and population trends.]

Specifically, tribes are interested in the health and function of this ecosystem since significant changes could impact the numbers and condition of resources the tribes seek to harvest (e.g., chinook and coho salmon, steelhead, pacific lamprey, bull trout, and white sturgeon). The presence and condition of aquatic species in the lower Snake and Mid-Columbia Rivers are considered, by tribes, to be a direct indicator of the health of fisheries available to them for the meaningful exercise of their tribal fishing rights. To ascertain the condition of these fisheries, tribes examine the conditions and changes to water quality, anadromous fish habitat, fishing places and their access, and competing/predatory fish species populations that may affect tribes' fisheries.

Tribes express concerns if Federal actions have the potential to alter or diminish habitat conditions that aquatic species rely on to migrate, spawn, and feed. Improved or diminished tribal fisheries have the potential to impact social-economic conditions in some tribal communities (Meyer Resources, 1999). Tribes are also concerned about effects to water quality as a health issue. The ability of tribes to maintain their cultural traditional knowledge and practices has the potential to be directly and negatively affected by changes in the aquatic ecosystem.

Another important issue for tribes is the potential impact of DMMP activities on cultural resources (i.e., archaeological sites and traditional cultural properties). Almost 600 cultural sites/properties documenting over 11,000 years of human occupation are located within the project area. Tribes and traditional Indian communities have a lengthy history within the study area and have developed complex "place attachments" that have become an integral part of community lifeways and values. This is still evident in communities today even as they adapt and change with modern times. Preservation of traditional cultural places and resources of significance to traditional communities is a concern of the tribes and is considered by Federal agencies during the planning of Federal undertakings.

Tribes have concerns for cultural properties that lie beneath reservoir waters. Management of these properties using standard methods and procedures is difficult under such conditions. The District is presently undertaking a multi-year study to identify traditional cultural properties located within the McNary and four lower Snake River reservoirs. As these properties are formally documented, they will be considered in planning DMMP actions. Additional cemeteries, villages, homesteads, food processing stations, and ceremonial places could all lie unknown and undocumented beneath reservoirs. Tribes are concerned that such properties and cultural values associated with them may be affected under the DMMP. At least one tribe has indicated that burial of cemeteries under dredged materials is inappropriate given their religious values.

Tribes would like their interests and rights considered within the context of certain tribal cultural values and perspectives not universally represented in Federal decision-making. The context for tribal interest must be examined both from the perspective of Federal legal responsibilities as well as those points raised by tribal government representatives. Protection of treaty rights and resources and cultural resources are of interest to both tribes and the Corps.

3.14.4 Government-to-Government Relations

National policy statements originating from the executive branch of the Federal government provide direction to Federal agencies on how to formulate relations with American Indian tribes and people and deal with common issues. The following are those most often referred to by Federal and tribal representatives:

1983 - Presidential Statement on American Indian Policy (19 Weekly Comp. Doc. 98-102). President Reagan's statement dated January 24, 1983, provided direction on treatment of American Indian tribes and their interests.

1984 - Department of Defense Directive No. 4710.1- June 21.

1993 - Executive Order 12866, Regulatory Planning and Review. The Order enhanced planning and coordination concerning new and existing regulations. It made the regulatory process more accessible and open to the public. Agencies were directed to seek views of tribal officials before imposing regulatory requirements that might affect them.

1994 - Executive Order on Environmental Justice.

1994 - White House Memorandum for the Heads of Executive Departments and Agencies. This emphasized the importance of government-to-government relations with tribal governments and the need to consult with tribes prior to taking actions that may affect tribal interests, rights, or trust resources.

1994 - Government-to-Government Relations with Native American Tribal Governments, Memorandum of 22 April 1994.

1995 - Government-to-Government Relations. The United States Justice Department, Attorney General, issued and signed a policy statement on government-to-government relations on June 1, 1995. It includes references to tribes' sovereignty status and the Federal government's trust responsibility to tribal governments.

1998 - Executive Order 13084, Consultation and Coordination with Indian Tribal Governments, May 14, 1998.

Policy Guidance Letter No. 57, Indian Sovereignty and Government Relations with Indian Tribes. Implements Executive Order 13084.

1998 - DOD American Indian and Alaskan Native Policy, 20 October 1998.

1999 - Project Operations Native American Policy, 12 July 1999.

As noted in Executive Order 13084, the Federal government continues to work with tribes on issues concerning tribal self-government, trust resources, tribal treaty, and other rights as one government to another government. The Order directs agencies to consider affected Federally recognized tribes through the following policy principles:

1. The United States has a unique legal relationship with Indian Tribal governments as set forth in the Constitution, treaties, statutes, executive orders, and court decisions.

2. Tribes, as dependent nations, have inherent sovereign powers over their members and territories with rights to self-government. The United States works with tribes as one government to another government addressing issues concerning tribal self-government, trust resources, and tribes' treaty and other rights.

3. Agencies will provide regular, meaningful, and collaborative opportunities to address the development of regulatory practices that may have significant or unique effects on tribal communities.

4. Cooperation in developing regulations on issues relating to tribal self-government, trust resources, or treaty and other rights should use, where appropriate, consensus-building methods such as rule-making.

The historic development of Federal relations with tribes is based also on many important legal concepts and congressional actions that now form the basis of modern government-to-government relations.

See section 6.4 of this document for further discussion of the Corps' tribal consultation efforts.

SECTION 4
ENVIRONMENTAL EFFECTS OF ALTERNATIVES

This section presents the anticipated environmental effects of the plan alternatives discussed in section 2.5. Consistent with the Council on Environmental Quality's regulations implementing NEPA, environmental effects can be described as:

- *Direct effects*, which are caused by an action and occur at the same time and place;
- *Indirect effects*, which are caused by an action, but are later in time or removed in distance from the action (40 CFR 1508.8); and
- *Cumulative effects* resulting from the incremental impact of an action when considered in combination with past, present, and reasonably foreseeable future actions, regardless of the agency or individual that undertakes such other actions.

Cumulative impacts can result from actions that are, of themselves, minor, but when considered collectively over time, can be significant (40 CFR 1508.7). Cumulative impacts are discussed in section 4.14.

Evaluations of environmental effects presented in this section were based on:

- Documentation of past activities similar to those considered in this EIS.
- Data available on current environmental conditions and probable environmental effects.
- Scientific analysis, knowledge, and experience.

Given the programmatic nature of this DMMP/EIS, efforts were made to project environmental effects of a long-term program. Of necessity, some evaluations of environmental effects are qualitative in nature. Evaluations of the duration and potential severity of anticipated impacts are presented. In general, impacts are characterized as beneficial (positive) or adverse (negative). The severity of impacts is described as *minor*, *moderate*, or *major*, and the duration of the impacts are generally described as *short*- or *long-term*. In some instances where impacts are expected to have a temporary duration, but would be recurring regularly over the 20-year timeframe of the DMMP/EIS, the effects are described as *short-term*. Where adverse environmental effects are expected, mitigation measures have been proposed.

Table 4-1 presents a summary of the anticipated environmental effects of the plan alternatives considered in this DMMP/EIS.

TABLE 4-1. Environmental Effects Summary Matrix.

Discipline	Alternative 1 No Action (No Change) - Maintenance Dredging with In-Water Disposal	Alternative 2 Maintenance Dredging with In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise	Alternative 3 Maintenance Dredging with Upland Disposal and a 3-Foot (0.9-m) Levee Raise	Alternative 4 Maintenance Dredging with Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise
Aquatic Resources	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term effects anticipated. Potential beneficial effects from creation of some in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. Potential beneficial effects (greater than Alternative 1) from creation of shallow water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species. No long-term negative effects anticipated. No creation of in-water fish habitat.	Direct and indirect, minor, short-term effects on food source for aquatic species; no long-term effects anticipated. Potential beneficial effects from creation of shallow water fish habitat, woody riparian habitat and/or beneficial use that may restore habitat.
Terrestrial Resources	Indirect, short-term minor effects on terrestrial wildlife and habitat	Similar effect as Alternative 1; Minor, short-term, indirect impacts on terrestrial species through disruption of habitat from levee raise and displacement during dredging.	Direct, moderate effects to terrestrial species from loss of habitat at upland disposal site and disruption of habitat from levee raise. Positive effects from habitat creation in old borrow area at disposal site.	Indirect, minor, short-term, negative effects through disruption of habitat from levee raise; potential long-term positive effects from beneficial use of dredged material to create upland habitat and woody riparian habitat.
Endangered Species	• *Fish* – "May affect and would likely adversely affect" salmonids but no jeopardy to listed species; "may affect, not likely to adversely affect" bull trout. • *Terrestrial Wildlife* – "May affect, not likely to adversely affect" bald eagle. • *Plants* – "May affect, not likely to adversely affect" Ute ladies' tresses and water howelia; "no effect" on Spalding's silene.	Same effects as Alternative 1.	• Same effects as Alternative 1.	• Same effects as Alternative 1.
Recreation	Minor, short-term impact on access to portions of the river for recreational boats near proposed dredging and disposal activities. Maintains ability to use recreational facilities.	Minor, short-term, direct impact due to disruption of recreational facilities in Lewiston area due to levee raise, and minor short-term impact to recreational boating near dredging and disposal. Maintains ability to use recreational facilities.	Same effects as Alternative 2 except for dredged material disposal. Minor indirect effects to recreational users in the vicinity of the upland disposal site. Maintains ability to use recreational facilities.	Same effects as Alternative 2. Potential long-term, beneficial effect from beneficial use of dredged material if used to enhance recreation sites. Maintains ability to use recreational facilities.
Cultural Resources	Known submerged cultural properties would be avoided to the maximum extent practicable during dredged material disposal and management activities.	Same effects as Alternative 1.	Same effects as Alternative 1. Cultural properties in vicinity of upland disposal site would be avoided.	Same effects as Alternative 1. Potential effects of beneficial uses would be evaluated as proposals are developed.
Socioeconomics	Long-term, positive effect from maintaining navigation. Indirect, long-term, moderate negative effect from greater potential flood risk (no levee raise). Minor effects could occur. Low-income and minority populations not disproportionately affected.	Long-term, positive effect from maintaining navigation. Direct, short-term and long-term positive effect from levee raise due to added jobs and materials required by levee construction. Reduction of flood risk from levee raise. Low-income and minority populations not disproportionately affected.	Same effects as Alternative 2.	Same effects as Alternative 2.
Transportation	Maintains existing transportation systems.	Direct, short-term, minor effect on roadways and railroads from proposed levee/road raise construction activities.	Same effects as Alternative 2.	Same effects as Alternative 2. Potential positive effect if dredged material is used for transportation projects.
Geology and Soils	Local displacement of soils and alluvial material.	Potential short-term effect to soils in the vicinity of levee raise due to construction activities.	Potential short-term effect to soils in the vicinity of the levee raise. Long-term effect on soils at upland disposal site due to construction and disposal activities.	Potential short-term effect to soils from implementation of beneficial use due to construction activities.
Water Quality/ Water Resources	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No effect. • *Flood Plains* – No impacts	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise. • *Flood Plains* – Minor, short-term impact at proposed upland containment site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity. • *Wetlands* - No direct effect. Minor indirect effects associated with levee raise and upland disposal. • *Flood Plains* – Minor, short-term impact at upland disposal site.	• *Water Quality* - Direct, minor, short-term effects due primarily to turbidity and placement of fill in shoreline areas for woody riparian habitat creation. • *Wetlands* - Minor direct effect from woody riparian habitat creation adjacent to wetland. Minor indirect effects associated with levee raise. • *Flood Plains* – No impact to floodplain from woody riparian development. Future beneficial uses may require assessment of floodplain impacts.
Hazardous, Toxic, and Radioactive Waste	No effects anticipated; sediments will be tested for contamination.	Same effects as Alternative 1.	Same effects as Alternative 1.	Same effects as Alternative 1.
Air Quality	Direct, minor, short-term effects to local air quality due to dredging and disposal equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation and upland disposal activities.	Direct, minor, short-term effects to local air quality due to dredging, disposal, and construction equipment operation, including implementation of beneficial use(s).
Noise	Direct, minor, short-term effects due to noise from dredging and disposal equipment operation.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.	Same effects as Alternative 1. Localized minor, short-term noise from construction levees.
Aesthetics	Direct, minor, short-term effect on aesthetics from dredging and disposal activities.	Direct, minor, short-term effects on aesthetics from dredging and disposal activities; long-term, minor impacts from levee raise.	Direct, minor, short-term effects from dredging. Long-term, minor impacts from levee raise. Direct, minor, long-term effects from upland disposal.	Direct, minor, short-term effects from dredging and disposal; long-term, minor impacts from levee raise; and long-term beneficial effect to shoreline area for woody riparian habitat creation.
Native American Tribal Communities	Potential positive effects on salmon fishing from creation of salmon rearing habitat and cultural resources to be avoided.	Potential positive effects (greater than Alternative 1) on salmon fishing from creation of salmon rearing habitat.	No effects anticipated.	Same effects on salmon fishing as for Alternative 2.
Cumulative Effects	Potential positive effects on salmonid fish from creation of shallow-water fish habitat. Other resources were evaluated regarding cumulative effects and nothing was determined to preclude the selection of this alternative.	Potential positive effects on salmonid fish (greater than Alternative 1) from creation of shallow-water fish habitat. Same effects on other resources as Alternative 1.	Potential positive effects to terrestrial species from filling old borrow area at disposal site and establishing vegetation. Same effects on other resources as Alternative 1.	Same effects as Alternative 2. Positive effects from proposed beneficial use of dredged material (e.g., woody riparian habitat development). Same effects on other resources as Alternative 1.

[1] "Impacts" and "effects" are used interchangeably. Unless otherwise noted as beneficial or positive, impacts described are negative.

4.1 AQUATIC RESOURCES

A number of management alternatives to alleviate the sediment accumulation in the navigation channel of the lower Snake River reservoirs and McNary reservoir have been examined in the past. Most have involved removal of sediment through dredging with either in-water or upland disposal. Habitat changes resulting from dredged material disposal can be either beneficial and increase the suitability and availability of habitat for a given species, or can be detrimental and result in less suitable habitat. Improved suitability can result in increased abundance and overall increased biological production, but conversely, decreased suitability can result in decreased abundance or even extirpation of a species from a given area. (Bennett et al., 1997a and 1998)

4.1.1 Dredged Material Removal

Nearly all dredging would be completed mechanically using a clamshell bucket. Due to the characteristics of this equipment, it is generally accepted that clamshell buckets do not have the potential to entrain fish. Specifically, the clamshell bucket descends to the substrate in an open position. The force generated by the descent drives the jaws of the bucket into the substrate, which "bites" the sediment upon retrieval. During the descent, the bucket cannot trap or contain a mobile organism because it is totally open. Based on the operation of the clamshell dredge bucket, it is determined that the dredging operation should not entrain any salmonid species.

The limited use of hydraulic dredging would be restricted to non-agitation suction type dredging and would be used only in off-channel areas (such as HMU irrigation intakes). Hydraulic dredging can have direct impacts to fish and other aquatic organisms by entrainment through the device itself. The timing of use and the use of other fish exclusion techniques (i.e., bubble curtains) would substantially limit these impacts.

Dredging could cause temporary and localized impacts by increasing turbidity and suspended solids. However, the Corps anticipates that, although dredging operations may create a detectable plume extending 1,000 feet (304.8 m) downstream, if operations cause a 5-NTU increase over background (10 percent increase when background is over 50 NTUs) at a point 300 feet (91.4 m) downstream, immediate actions would be taken to reduce the plume.

Ecologically, a number of benefits would accrue from dredging to the original river channel. Among those benefits would be the maintenance of "original" riverine-like habitat for white sturgeon (*Acipenser transmontanus*) and production of riverine-like benthic macroinvertebrates. To date, only one species of crayfish [the signal crayfish (*Pacifastacus leniusculus*)] has been found in Lower Granite reservoir (Lepla, 1994; Anglea, 1997) and its habitat seems to be linked with substrate since it is a hiding species and not burrowing. Lepla's (1994) distribution of spatial abundance of white sturgeon was nearly identical to that for crayfish, an important food item for white sturgeon in Lower Granite reservoir. Anglea (1997) and Naughton (1998) have both demonstrated that crayfish constitute a significant dietary item for smallmouth bass (*Micropterus dolomieui*), and others (Bennett and Shrier, 1987; Bennett et al., 1988; Chandler, 1993) have reported their significance as food for northern pike minnow (*Ptychocheilus oregonensis*) and channel catfish (*Ictalurus punctatus*). In addition, several taxa of aquatic organisms commonly found in the stomachs of juvenile anadromous salmonids in Lower Granite reservoir were from organisms produced on firm substrates (Karchesky, 1996). Hard substrata in lower Granite reservoir occur along riprap (Nightingale, 1999) and the original river channel. Therefore, dredging that could improve the “natural” integrity of the bottom of the river channel in the upstream portion of Lower Granite reservoir and would be beneficial to the production and potential availability of macroinvertebrates to fishes.

However, the upstream end of the reservoir is ecologically the most important habitat area of Lower Granite reservoir for both resident fishes and food items for juvenile anadromous salmonids (Curet, 1994; Lepla, 1994). From a biological perspective, repeated large volume dredging in the area identified for the expanded footprint would deleteriously affect the ecosystem. Effects could include loss of benthic macroinvertebrate production and, in turn, loss of fish rearing habitat. Therefore, dredging alternatives were limited to navigation maintenance.

In addition to material being removed from Lower Granite reservoir, various other locations would require dredging activity. The approach to all navigation locks on the lower Snake River and the navigation channel at Schultz Bar would need to be dredged to maintain navigation in the lower Snake River. Sites requiring material removal related to recreation include boat basins throughout the project area and irrigation intakes at the HMUs maintained by the Corps. In addition, the channel providing navigation access to local ports may also need to be dredged to maintain access to port facilities.

Dredging activities in backwater areas (HMUs and boat basins) would impact different species of fish at different times of the year. During the summer months, dredging the backwater areas has a higher potential for impacting resident fish that prefer warmer waters than the anadromous salmonids, which prefer cooler water. Curet (1994) reported that subyearling chinook salmon migrate from shallow shoreline areas to deeper waters in the spring/summer when shoreline temperatures reach 64.4 °F (18 °C). Therefore, summer dredging would have less potential to impact ESA-listed species occurring in boat basins and irrigation intakes. During the winter, however, both resident and anadromous species have been identified as using backwater areas of McNary reservoir. Most of the predatory resident fish component was comprised of introduced species, and salmonids were comprised of both yearling and subyearling chinook (Easterbrooks, 1996). Presuming that the backwater areas of McNary reservoir are indicative of the project area as a whole, dredging during the winter has a likelihood of adversely affecting these fish since they could be temporarily displaced from those habitats. Dredging occurring in off-channel areas is not expected to enhance or negatively impact fish habitat.

4.1.2 Dredged Material Disposal

Beneficial use of dredged material, such as the proposed woody riparian habitat creation would potentially have benefits for aquatic resources by providing structure and nutrients to the aquatic ecosystem. In-water beneficial disposal of dredged material in the lower Snake River reservoirs is proposed to raise mid-water-depth benches in the reservoirs to shallow-water benches in an attempt to create and enhance fish-rearing habitat. The goals are to provide physical habitat for various species, provide habitat for prey items, and influence near-shore water temperatures to enhance rearing fish. After emergence and initial dispersal, subyearling chinook salmon in both Lower Granite and Little Goose reservoirs have been collected over sand substrate and in areas of reduced velocity (Curet, 1994). Beach seine haul sampling by Curet (1993) suggests that subyearling chinook salmon were concentrated over suitable micro-habitats where conditions such as temperature and dissolved oxygen levels remain at levels conducive for rearing. Bennett and Shrier (1986) and Bennett et al. (1988, 1990, 1991, 1993a, 1993b) captured subyearling chinook salmon over low gradient, low velocity, sandy substrates in Lower Granite reservoir.

In addition, subyearling chinook salmon rearing along the shoreline of Lower Granite reservoir during the spring exhibit a strong selection for substrata consisting of primarily sand and a moderate avoidance of cobble/sand and talus/sand (Curet, 1994). Creation of shallow-water habitat is expected to enhance fall chinook rearing areas.

In-water disposal of dredged material can be designed to increase the abundance and availability of benthic macroinvertebrates to various fish species. With the exception of oligochaete worms, benthic density decreases with depth (Pool and Ledgerwood, 1997). Currently, greater than 90 percent of the habitat in Lower Granite reservoir (and likely the other lower Snake River reservoirs) is considered either mid-depth [20 to 60 feet (6.1 to 18.3 m)] or deep water [greater than 60 feet (18.3 m)]. Therefore, by raising the river bottom in some places, macroinvertebrate abundance could be enhanced in the lower Snake River. Bennett and Shrier (1987), Bennett et al. (1988), and Karchesky (1996) clearly demonstrated the importance of benthic macroinvertebrates in Lower Granite reservoir to downstream migrating salmonids. Dipterans (flies, mosquitoes, and midges) and ephemeropterans (mayflies) were highly abundant in the stomachs of juvenile steelhead and chinook salmon in Lower Granite reservoir. However, Muir and Coley (1996) showed that stomachs from a large proportion of juvenile salmonids collected at Lower Granite were empty, suggesting either low food abundance near the dam or the lack of feeding. The morphometry of the area surrounding the forebay may be one reason for the low presence of food in stomachs of juvenile salmonids collected at Lower Granite. The shoreline in the forebay is steep and water depth is great [50 to 70 feet (15.2 to 21.3 m)]. Food abundance near the water surface is low and seems to be limited to pupating and terrestrial insects that occupy the riprap used to protect the shoreline (Muir and Coley, 1996). Therefore, dredged material might be effectively deposited to enhance the abundance and availability of benthic macroinvertebrates for food to juvenile salmonids and bull trout in the forebay of Lower Granite and possibly other lower Snake River dams by decreasing water depths and rearing areas for prey species.

Creating additional shallow-water habitat could increase the availability of warmer shallow waters in all of the lower Snake River reservoirs. Currently, water temperatures are below optimum throughout the growing season for all resident game fish. Higher water temperatures could enhance annual growth increments and possibly result in higher survival and higher standing crops. Curet (1994) reported that subyearling chinook salmon migrate from shallow shoreline areas to deeper waters in the spring/summer when shoreline temperatures reach 64.4 °F (18 °C). These data indicate that if shallow-water temperatures warmed earlier in the spring up to 64.4 °F (18 °C), growth rates of subyearling chinook and possibly their survival might be enhanced by cuing them to out-migrate earlier in the season from the warmer shallow-water feeding areas during a time of cooler open water in the reservoirs.

The process of upland disposal would require a dewatering process at the transfer station used to move the material from water to land. The potential exists for effluent from dewatering to seep back into the river, possibly increasing turbidity in a localized area.

4.1.3 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Dredged material removal would be done by mechanical means during the winter in-water work window and would remove sediments down to the depth of the original riverbed; the effects of dredging this template to these depths is considered positive on the lower Snake River reservoirs. Sands, gravels and cobbles, expected to comprise 85 percent of the total material, would be placed in water at mid-depth to form shallow-water habitat for rearing anadromous and resident fish. Shallow-water habitat would be created wherever possible. No re-handling or reshaping of the disposed material would occur. Most of the material to be removed from the McNary reservoir is silt and would be deposited in deep water downstream, close to McNary Dam.

4.1.3.1 Direct Effects

Dredging and disposal activities of alternative 1 are anticipated to have short-term, minor effects on aquatic species. The macroinvertebrates in the dredged areas would be removed with the material and would then be redistributed or buried during the disposal process. Those invertebrates at the disposal site would also be buried. These two actions would cause a temporary and short-lived reduction in prey items for fish and crayfish at these two locations.

In most instances, mechanical removal methods would use a clamshell that has little to no opportunity to entrain fish. Both resident and anadromous fish could use the area upstream and downstream of the sites where dredging and disposal activities would occur. The dredging and disposal activities would not be a continuous activity confined to a single location and fish would return to the activity areas shortly after completion of the project. Turbidity and water quality problems are expected to be minimal.

4.1.3.2 Indirect Effects

Recolonization by invertebrate species would follow completion of dredging at both the dredging and disposal areas. Macroinvertebrate production would occur at both the dredge site location and on the disposed material during the following growing season. These species would be available as food organisms to resident and anadromous fish in the following spring.

Creating shallow-water habitat with dredged material may attract resident and anadromous fish to shallower areas for rearing. Continued in-water disposal as done in the past may provide areas of rearing for resident and anadromous fish and would provide structural habitat for adult predacious fish in the lower Snake River system. Material dredged from the McNary reservoir would contain invertebrates that would be redistributed at the disposal site in the lower reservoir. This may serve as a temporary food source to rearing white sturgeon.

4.1.3.3 Summary

Of the alternatives involving in-water disposal, this alternative would provide the least potential benefit to increasing shallow-water habitat for juvenile salmonids rearing in the McNary and lower Snake River reservoirs.

4.1.4 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Dredging and disposal would be similar to that proposed in alternative 1. The primary differences with alternative 2 include the 3-foot (0.9-m) levee raise, the manner in which the disposed material would be placed, and the methods and time of year used to accomplish the dredging. The 3-foot (0.9-m) levee raise would be performed outside of the wetted area of the river and would, therefore, have little to no impact to aquatic species. The disposal of material would occur on mid-depth benches to raise the river bottom, creating shallow-water habitat. The surfaces would be composed of sand and be smoothed over in an attempt to create rearing habitat preferred by fall chinook salmon. The dredging options include using both mechanical and hydraulic dredging. Mechanical dredging would be performed in most areas; however, in backwater areas when temperatures exceed 73 °F (22.7 °C), hydraulic dredging could be used, primarily at irrigation intakes. Curet (1994) reported that subyearling chinook salmon migrate from shallower shoreline areas when temperatures exceed 64.4 °F (18 °C). Therefore, when these fish are not using the backwater areas, hydraulic dredging would have the least potential for entraining anadromous salmonids.

4.1.4.1 Direct Effects

Dredging and disposal activities are similar to alternative 1 and could have short-term, minor effects on aquatic species. The macroinvertebrates in the dredged areas could be removed with the material and redistributed or buried during the disposal process. Those invertebrates at the disposal site could be buried. These two actions could also cause a temporary and short-lived reduction in prey items for fish and crayfish at these locations.

In most instances, mechanical removal methods would use a clamshell that has little to no opportunity to entrain fish. Hydraulic dredging could occur in backwater areas during the warm-water work window; and, although salmonids should not be entrained, this type of dredging may have a deleterious effect on resident fish (none of which are endangered or species of concern) that may prefer these areas during higher temperatures. Both resident and anadromous fish could use the areas upstream and downstream of the sites where dredging and disposal activities would occur. The dredging and disposal activities would not be a continuous activity confined to a single location and fish would return to the activity areas shortly after completion of the project. Turbidity and water quality problems are expected to be minimal since all dredging would occur during periods of low fish abundance.

4.1.4.2 Indirect Effects

Indirect effects are similar to alternative 1, but with greater habitat enhancement potential. Creating shallow-water habitat would attract resident and anadromous fish to shallower areas for rearing. In-water disposal meant to enhance fall chinook rearing areas would provide areas of rearing for resident and anadromous fish and would limit the habitat for adult predacious fish in the lower Snake River system. Few beneficial or detrimental effects would be expected in McNary reservoir.

Creating more shallow-water habitat could increase the availability of warmer shallow water in all of the lower Snake River reservoirs. Currently, water temperatures are below optimum throughout the growing season for all resident game fish. Higher shallow-water temperatures could enhance annual growth increments and possibly result in higher survival and higher standing crops of resident or anadromous fish. Curet (1994) reported that subyearling fall chinook salmon migrate from shallow shoreline areas to deeper waters in the spring/summer when shoreline temperatures attain 64.4 °F (18 °C). These data indicate that, if water temperatures warmed earlier in the spring up to 64.4 °F (18 °C), growth rates of subyearling fall chinook and possibly their survival might be enhanced by cuing them to out-migrate earlier in the season from the warmer shallow-water feeding areas during a time of cooler open water in the reservoirs.

Recolonization by invertebrate species would follow completion of activities at both the dredging and disposal areas. Macroinvertebrate production would occur at the dredge site location and on the disposed material during the following growing season. These species would be available as food organisms to resident and anadromous fish in the following spring.

4.1.4.3 Summary

As with alternative 1, impacts to fish species as a result of dredging and in-water disposal would be short-term and minor, primarily as a result of displacement during the dredging and disposal activities. The disposed dredged material would be shaped to provide a smooth, sandy bottom with depths and slopes beneficial to fish rearing. Impacts to fish habitat could be long term and beneficial if the dredged material is placed in shallow water. Monitoring of beneficial in-water disposal sites would be conducted to confirm the effectiveness of habitat creation (see section 4.3.1.1.2).

4.1.5 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impacts as described for alternatives 1 and 2 in the dredging areas. Although similar to alternative 2, the primary difference between alternatives 2 and 3 is the location of disposal (upland versus in-water).

4.1.5.1 Direct Effects

The direct effects are similar to those discussed in alternative 2, including redistribution of invertebrates at the dredging site; however, although aquatic invertebrates within the dredged material would be buried at the upland site, no aquatic invertebrates would be buried at any in-water disposal site. In addition, no entrainment of salmonids would be expected and minimal entrainment of resident fish would be expected.

4.1.5.2 Indirect Effects

The indirect effects of alternative 3 are similar to those in alternative 2, but without the additional benefits of the habitat enhancement. By dredging down to hard substrate river bottom, macroinvertebrate production and diversity would be enhanced. Thus, dredged material removal of accumulated sediments could have a positive effect.

The levee raise would occur on the adjacent uplands. The nominal 3-foot (0.9-m) levee raise would have no impact on aquatic species.

No aquatic ecological benefits would accrue from upland disposal. The process of upland disposal would require a dewatering process at the transfer station used to move the material from water to land. The potential exists for effluent from dewatering to seep back into the river, possibly increasing turbidity in a localized area.

4.1.5.3 Summary

As with alternatives 1 and 2, impacts to fish species as a result of dredging and in-water disposal would be short-term and minor, primarily as a result of displacement during the dredging and disposal activities. No long-term and beneficial results for aquatic habitat would occur with upland disposal.

4.1.6 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Dredging and disposal would be similar to that proposed in alternative 2. The primary differences between alternatives 2 and 4 include the manner in which the disposed material would be used. The 3-foot (0.9-m) levee raise would be performed outside of the wetted area of the river and would, therefore, have little to no impact to aquatic species. The disposal of dredged material could be used to create mid-depth-water benches to raise the river bottom, creating shallow-water habitat. The surfaces would be composed of sand and be smoothed over in an attempt to create rearing habitat preferred by fall chinook salmon. The dredging options include using both mechanical and hydraulic dredging. Mechanical dredging would be performed in most areas; however, mechanical or hydraulic dredging could be used in backwater areas when temperatures exceed 73 °F (22.7°C) or when it can be documented that ESA-listed fish would not be present.

This alternative states that dredged material would be put to beneficial use, and alternative 2 states that in-water disposal to create fish habitat would be used. These two options, although apparently similar, have some major differences. In alternative 2, all disposal of material (with exception of contaminated material) would occur in-water and would be used to create fish habitat. In alternative 4, in-water would be one disposal method, but other methods would also be considered. Initially, the proposed beneficial use would be creation of woody riparian habitat in shoreline areas of Chief Timothy HMU and possibly other areas along the lower Snake River, as described in Section 1.8. Members of the LSMG would be able to suggest other beneficial uses of the material, including fill of land and ports, capping areas in need of topsoil, creating or restoring riparian areas, and use of silt in industrial practices such as making potting soil.

4.1.6.1 Direct Effects

Dredging and disposal activities are assumed to be similar to alternative 2 and could have short-term, minor effects on aquatic species. The macroinvertebrates in the dredged areas would be removed with the material and redistributed or buried during the disposal process. Those invertebrates at the disposal site could be buried. These two actions could also cause a temporary and short-lived reduction in prey items for fish and crayfish at these locations.

In most instances, mechanical removal methods would use a clamshell that has little to no opportunity to entrain fish. Hydraulic dredging could occur in backwater areas and, although salmonids should not be entrained, this type of dredging may have a deleterious effect on resident fish (none of which are endangered or species of concern) that may prefer these areas. Both resident and anadromous fish could use the areas upstream and downstream of the sites where dredging and disposal activities would occur. The dredging and disposal activities would not be a continuous activity confined to a single location. Fish would return to the activity areas shortly after completion of the project. Turbidity and water quality problems are expected to be minimal since all dredging would occur during periods of low fish abundance.

Creation of woody riparian habitat would involve placement of dredged materials in shoreline areas of the lower Snake River. This would have long-term positive effects for aquatic resources. Placement of dredged material in-water to create fish habitat would have similar effects to alternative 2.

4.1.6.2 Indirect Effects

Indirect effects are similar to alternative 2. Creating shallow-water habitat may attract resident and anadromous fish to shallower areas for rearing. In-water disposal meant to enhance fall chinook rearing areas would not only provide areas of rearing for resident and anadromous fish but also would limit the habitat for adult predacious fish in the lower Snake River System. Recolonization by invertebrate species would follow completion of dredging at both the dredging and disposal areas. Macroinvertebrate production would occur at the dredge site location and on the disposed material during the following growing season. These species would be available as food organisms to resident and anadromous fish in the following spring. Any creation or restoration of riparian zones, such as the proposed woody riparian habitat program at Chief

Timothy HMU, would also be beneficial to fish by creating a more natural shoreline conducive to food production.

4.1.6.3 Summary

As with alternative 2, impacts to fish species as a result of dredging and riparian habitat creation, as well as in-water disposal, would be short-term and minor, primarily as a result of displacement during the dredging and disposal activities. Restoration of riparian zones would be conducive to restoring fish habitat, as it would provide structure and nutrients that are beneficial to the aquatic ecosystem. If the disposed dredged material were placed in water, it would be shaped to provide a relatively smooth bottom with depths and slopes beneficial to fish rearing. Impacts to fish habitat could be long-term and beneficial. Monitoring of beneficial in-water disposal sites would be conducted to confirm the effectiveness of habitat creation (see section 4.3.1.1).

4.1.7 Critical Habitat Considerations

The project area is designated to be Critical Habitat for all four Snake River salmon ESU stocks, Upper Columbia River Spring-Run Chinook Salmon, and for Snake River, Middle Columbia, and Upper Columbia Basin steelhead. In designating Critical Habitat, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing of offspring; and, generally, (5) habitats that are protected from disturbance or are representative of historical geographical and ecological distributions of the species.

In addition to these factors, NMFS also focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection, termed Essential Fish Habitat (EFH) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 *et seq*. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation [50 CFR 424.12(b)], and can be generally described to include the following: (1) juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas. Within these areas, essential features of Critical Habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions. Adjacent riparian area is defined by NMFS as the area adjacent to a stream (river) that provides the following functions [components of Properly Functioning Habitat or Properly Functioning Condition]: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Section 9 of the ESA makes it illegal to “take” a threatened or endangered species of fish. The definition of “take” is to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 U.S.C. 1532(19)). The NMFS interprets the term "harm" in the context of habitat destruction through modification or degradation as an act that actually kills or injures fish.

Table 4-2 and visual surveys of 1934 sounding data used to recreate the pre-dam lower Snake River channel demonstrate that an unimpounded large class river is primarily composed of greater than 70 percent shallow-water habitat in the form of opposing deposition bars of sand for most flow years, and at least 50 to 60 percent shallow-water habitat for very high flow years where possibly 10 percent of the lower Snake River could constitute deep water. The pooling of Lower Granite reservoir in 1975 inundated the historical shallow-water habitat, thus converting approximately 40 to 60 percent of the shallow-water sand bar habitat used by juvenile fall chinook salmon into mid-depth bench habitat more suitable for white sturgeon (if no additional structural cover is provided in the substrate) or adults of resident predator species (if additional structural cover is provided in the substrate) or deep-water habitat utilized by few species (e.g., channel catfish). An analysis of limiting conditions for reservoir-wide habitat readily indicates that shallow-water habitat composed of low gradient, open sand with no additional cover structure (e.g., opposing sand bars) suitable for and replicative of fall chinook salmon rearing habitat should be a main objective for maximizing beneficial use of in-water disposal of dredged material.

Table 4-2. Quantification of Three Water Depth Habitats in Lower Granite Reservoir, Snake River (SR) and Clearwater River (CR) During the Early- to Mid-1980's [(1)].

Reservoir Reach (RM)	Shallow [<20 ft (6.1 m)] Acres/Hectares (Percent)	Mid-Depth [20-60 ft (6.1-18.3 m)] Acres/Hectares (Percent)	Deep [>60 ft(18.3 m)] Acres/Hectares (Percent)	Total Acres/Hectares (Percent of Total Reservoir or Reach)
SR107.4-SR120.46	281/113.7 (8%)	1,241/502.2 (34%)	2,147/868.9 (57%)	3,669/1 484.8 (43%)
SR120.46-SR146.33	983/397.8 (8%)	2,795/1 131.1 (58%)	1,017/411.6 (21%)	4,795/1 940.5 (57%)
SR107.4-SR146.33	1,264/511.5 (15%)	4,036/1 633.3 (48%)	3,164/1 280.4 (37%)	8,464/3 425.3 (94%)
CR0.0-CR4.4	349/141.2 (71%)	141/57.1 (29%)	0/0 (0%)	489/197.9 (6%)
SR107.4-SR146.33 and CR0.0-CR4.4	1,612/652.4 (18%)	4,177/1 690.4 (47%)	3,164/1 280.4 (35%)	8,953/3 623.2 (100%)

(1) Estimates calculated from U.S. Army Corps of Engineers cross section profiles. SR120.46 is the mid-reservoir section where the majority of the fine silt and sand material settles out due to increased rate of depth affecting the slowing rate of water velocity.

To determine the minimum surface acreage of habitats to be created, pre-impoundment aerial photos of the shorelines of the lower Snake River were studied and the sandy, shallow-water areas conducive to rearing fall chinook salmon were measured. Historically, a wide size range of these habitats existed but a minimum surface area for shallow-water habitat creation was designated as 4 acres (1.6 hectares). This acreage was actually lower than the average habitat area found pre-impoundment, but was calculated as the minimum necessary to attempt to mimic the free-flowing shoreline habitat required by fall chinook salmon.

Apart from this comparison between the abundance and suitability of historical versus existing shallow-water sandbar habitat, very few of the EFH components that existed along the shoreline of the lower Snake River reservoirs have been modified or eliminated in the recent past due to previous maintenance dredging, where other associated human activities and economic growth along the shorelines have resulted in some modification of habitat that introduced additional needs for dredging. The two EFH components that may have been potentially influenced by confluence dredging in the past are juvenile migration corridor and adult migration corridor, specifically the essential features of substrate, water quality, food (as in macroinvertebrate production), and safe passage conditions. Adjacent to the footprint boundary for dredging in the confluence is a critically important juvenile rearing area for fall chinook salmon in the embayment of Wilma. The existing open, sandy, shallow-water rearing habitat within Wilma remains protected from modification of any bathymetric feature that would be due to proposed dredging and, therefore, would not be affected by the dredging proposed to occur in the main stem channel. Dredging activities would be confined to the in-water work window when no or very few salmonids would be migrating or requiring pre-migration rearing, so exposure to short-term increases in turbidity should not exist. Dredging is not allowed at elevations below the existing channel bottom contours because removal of input sand and silt is the target; hence, native substrate classes of cobble and gravel suitable for spawning should not be affected. It has been routinely shown that macroinvertebrates displaced by dredged material removal aid in colonizing or supplementing existing populations at the in-water disposal sites and that the populations at the removal site become recolonized relatively rapidly depending upon season (Bennett et al., 1990, 1991, 1993a, 1993b, 1995a, 1995b; Bennett and Nightingale, 1994), both influenced through the mechanism of drift.

The EFH components that may be potentially influenced by dredging in the boat basins or their approaches from the main channel are juvenile rearing areas, juvenile migration corridors, and adult migration corridors (specifically the essential features of substrate, water quality, water velocity, food (as in macroinvertebrate production), and safe passage conditions. Boat basins and HMU water intake basins fill with fine substrate dominated by silt that is not suitable substrate preferred by salmonids. High use by recreational boat traffic can limit their suitability for salmonid rearing. Dredging activities would be conducted during both the winter in-water work window and during the summer if water temperatures exceed 73 °F (22.7 °C). Few to no salmonids would be expected to occur in backwater areas during both of these time periods, so exposure to short-term increases in turbidity would either not exist or would have a minimal effect. These areas would be dredged primarily by mechanical means; however, limited amounts of hydraulic dredging may occur during periods of warm water when salmonids would not be present. Water velocities would not be affected since these areas are functionally shallow water back eddies more suitable for resident fish. Macroinvertebrates displaced by dredged material removal can aid in colonizing or supplementing existing populations at the in-water disposal sites and the populations at the removal site become recolonized relatively rapidly depending upon season. An additional concern with the substrate quality removed from boat basins that have not been dredged in a number of years is the potential for the accumulation of bound contaminants in the silt as a result of spillage from fueling or other activities, or brought downriver to settle in the lower velocities of the backwater eddy environment. Recent sampling in these basins indicates that concentrations of contaminant indicators are below the level that would preclude their disposal in-water. In the event that a pocket of visually contaminated sediments is hauled up in the clamshell or bucket, the Corps would direct that area be classified and investigated as HTRW and deposited in a truck for removal to an appropriate established waste disposal site.

The EFH component that may be potentially influenced by dredging in the lock approaches of Lower Granite and Lower Monumental, which are spawning areas, specifically concerns the essential features of substrate, water velocity, cover/shelter, and possibly food (as in macroinvertebrate production). Prior to dredging, these areas would be surveyed for redds according to established protocol (Dauble et al., 1995) to determine if modifications to velocity and substrate could cause salmon to avoid these areas for spawning. If redds are found and verified, then location and duration of dredging would be modified to accommodate avoidance and protection of any verified redds.

The Corps believes that periodic maintenance dredging performed on a schedule of every 2 to 3 years and contained entirely within the previously disturbed footprint would not degrade the suitability of that habitat for Snake River Basin Sockeye, Snake River spring/summer and/or fall chinook salmon, Snake and/or Middle Columbia and/or upper Columbia River Basin steelhead, or Upper Columbia River Spring-Run Chinook salmon, thus not adversely modifying Critical Habitat or EFH components of that Critical Habitat. This is because the area is used primarily as a migration corridor for all life stages of these stocks and migration of each life stage of each stock has terminated for the brood years, with the exception of potential for utilization of the submerged shallow water for rearing and feeding by fall chinook and some adult migration by B-run steelhead to upriver tributaries to hold for spawning in the following spring. None of the known or potential areas used by fall chinook salmon for rearing would be disturbed by any dredged material removal action.

4.1.8 Mitigation

Dredging would remove macroinvertebrate prey species within the dredging template. Recolonization would occur at the dredging site within a few months (during the next growing season). Alternative 2, to a lesser extent alternative 1, and the fish habitat creation and riparian habitat creation beneficial uses proposed in alternative 4, would reposition these materials to locations within the reservoirs that would allow for additional macroinvertebrate production. Prey availability would increase for juvenile out-migrating salmonids and bull trout at the disposal locations.

Dredging to the natural river channel and in-water disposal would improve habitat conditions by providing habitat more conducive to additional prey species production. In order to avoid direct impacts such as entrainment of juvenile salmonids, dredging and disposal activities would occur when salmonid species are less likely to be present.

The disturbance of silt during dredging and the discharge of dredged material have the potential to impact listed species. However, the disturbance caused by the mechanical dredge as it enters the water and removes material would tend to cause any listed species present to leave the dredging area. The engine noise from the tugboat pulling the transport barge may cause fish to move away as the barge approaches the disposal site. Fish are known to respond evasively to a variety of stimuli (Popper and Carlson, 1998). Except in the very shallow disposal sites, the sudden stimulus of the nose or shock wave associated with the release of the dredged material or the sudden decrease in light would be expected to startle fish and induce them to dart away from the source (Anderson, 1990).

In addition to ESA consultation with the USFWS, the LSMG would, on a case-by-case basis, evaluate the potential for impacts to bull trout and other listed species. Depending upon the location, the quantity of material to be dredged, and the proposed disposal location, modifications to the typical "fish window" may be considered.

4.2 TERRESTRIAL RESOURCES

4.2.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

For the navigation project, a 14-foot (4.3-m) channel with at least 15 feet (4.3 m) over the sills at each of the locks and 14-foot-by-250-foot (4.3-m-by-76.2-m) channels providing access to port and barge loading facilities in each reservoir will be provided. For the dredging in the Lower Granite reservoir, dredged materials would continue to be disposed of near Centennial Island in shallow water [15 to 35 feet (4.6 to 10.7 m)] and at mid-depth [35 to 63 feet (10.7 to 19.2 m)] and deep water [greater than 63 feet (19.2 m)]. For the remaining three reservoirs on the lower Snake River, dredged material would continue to be disposed of in deep water, mid-depth water, and near-shore water. Habitat has been and would continue to be created or enhanced. For example, in McNary reservoir, dredged materials have been used in the past to create islands and to enhance wildlife habitat.

Dredging and disposal actions within and adjacent to the river would not prevent wildlife from obtaining food from adjacent areas. No trees would be removed; therefore, streamside and shoreline perch trees would not be impacted. Waterfowl, fish, and other wildlife would use the areas above and below the sites where dredging and disposal activities occur. The dredging and disposal activities would not be a continuous activity confined to a single location. Waterfowl, fish, and other wildlife would return to the activity areas shortly after completion of the project.

Similarly, aquatic furbearers that occur at or near the dredging or disposal site vicinity have not been adversely impacted by past dredging and disposal activities. They have been and would continue to be deterred from using the sites during the dredging, transport, and disposal activity but would continue to use adjacent areas during dredging/disposal activities.

Other mammals, such as mule deer, would not be impacted by this alternative since there would be no impacts to existing uplands.

In summary, dredging and disposal activities under alternative 1 would have indirect, short-term, minor effects on terrestrial wildlife and habitat.

4.2.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

As noted above, impacts to terrestrial species as a result of the dredging and in-water disposal would be indirect and minor, primarily as a result of displacement during the operation. With completion of the dredging and disposal activities, wildlife and waterfowl displaced by the activities would return.

For this alternative, material unsuitable for beneficial use or in-water disposal would be isolated at the Joso upland disposal site and appropriate confinement measures would be taken to isolate this material (i.e., an impervious liner). The barge facility for off-loading these dredged materials would be located at the west end of the site. The disposal site at Joso is contained primarily within an abandoned gravel quarry, used during the construction of Lower Monumental reservoir. The total impact area would be approximately 100 acres (40.5 hectares). Wildlife using this area would be displaced from the barge facility area and the disposal area during construction and operation of the facility. The facility would not be used continuously and some wildlife and waterfowl would return to the area during the months and years when dredging and disposal activities were not occurring. Depending upon the quantity of material requiring disposal, some poor-quality, previously disturbed upland habitat would be lost in the quarry area. Disturbances caused by noise and general activity during disposal activity may cause more sensitive species to abandon the site. Upland disposal at Joso is expected to have a direct, long-term, moderate impact on terrestrial wildlife. The disposal area will be planted to native vegetation, which would benefit terrestrial wildlife in the future.

The proposed 3-foot (0.9-m) levee raise would similarly have minimal, indirect, temporary impacts on terrestrial species. Construction could disturb wildlife. However, the areas proposed for the levee raise are in an urban setting and only those species accustomed to human activity would be present. The levee raise would be placed atop the existing levee. Revegetation would result in habitat similar to existing conditions.

4.2.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impact as described for alternatives 1 and 2. Some displacement of waterfowl and aquatic furbearers from the dredging area could occur. Long-term impacts would not occur.

Disposal of dredged material would occur at the Joso site on the Snake River below Little Goose. The entire site is approximately 568 acres (229.9 hectares), with open space/wildlife habitat management being the present use. Barge access to the Joso site would be at the west end, providing access to a disposal area of approximately 280 acres (113.3 hectares) located in the center of the site with 600-foot (182.9-m) buffers from the river. Part of the disposal area is a disturbed site that was historically used for gravel extraction and currently contains an exposed open gravel quarry. This action would also disturb approximate 190 acres (76.9 hectares) of upland habitat outside of the quarry by direct deposition of dredged material on top of the existing vegetation. Less than 2 acres (0.8 hectare) of riparian habitat would be removed to construct this barge off-loading facility. Wildlife using these areas would be displaced from the barge facility area and the disposal area during construction and operation and some species may be displaced permanently. The 600-foot (182.9-hectare) buffer along the shoreline would continue to provide habitat; however, disturbances during disposal activity may cause more sensitive species to abandon the site.

The area would be stabilized following each dredging cycle and would be recontoured and restored with native plantings following completion of all dredging over the next 20 years. With completion of the disposal and revegetation, the site would revert to wildlife habitat similar to the surrounding area. Upland disposal at Joso is expected to have a direct, long-term, moderate impact on terrestrial wildlife. The impacts would be from dredged material storage activities at the site over the next 20 years. Habitat would also be decreased as the dredged material storage expands across the impact area. There would also be a time lag of 5 to 7 years where habitat once available would be either unvegetated or in the early regrowth stages after restoration. If restoration progresses as areas are filled, developed habitat would still be fragmented until all work ceases after 20 years.

As with alternative 2, dredged materials unsuitable for in-water disposal or beneficial use would be isolated and appropriate confinement measures taken (e.g., an impervious liner installed to prevent leaching).

The impact of the 3-foot (0.9-m) levee raise would be similar to alternative 2.

4.2.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impact as described for alternatives 1, 2, and 3.

Disposal activities would have varying impacts to terrestrial species, depending upon which beneficial use was used for a particular dredging activity. The proposed woody riparian habitat creation would have a short-term direct impact on terrestrial wildlife in the vicinity of the selected sites. However, creation of woody riparian habitat would provide long-term benefits for terrestrial wildlife by creating additional habitat consistent with the Lower Snake River Fish and Wildlife Compensation Plan. If in-water disposal to create fish habitat were selected as the disposal option, impacts to terrestrial species would be similar to those for alternative 2. If riparian habitat restoration were selected, species dependent upon riparian vegetation would benefit the most. Fill activities on upland sites may have adverse impacts to terrestrial species. Potential impacts to terrestrial species would be considered prior to the selection of a beneficial use.

Impacts to Joso as a result of disposal of unsuitable dredged material would be the same as for alternatives 2 or 3.

4.2.5 Mitigation

With the exception of alternative 3 and upland disposal of some of the dredged material at Joso, the impacts to terrestrial species would be minimal and short-term. Mitigation for alternatives 1, 2, and 4 is not necessary since impacts to existing habitat are minimal and the future habitat would be enhanced after dredging and disposal activities are completed.

Alternative 3 involves direct, long-term, moderate impact to an HMU. The HMUs were developed to mitigate for habitat loss due to the inundation of lands behind dams. These lands are designated for wildlife habitat protection and enhancement under the Lower Snake River Fish and Wildlife Compensation Plan (Corps, 1999b). Existing habitat is a part of those contributing to the total habitat value calculated for the lower Snake River (Sather-Blair et al., 1991). Shrub-steppe, grassland, and forbland habitats are found within the potential impact area under alternative 3. Although, the site would be restored after the dredging cycle is completed, interim compensation for lost habitat may still be needed. The interim loss of 190 acres (76.9 hectares) of upland habitat could be compensated by replacement through the purchase of new land.

Mitigation/replacement of the upland and riparian vegetation would be coordinated with the WDFW and USFWS. A revegetation planting and monitoring plan would be prepared for review and comment. This plan would be the basis for site restoration. The plan would be developed following final selection of the Joso site as the preferred disposal site.

For Joso, the disposal area could be contoured and restored as cells are completed. This would be a long-term mitigation program depending upon the amount of material that is disposed of annually.

4.3 ENDANGERED SPECIES

4.3.1 Fish

4.3.1.1 Anadromous Fish

The Corps consulted with NMFS and prepared a Biological Assessment for the proposed dredging and dredged material management activities documented in the DMMP/EIS (see appendix F). NMFS determined that, based upon implementation of a series of Reasonable and Prudent Measures, the proposed actions would not cause jeopardy to, or adversely modify the Critical Habitat of anadromous fish species listed under the Endangered Species Act (ESA).

4.3.1.1.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

The ESA-listed anadromous fish known to occur in the proposed project area include Snake River Basin Spring/Summer, and Fall chinook salmon; Sockeye salmon; and steelhead. In addition, Middle Columbia Steelhead, Upper Columbia steelhead, and Upper Columbia Spring

Chinook salmon are expected to occur in McNary reservoir. The ESA-listed anadromous salmonid species using the existing shallow-water habitat would be primarily Snake River fall chinook salmon. The main benefits of this alternative are that dredging would restore hard substrate for prey production and would create shallow-water habitat. This alternative provides the least potential benefit to increasing habitat for fall chinook salmon rearing in the McNary and lower Snake River reservoirs since they prefer smooth sandy substrates. A review of potential impacts to fall chinook salmon is presented in section 4.1.2. Because of the potential for individuals of ESA-listed salmonids to exist within the dredging and disposal areas year round, it was determined that this alternative "may affect and would likely adversely affect" six of the seven above-listed salmonid ESUs. The exception would be the Snake River Sockeye salmon, which have not been documented in the main stem Snake or Columbia Rivers or its backwaters outside of the normal migratory windows.

4.3.1.1.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

As discussed in section 4.1.4, this alternative would provide the opportunity to develop shallow-water habitat throughout the project area. This alternative "may affect and would likely adversely affect" six of the seven ESA-listed salmonid ESUs (with the exception of sockeye salmon) similar to alternatives 1 and 4. To confirm the effectiveness of habitat creation, biological monitoring would be conducted in accordance with the mitigation plan.

4.3.1.1.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

As noted in section 4.1.5, the dredging activity associated with this alternative would have the same impacts as described for alternatives 1 and 2 in the dredging areas but no beneficial shallow-water habitat would be created. This alternative "may affect and would likely adversely affect" six of the seven ESA-listed salmonid ESUs with the exception of sockeye salmon.

4.3.1.1.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The impacts to listed anadromous fish species from this alternative are discussed in section 4.1.6. A number of beneficial uses are discussed in section 2.5.4. These include:

- Woody Riparian Habitat Creation – This is the proposed beneficial use that would be implemented during the initial years of the DMMP. This program would establish woody riparian habitat in shoreline areas of Chief Timothy HMU in Lower Granite Reservoir and possibly other sites along the lower Snake River. The Corps would evaluate the areas of proposed dredged material placement to ensure that fish habitat would not be disturbed and would monitor the success of the habitat creation and, if appropriate, propose additional areas where this beneficial use of dredged material could occur.

- Hanford Capping - This use would improve the dredged area by providing hard substrate for prey species. No benefit for listed aquatic species would be accrued by disposal since the dredged material would be placed on uplands.

- Potting Soil- Impacts from this use would also be beneficial at the dredge location. No benefit would be derived for listed aquatic species from the disposal of dredged material.

- Riparian Habitat Restoration -This use would have similar impacts at the dredge site location. The dredged material would be used to create shallow shoreline areas. These new shoreline areas would provide additional rearing and feeding habitat for listed species.

- Port of Wilma Fill - Dredging would provide hard substrate for prey species. The dredged material would be removed from use for habitat creation and, thus, no benefit would be realized from disposal.

- Fill of Non-Federal Public Land - Benefits from dredging would be realized. The location and nature of the fill activity is not yet defined; however, the range of impacts would be similar to those above. If shallow-water habitat is created by the fill, the activity would be beneficial to listed species. Conversely, since upland areas are filled, no benefit to aquatic habitat from disposal would be realized.

- Lower Granite SR193/SR194 Road Connection - A number of alternative alignments have been considered. Depending on the alternative selected, some shallow-water habitat could be created that would be beneficial to listed species.

- Research of Beneficial Uses - Two research groups at the Corps Waterway Experiment Station are investigating measures to use fine-grained sediment suitable for use as a top dressing and habitat restoration.

Each of these beneficial uses would have a positive impact on listed species and their prey organisms as a result of dredging. As pointed out above, some of these proposed uses would also create shallow-water habitat. However, due to the potential for direct impacts to anadromous fish, this alternative "may affect and would likely adversely affect" six of the seven listed salmonid ESUs (except Sockeye salmon). This determination would be reevaluated as specific actions are selected. However, the NMFS has determined that the effects of the proposed actions will not jeopardize the continued existence of endangered SR sockeye, threatened SRF chinook, threatened SRSS chinook, threatened SRB steelhead, endangered UCRS chinook, endangered UCR steelhead, or threatened MCR steelhead or result in the adverse modification or destruction of their Critical Habitat. The determination of no jeopardy is based upon the current status of the species, the environmental baseline for the action area, and the effects of the proposed actions (Appendix F).

4.3.1.2 Resident Fish

The Corps has conferred with the U.S. Fish and Wildlife Service (USFWS) and prepared a Biological Assessment (BA) regarding listed fish species that fall within their jurisdiction (i.e., resident, non-anadromous fish). The Biological Assessment and the USFWS' concurrence letters are presented in appendix G. The BA findings for each alternative are summarized below.

4.3.1.2.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Bull trout (*Salvelinus confluentus*) generally are not found in the main stem Snake River, preferring colder water and gravelly substrate. The main subpopulation of bull trout associated with the four lower Snake River reservoirs spawns and rears in the Tucannon River Basin. Both resident and migratory forms occur there. They have been reported in the Clearwater River, although in the headwaters upstream of the project area (Bowerman et al., 1998). A very limited number have also been reported in the Snake River. Hayley (1999) noted 37 records of bull trout in the lower Snake River since 1991. Most were noted at adult fish counting stations at the dams and passed in April, May, or June.

The disturbance of silt during dredging and the discharge of dredged material have the potential to impact bull trout. However, the disturbance caused by the mechanical dredge as it enters the water and removes material would tend to cause any bull trout present to leave the dredging area. The engine noise from the tugboat pulling the transport barge may cause fish to move away as the barge approaches the disposal site. Fish are known to respond evasively to a variety of stimuli (Popper and Carlson, 1998). Except in the very shallow disposal sites, the sudden stimulus of the nose or shock wave associated with the release of the dredged material or the sudden decrease in light would be expected to startle fish and induce them to dart away from the source (Anderson, 1990).

Although bull trout have been reported in the Snake River only during April, May, and June, it should be noted that the counting stations are closed during the winter months and thus bull trout could be present during the dredging and disposal periods. Therefore, alternative 1 could have an impact on bull trout in select locations within the project area (i.e., near the Tucannon River). Bull trout are least likely to be present during times of highest main stem water temperatures (late summer).

Dredging would be completed using mechanical means, primarily by means of a clamshell. Due to the characteristics of this equipment, it is generally accepted that clamshell buckets do not have the potential to entrain fish. Specifically, the clamshell bucket descends to the substrate in an open position. The force generated by the descent drives the jaws of the bucket into the substrate, which "bites" the sediment upon retrieval. During the descent, the bucket cannot trap or contain a mobile organism because it is totally open. Based on the operation of the clamshell dredge bucket, it is determined that the dredging operation should not entrain bull trout.

Dredging and disposal would cause temporary and localized impacts by increasing turbidity and suspended solids. The Corps anticipates dredging operations may create a detectable plume extending 1,000 feet (304.8 m) downstream. Should dredging and disposal operations cause more than a 5-NTU increase over background (10 percent increase when background is over 50 NTU's) at a point more than 300 feet (91.4 m) downstream, immediate actions would be taken to reduce the plume. Background turbidities in the lower Snake River reservoirs and McNary reservoir, generally do not exceed 10 NTU's (Corps, 1999). Van Oosten (1945) concluded from a literature survey that average turbidities as high as 200 NTU's are harmless to fish. Based on the disparity between the turbidity increases anticipated as part of the dredging and disposal operation and the levels reported to be harmful to fish, it is determined that the dredging and disposal operations would not effect bull trout as a result of increased turbidity.

The likelihood of bull trout being in the project(s) location is remote. The ability of fish to avoid high turbidity and clamshell dredge equipment suggests that bull trout, if they were to occur in the action area, would not be entrained by dredging and disposal activities. Thus, this alternative "may affect but is not likely to adversely affect" bull trout.

4.3.1.2.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Impacts would be similar to alternative 1. Bull trout occurrence in the dredging and disposal areas, while possible, would be very unlikely. Should the Corps use hydraulic dredging at irrigation intakes in the summer, bull trout would not likely be in the vicinity of the dredging since the intakes would be in isolated locations with water temperatures high enough to exclude bull trout. If the water temperatures were not high enough to exclude bull trout, bubble curtains could be employed to scare fish away from the dredging zone. Use of hydraulic dredging at a particular site would be coordinated with USFWS prior to the start of dredging. This alternative could be used to enhance habitat potentially used by bull trout. Although they are very rare in the Snake River, creation of shallow-water habitat could provide impact. Thus, beneficial uses could have a positive effect on bull trout. The alternative "may effect but is not likely to adversely effect" bull trout.

4.3.1.2.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Impacts would be similar to alternatives 1 and 2 for bull trout. Upland disposal and the levee raise would have no direct impact on bull trout. The alternative "may affect but is not likely to adversely affect" bull trout.

4.3.1.2.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impact as described for alternatives 1, 2, and 3.

Disposal activities would have varying impacts to bull trout, depending upon which beneficial use was used for a particular dredging activity. Proposed woody riparian habitat creation at Chief Timothy HMU in Lower Granite Reservoir (and possibly other sites on the lower Snake River) would be unlikely to adversely affect bull trout. If in-water disposal to create fish habitat were selected as the disposal option, impacts to bull trout would be similar to those for alternative 2. Although bull trout are very rare in the Snake River and generally have only been reported during the spring and summer months, creation of shallow-water habitat could provide a beneficial impact. If riparian habitat restoration were selected, bull trout may benefit. Fill activities on upland sites would have no impact on bull trout. Potential impacts to bull trout would be considered prior to the selection of a beneficial use.

The alternative "may affect but is not likely to adversely affect" bull trout. This evaluation will be reevaluated as specific actions are selected.

4.3.1.3 Mitigation

Dredging would remove macroinvertebrate prey species within the dredging template. Recolonization would occur at the dredging site during the next growing season. Alternative 2, to a lesser extent alternative 1, and potentially alternative 4 under the secondary disposal management option, would reposition these materials to locations within the reservoirs that would allow for additional macroinvertebrate production. Prey availability would increase for juvenile out-migrating salmonids at the disposal locations.

Dredging to the natural river channel depth and in-water disposal can improve habitat conditions by providing habitat more conducive to additional prey species production. In order to avoid direct impacts such as entrainment of juvenile salmonids, dredging and disposal activities would occur when salmonid species are not likely to be present.

No mitigation is proposed since no impacts are anticipated.

4.3.2 Terrestrial Wildlife

4.3.2.1 Alternative 1 - No Action (No Change) -Maintenance Dredging With In-Water Disposal

Under this alternative, no trees would be removed; therefore, streamside and shoreline perch areas for bald eagle would not be affected. Waterfowl, fish, and other prey would return to the dredged area very quickly after dredging. The dredging and disposal activities would not be a continuous activity confined to a single location. If impacts were to occur, they would be minor, short-term, and localized. Adjacent areas would be available for foraging, feeding, and perching.

This alternative "may affect but is not likely to adversely affect" bald eagles.

4.3.2.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Impacts in the reservoirs would be similar to alternative 1.

Construction and operation of the Joso contingency upland disposal site would not affect habitat used by bald eagles. No suitable perch trees would be removed and no habitat for prey species would be affected.

The levee raise would not result in the loss of any trees or shoreline perch areas. Prey species would not be impacted. Thus, impacts if they were to occur would be related to disturbance during construction and would be minor, short-term, and localized.

This alternative "may affect but is not likely to adversely affect" bald eagles.

4.3.2.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Dredging and disposal impacts would be similar to alternatives 1 and 2. The activity areas would be localized. Eagles could continue to forage and feed in areas adjacent to the project. Upland disposal is anticipated to have a direct, long-term, minor impact on eagles. These impacts are mainly attributable to increased activity at the Joso site. Bald eagles are seen very infrequently in this section of the Snake River. Most eagle activity has been associated with migration through the area. None have been noted to winter on Lower Monumental reservoir except near the mouth of the Tucannon River.

This alternative "may effect but is not likely to adversely effect" bald eagles.

4.3.2.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impact as described for alternatives 1, 2, and 3.

Disposal activities would have varying impacts to bald eagles, depending upon which beneficial use was used for a particular dredging activity. For woody riparian habitat restoration, prey species dependent upon riparian vegetation would benefit the most, which may increase the food source for bald eagles. Establishment of shoreline vegetation and trees may provide additional perch sites for bald eagles. Activities related to development of the shoreline habitat would potentially have short-term impacts on bald eagles related to noise and construction activities. If in-water disposal to create fish habitat were selected as the disposal option, impacts to bald eagles would be similar to those for alternative 2. The creation of shallow water using dredged material would result in additional habitat for eagle prey species. This, in turn, would increase the availability of opportunity for feeding and, thus, would be a beneficial impact for these birds. Fill activities on upland sites may have the potential to impact bald eagles if the activities occur near the shoreline. Potential impacts to bald eagles would be considered prior to the selection of a beneficial use.

This alternative "may affect but is not likely to adversely affect" bald eagles. This determination would be reevaluated as specific actions are selected.

4.3.2.5 Mitigation

Mitigation may be required for alternative 3. If perch trees are removed, artificial perches could be placed along the shoreline as replacements. These could be located at the disposal site or at sites distant from the disposal activity.

4.3.3 Plants

4.3.3.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

The dredging and disposal activities would be in habitats where water howelia (*Howellia aquatilis*) are not likely to exist. No impacts are anticipated. Thus Alternative 1 "may affect, but is not likely to adversely affect" water howelia.

The dredging and disposal activities would not occur in habitats where Ute ladies' tresses (*Spiranthes diluvialis*) exists (i.e., wetlands). Thus Alternative 1 "may affect, but is not likely to adversely affect" Ute ladies' tresses. There would be no effect on Spalding's silene.

4.3.3.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Impacts of dredging and disposal activities would be similar to alternative 1.

The construction and operation of the Joso upland disposal contingency site would have no impact on the listed plant species since the plants do not occur at the site.

Habitat for the three listed plant species does not occur in the vicinity of the levee raise. The levee raise would have no impact on these species.

4.3.3.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Water howelia do not occur in upland locations such as the Joso site or the area of the levee raise. No impacts would occur. There would be "no effect" on water howelia.

No wetland impacts would occur with this option, therefore no impacts on Ute ladies' tresses are expected to occur. Thus, there would be "no effect" on Ute ladies' tresses.

4.3.3.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The dredging activity associated with this alternative would have the same impact as described for alternatives 1, 2, and 3.

Disposal activities would have varying impacts to listed plant species, depending upon which beneficial use was used for a particular dredging activity. Placing dredged material in the river to provide new or additional shallow-water habitat, as described in section 2.5.4, would not impact any plant species. For dredged material placement along the shoreline to create woody riparian habitat, plant surveys may be required to determine the presence of Ute ladies' tresses. Any sites found to support these plants would need to be avoided to preclude impacts to these plants. Ute ladies' tresses are not likely to occur downstream of Clarkston, Washington, due to the prevalence of exotic plants within the existing wetlands. Since no formal surveys have been conducted for this species on the lower Snake River, the shoreline will be surveyed prior to dredged material placement. If plants of this species are found and would be impacted by the fill action, Consultation with USFWS would be reinitiated.

4.3.3.5 Mitigation

No impacts to endangered plants are anticipated. Mitigation is not deemed to be necessary unless plant surveys determine endangered plant species are present.

4.4 RECREATION

4.4.1 Recreation Facilities, Activities, and Use Patterns

4.4.1.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Actions proposed as part of alternative 1 are expected to have a minor, short-term effect on those recreation activities and facilities located near proposed dredging and disposal locations. Dredging scenarios proposed under alternative 1 may temporarily close boat ramps and boat basins and affect public recreation areas (swimming beaches) on a short-term, temporary basis during maintenance dredging. Effects would be minor due to low levels of activities that occur during the months for which dredging and disposal are proposed.

4.4.1.2 Alternative 2 -Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Actions proposed as part of alternative 2 are expected to have short-term, direct effects on recreational facilities and activities. Dredging and disposal activities are expected to have effects similar to those discussed for alternative 1 above. Should dredging of the boat basins and swimming beaches occur during the summer months, there would be a greater chance of disturbing recreational use. However, the disturbance would be short-term and recreational use would resume once the dredging was complete. The proposed construction of the levee raises within the Lewiston Levee Parkway under alternative 2 is anticipated to have a short-term, direct effect on the recreational activities that occur at this park. These effects would be minor because they impose a temporary disruption of activities at the Lewiston Levee Parkway; specifically, multi-use paths and day-use facilities such as picnic tables on and adjacent to the levees could not be used during construction of the levee raise. Recreational facilities would be restored and activities resumed following the interruption caused by the construction of the levee raise.

Construction and operation of the Joso upland contingency disposal site would have no direct impact on recreation. The activities at the disposal site may have an indirect impact on river users, hunters, and users of Lyon's Ferry State Park and Lyon's Ferry Marina. Impacts would be sporadic, depending upon the need to use the disposal facilities and would be of short duration each time the disposal site is used.

4.4.1.3 Alternative 3 -Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Dredging and levee modification activities proposed under alternative 3 would have the same effects on recreation as alternative 2. Upland disposal activities at the Joso site would have long-term, indirect effects on river users, hunters, and the nearby Lyon's Ferry State Park and Lyon's Ferry Marina facilities. These effects are anticipated to be minor since the disposal area is set back at least 600 feet (182.9 m) from the river shoreline and is not directly visible from Lyon's Ferry State Park and Lyon's Ferry Marina, which are located on the opposite side of the Snake River.

4.4.1.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Dredging and levee modification activities proposed under alternative 4 would have the same effects on recreation as alternatives 2 and 3. To the extent that beneficial uses of dredged material would reduce the need to dispose of the material either upland or in water, these uses are expected to have minor, direct impacts to recreational facilities and activities, depending on where the material is placed. Beneficial uses that would create or enhance wildlife habitat would have indirect beneficial effects on recreation if they enhanced hunting, fishing, or wildlife viewing opportunities.

4.4.2 Mitigation

None of the alternatives considered are expected to have a significant impact on recreation facilities, activities, or use patterns. Effects of maintenance dredging of recreational facilities in the winter would be minor due to low levels of activities that occur during the winter months for which dredging and disposal are proposed, and would provide a long-term benefit for recreational boating. If maintenance dredging of recreational facilities were performed during the summer months, the impacts on recreation would be greater since recreational use is higher in the summer. However, this impact would still be minor since the dredging would require closing the recreational facility for only a few days. The public would be notified of dredging operations and temporary boat ramp/basin closures. Construction of the nominal 3-foot (0.9-m) levee raise in the Lewiston area is expected to directly affect recreational facilities, activities, and uses associated with those levees. These effects can be lessened by creating detours for bike and pedestrian users of these facilities, so they may remain usable while construction is taking place.

4.5 CULTURAL RESOURCES

Cultural properties located in the project area could potentially be affected by proposed dredging and disposal activities. This section describes potential project effects on cultural properties. As with all proposed DMMP/EIS actions, Section 106 cultural resources reviews under NHPA would occur dredging and dredged material disposal actions are developed.

During the NHPA evaluations, the Corps would consult with SHPOs of Washington, Idaho, and Oregon; Indian tribes; and other interested parties to identify potential effects of the alternatives on cultural properties. Affected tribal and other local governments would also be consulted during NEPA activities and implementation of Federal policies to the degree the governments are interested.

4.5.1 Cultural Resources Effects

4.5.1.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Alternative 1 would continue the District's current reservoir maintenance operations, which involves programmatic dredging to maintain the navigation channel, access channels to ports and moorages, public recreation areas, and irrigation intakes for wildlife HMUs. Disposing of dredged material at designated in-water disposal sites would continue.

To maintain reservoir navigation, dredging would be confined to existing navigation channels. Associated project activities are, therefore, not expected to affect cultural properties. Dredging other identified project areas in some cases would occur over or very near cultural properties. The depth of dredging would be indirectly controlled by hydrographic measurements taken before and after dredging and by not removing material below the target elevation. In these few cases, cultural resources located in McNary, Ice Harbor, Lower Monumental, and Little Goose reservoirs could be adversely affected. Proposed in-water disposal of dredged materials could affect cultural properties located underwater in the lower Snake River and McNary reservoirs. This alternative could have long-term effects on cultural properties associated with in-water disposal areas. Cultural properties could be affected by the drift of dredged materials over time that cover known cultural properties with too much sediment load or that create an incompatible chemical environment with existing site soils. Unknown cultural properties could be buried by in-water disposal actions. Monitoring of cultural resources during dredging and disposal activities would be limited to standard inadvertent discovery procedures.

4.5.1.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Alternative 2 involves the same dredging scenario as alternative 1 and also includes a nominal 3-foot (0.9-m) levee raise in the Lewiston area. Under alternative 2, disposal actions would be similar to those in alternative 1 except in-water disposal would be limited to shallow-water and mid-depth disposal areas. Cultural properties are not expected to be affected by dredging, disposal, or levee raise actions. The individual dredging projects would be subject to NHPA

Section 106 reviews. There is the potential that unknown cultural properties could be affected by burial with dredged materials. Cultural properties would need to be considered in planning future DMMP/EIS actions within the area of potential effect of the proposed modification of the levee raise.

4.5.1.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Alternative 3 involves the same dredging scenario and would have the same effects from dredging as alternatives 1 and 2. Cultural properties identified at the Joso upland disposal site could potentially be affected by work site preparation and upland disposal operations. Some of these sites are potentially eligible for the NRHP. However, proposed activities are expected to remain at a considerable distance from any known cultural resources. There are no cultural properties associated with the existing pit at Joso where dredged materials would be disposed under the DMMP/EIS. Access to the Joso disposal area would involve dredging to provide barge access to an existing barge slip. This would require consideration for submerged cultural resources. Thus, the same considerations for cultural properties would be followed as under alternative 2.

4.5.1.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Dredging effects on cultural properties would be the same as those for alternative 2. In addition, beneficial uses for dredged material other than for creating in-water fish habitat could potentially affect cultural properties depending on how and where the use would be planned. The areas for the proposed woody riparian habitat creation under alternative 4 would be selected to avoid impacts to known cultural resources sites. Prior to implementation of any beneficial use, the Corps would need to conduct research and field investigation to determine if cultural resources would be potentially affected and would consult with the appropriate SHPO's and other consulting parties.

4.5.2 Mitigation

The cultural properties that could be most affected by proposed activities involve those submerged beneath reservoir waters and associated with in-water disposal areas. The Corps would, in consultation with SHPO's and other consulting parties, determine the effect of in-water disposal on identified cultural properties. Access to most cultural properties in the study area for the purpose of conducting NRHP evaluations is prohibitive since they lie beneath reservoir waters. The Corps is not aware of existing technology or methods that would allow it to effectively address the matter of unidentified submerged cultural resources. Consequently, the Corps would likely avoid known cultural properties in the study area as a practical approach in the planning of future in-water DDMP/EIS actions. The Corps would apply contractual controls to dredging actions to provide accountability of dredging operations and protection of cultural deposits.

Indirect effects resulting from disposal activities on nearby cultural properties would be assessed for each resource and disposal action. This would be done until project effects could be reliably predicted and, if needed, alterations made in disposal practices to avoid adverse effects to cultural properties. Submerged resources not NRHP eligible could be buried by the disposal of dredged materials since this would not constitute an adverse effect under NHPA. However, given the unique qualities of study area cultural properties, practicable efforts to avoid them would be taken when planning in-water disposal operations.

Steps similar to those described above would be taken to consider effects to cultural properties located on land whether on or off Corps property in accordance with NHPA and the Reservoir Salvage Act, as amended. If necessary, cultural properties would be evaluated to determine their NR eligibility status.

The Corps would develop a detailed cultural resources monitoring plan if required by consultation under Section 106 of the NHPA. Consultation will be completed prior to release of this document. The monitoring plan would assure that project activities were assessed for their potential to affect cultural resources and provide avenues for adaptive management within the DMMP/EIS. This plan would seek to integrate information from ongoing District-wide cultural resources monitoring activities. If new cultural properties are found in the DMMP/EISs area of potential effect, this new information would be considered and compliance with NHPA guidance would occur. In addition, a programmatic agreement may be developed if SHPOs find this to be appropriate. Such a document would addresses how NHPA reviews would be applied for future DMMP/EIS actions.

If human remains are inadvertently discovered during dredging or dredged material handling operations, all work in the immediate area of the discovery would stop and would not resume until the matter regarding the discovery is satisfactorily resolved by the Corps archaeologist. The Corps designated cultural resources specialists would be notified immediately of the discovery and the Corps would notify appropriate tribes, law enforcement, and coroner's offices. Every effort would be made to identify the cultural identity of the remains and, if the remains are determined to be Native American, the Corps would comply with the terms set forth in the Native American Graves Protection and Repatriation Act. The Corps would employ the same procedures if an archaeological site is inadvertently discovered or impacted during dredging and/or dredged material management activities.

4.6 SOCIOECONOMICS

4.6.1. Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Dredging to maintain the navigation channel, access channels to ports and moorages, public recreation areas, irrigation intakes for HMUs, and flow conveyance capacity of the Lower Granite reservoir, and disposal of dredged material in-water represent no change in the management of the projects and associated facilities. Therefore, this alternative is anticipated to have no effects on regional population, employment, or income. Since navigational clearances and water surface profiles would be maintained and no changes in overall reservoir operations are proposed, this alternative is also expected to have little to no effect on river uses or users. Since alternative 1 does not include a levee raise in Lewiston, allowing continued loss of levee freeboard and increased risk associated with flooding, it could be expected (in comparison to the other alternatives being considered) to have an indirect, long-term, moderate negative effect on the local economy of the Lewiston area.

4.6.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Alternative 2 is expected to have the same socioeconomic effects as alternative 1 with respect to proposed dredging and disposal activities. Proposed levee modifications are anticipated to have a direct, short-term, positive effect on the local economy of the Lewiston area due to the added jobs and materials required for construction of the levee modifications.

4.6.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Socioeconomic effects of the proposed dredging and levee modification activities for alternative 3 would be the same as those for alternative 2. However, upland disposal would be expected to have a direct, short-term positive impact due to jobs created for construction and initial operation of the disposal facility at the Joso site. The economic effects would remain positive, but lessen over time, for the continued use of the upland disposal facility.

4.6.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

As with alternative 3, the dredging and levee modification components are anticipated to have the same socioeconomic effects as those documented for alternative 2. Beneficial use of dredged material would be expected to have a direct, minor, short-term positive economic effect due to construction activities associated with implementation of the beneficial use. Also, beneficial uses that create or enhance wildlife habitat or recreational resources would potentially have minor, indirect, long-term beneficial effects attributable to enhancement of recreational resources and opportunities.

4.6.5 Low-Income or Minority Populations

The proposed project alternatives would result in no disproportionately high and adverse impacts to the environmental justice communities identified by project area census tract in section 3.6.3. The proposed dredging and dredged material disposal activities would not directly affect any of the identified low-income or minority regions in the project area. Proposed mitigation and emphasis on beneficial uses of dredged material would minimize adverse impacts that have been identified. Similarly the proposed levee raise would not negatively impact any project area residences in a significant manner, but will provide added flood protection in the Lewiston/Clarkston area. The proposed levee raises would not result in disproportionate flood hazard to the identified low-income and minority communities.

The Tribes in the project area rely on the aquatic resources in the project area to a substantially greater degree than other inhabitants of the project area, such that any significant negative impact to aquatic resources in the project area could disproportionately impact the Tribes. Cultural resources in the project area are also sensitive for this same reason. However, the alternatives documented in the DMMP do not result in any significant impacts to the aquatic or cultural resources which are important to the Tribes. As described in Section 4 of the DMMP/EIS, no significant adverse impacts to water quality or aquatic resources are anticipated to result from the DMMP alternatives. The National Marine Fisheries Service has concluded that the proposed action could not be likely to jeopardize the continued survival of listed anadromous fish species in the project area. As described in section 4.5, all known cultural resources could be avoided in the proposed alternative. As described in sections 4.14 and 4.15, the proposed alternatives could result in either no effect to fish and fishing, or in a net positive effect. The preferred alternatives recommended plan was determined to not have a negative disproportionate impact on tribal communities.

None of the proposed alternatives are expected to have negative impacts to agricultural pursuits in the project area. As such, all project alternatives are expected to result in no negative disproportionate impacts to Hispanic farm workers in the project area.

4.6.6 Mitigation

None of the plan alternatives are expected to have adverse socioeconomic effects. Mitigation measures are proposed to avoid and/or minimize environmental impacts. Proposed mitigation measures that would address anticipated environmental impacts are described in Section 4 within the context of the resources impacted.

4.7 TRANSPORTATION

4.7.1 River Navigation

4.7.1.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

This alternative would have a long-term beneficial impact on river navigation by ensuring adequate depths in the navigation channels, and access channels to ports, moorages, and public recreation areas. Dredging would be completed in the navigation channels in each of the reservoirs to provide depths up to 14 feet (4.3 m), plus another 2 feet (0.6 m) for advanced measures and overdig. Materials would be disposed of in each reservoir in shallow-, mid-depth-, and deep-water areas away from areas of commercial and recreational river navigation. Dredging in the navigation channels could occur as frequently as a 2-year cycle, causing some disruption in the in-water work period from December 15 to March 1 in the Snake River and December 1 and March 31 in the Columbia River. Dredging in the access channels to ports and moorages would occur on an as-needed basis. Disruption would be minimized through notification to mariners and processes that avoid blocking busy waterway segments for periods longer than 1 or 2 days. Barges used to transport dredged material would traverse only the reservoir where the material was dredged and would not impact lock utilization. No disruption to recreational boating would be expected in the main river channels; only short-term disruption may occur during maintenance dredging of boat basins.

4.7.1.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

This alternative would have similar impacts to river navigation as alternative 1. There could be increased barge traffic through some of the navigation locks if material dredged from the downstream reservoirs is barged to Lower Granite reservoir for in-water disposal. Additionally, the transport of any dredged material to the Joso site would require use of the locks, except for Lower Monumental where Joso is located. No measurable impacts to river navigation through the locks are expected as a result of this material.

4.7.1.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same impacts as alternatives 1 and 2 with the addition of impacts to utilization of the locks. Dredged material from each of the reservoirs would be deposited at the Joso site located in the Lower Monumental reservoir. Barges carrying dredged material could increase the number of lockages during the dredging period by as much as 150 lockages as frequently as every 2 years (up to 113 barges with an average of 4 lockages of 3 barge tows). These lockages would occur during a time of year when they would cause very little impact to other commercial or recreational traffic.

4.7.1.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

This alternative would have impacts similar to all others in the dredging area. It could have different effects in the disposal area depending on the disposal location and method employed to develop the beneficial use. In every case considered, the adverse impacts to other river navigation would be short-term and minor. In some cases beneficial uses could have positive impacts to river navigation by using the dredged material as fill to improve terminal and port areas.

4.7.2 Railroads

4.7.2.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Continued maintenance of the navigation channels, access channels to ports and moorages, public recreation areas, irrigation intakes, and flow conveyance capacity would have no adverse effect on the railroads in the area and would continue to support the multi-modal flow of commerce to and from the study area.

4.7.2.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same affect on railroads in the area as alternative 1, with minor, short-term impacts resulting from construction of the 3-foot (0.9-m) levee raise and use of the Joso disposal site. The nominal 3-foot (0.9-m) levee raise includes construction of a bin wall to the west levee below the south abutment of the CPRR Bridge over the Clearwater River at Lewiston. Construction of the bin wall could cause minor disruption to rail operations for a short period due to construction adjacent to bridge abutments. This would not have a noticeable effect on rail operations. The Joso site, located on the south bank of the Snake River between RM's 56.5 and 58.6, would be used by an estimated two to three barge loads per year. The UPRR runs along the south boundary of the site and land access to Joso crosses the railroad's right-of-way. While the development of this site and future disposal operations would be conducted from the water over barge access facilities, minor increases in crossings of the UPRR right-of-way during construction could be expected. These impacts would be minimized through appropriate early communication and coordination with the UPRR.

4.7.2.3 Alternative 3 -Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same impacts as alternative 2 plus minor, long-term, direct impacts to the UPRR resulting from development of the Joso disposal site, located on the south bank of the Snake River between RM's 56.5 and 56.8. As with alternative 2, land access to this site crosses the UPRR right-of-way. While the development of this site and future disposal operations would be conducted from the water over barge access facilities, minor increases in crossings of the UPRR right-of-way during construction could be expected. These impacts would be minimized through appropriate early communication and coordination with the UPRR.

4.7.2.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The potential impacts to railroads from this alternative are expected to be minor. The beneficial use of the dredged material would be determined on a case-by-case basis and may affect the railroads due to minor disruptions of the type described under alternatives 2 and 3, or could potentially involve the railroad to transport dredged material to a final destination point. When beneficial use options that could impact the railroads are considered for implementation, the appropriate railroad officials would be involved early in the planning phase.

4.7.3 Highways/Roadways

4.7.3.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

This alternative would have no effect on the highways/roadways in the area. No direct effects to roadways are anticipated. River navigation would be maintained and would contribute to commercial truck transportation serving port and river terminal facilities.

4.7.3.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same impact as alternative 1, with the added short-term, direct impacts to Highway 129 and the Snake River Road resulting from the construction of the nominal 3-foot (0.9-m) levee raise. Highway 129 between Asotin and Clarkston would be raised 3 feet (0.9 m) for approximately 1 mile (1.6 km). The Snake River Road above Asotin would be raised 1 foot (0.3 m) for a length of approximately 0.2 mile (0.3 km). Appropriate traffic control during construction and use of detours would mitigate the impacts to traffic over these roadways.

4.7.3.3 Alternative No. 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same impacts as alternative 2. Upland disposal would have no additional effect on any roadways since all material would be transported to the Joso upland disposal site by barge.

4.7.3.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same effect as alternative 2 and may potentially have a beneficial effect. One concept for beneficial use of dredged material would use the material to form a roadway connection on the north shore of the Lower Granite reservoir linking SR 193 at Wawawai to SR 194, a distance of 3 miles (4.8 km). This new section of roadway would eliminate the need to use an existing 32-mile (51.5-km) stretch of narrow, steep road.

4.7.4 Mitigation

Overall, effects of any of the alternatives considered are expected to be minor. Mitigation of impacts to transportation from each of the alternatives would include establishing road detour routes during construction of the proposed 3-foot (0.9-m) levee raise and appropriate notification and coordination with the UPRR, which could be affected by upland disposal options. Where activities under each of these alternatives may impact existing transportation, actions would be taken to notify and coordinate with affected parties in advance of any of the temporary disruptions.

4.8 GEOLOGY AND SOILS

4.8.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

This alternative involves dredging to maintain the authorized depths in the navigation channels of the lower Snake River and McNary navigation projects, maintenance dredging of access channels to port and moorages, public recreation areas, irrigation intakes for wildlife HMUs, and flow conveyance capacity of the Lower Granite reservoir. This alternative would ensure navigation clearance and provide some restoration of the flow conveyance capacity with maintenance dredging, but does not involve modifications to the levees in Lewiston. Disposal of dredged material would be in-water at selected sites in each reservoir.

This alternative is not anticipated to significantly affect the geology and soils in areas surrounding the lower Snake River and McNary reservoirs. Dredging would cause local soil and rock disturbance and relocation of some alluvial material.

4.8.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities as alternative 1 with a nominal 3-foot (0.9-m) raise to the Lewiston levees. Dredging would improve the navigation clearances in each reservoir and a 3-foot (0.9-m) levee raise at critical locations would restore the flow conveyance capacity of the upper reach of Lower Granite reservoir.

The proposed dredging is not expected to affect the geology and soils in the study area. However, modifications to the levee system in Lewiston are expected to result in direct effects on the geology and soils of the levees and surrounding areas.

The existing levees were modeled for stability using the UTEXAS3 slope stability model. The steady seepage condition for the landside slope was analyzed. A high safety factor was computed for the levees based on past experience with levee stability and seepage issues.

Minor, short-term effects to soils and topography, resulting from earthmoving and construction activities, are expected during construction of the levee modifications. However, the proposed levee modifications are not expected to have long-term effects on the geology or soils of the surrounding areas. The use of construction best management practices (BMP's) would reduce the erosion that could occur as a result of the levee modifications.

4.8.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities as alternatives 1 and 2, with upland disposal of dredged material instead of in-water disposal. The 3-foot (0.9-m) levee raise described as part of alternative 2 would be included with this alternative. In this alternative, dredged materials from all reservoirs would be transported by barge to the Joso upland disposal site, located on the Snake River between RMs 56.5 and 56.8.

Other than at the Joso site, no significant changes in the geology and soils of the surrounding areas are expected.

Upland disposal is anticipated to have a direct, long-term effect on the soils and topography of the Joso site. Erosion and compaction would occur from construction and dredged material disposal activities. Runoff and erosion would be mitigated during disposal by use of BMPs. Disposal materials would be placed on the Joso site in increments to maximize site restoration and minimize the land used. Site restoration would include stabilizing and seeding of the dredged material after it has been disposed of onsite. Disposal material would be contained within a bermed area and drainage would be controlled to minimize erosion. In addition, a 600-foot (182.9-m) setback from the river would help minimize shoreline erosion.

4.8.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Alternative 4 involves the same dredging and levee modification components as alternatives 2 and 3 above, but would use some or all of the dredged material for beneficial uses. Beneficial uses, such as woody riparian habitat creation, other habitat creation/enhancement, landfill cover, or other activities, would be expected to have direct, short-term impacts to the soils in the areas where the uses would be implemented. Impacts could be mitigated by use of BMPs to control erosion and by minimizing the areas that would be disturbed by the placement of dredged material.

4.8.5 Mitigation

Construction BMPs to reduce soil erosion are recommended for alternatives 2, 3, and 4, which involve modification of levees in the Lewiston area. Use of BMPs in the construction and operation of the dredged material disposal facility at the Joso site, proposed under alternative 3, is recommended to reduce soil erosion. Phased development and filling of the disposal facility, site restoration, and creating a 600-foot (182.9-m) buffer between the disposal facility and the shoreline are also recommended for alternative 3 as measures to reduce impacts to soils.

4.9 WATER QUALITY/WATER RESOURCES

4.9.1 Water Quality

4.9.1.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Under alternative 1, all dredging would continue to be performed during the winter in-water work window using mechanical methods only. The proposed dredging and dredged material disposal is expected to have a temporary, direct negative effect on water quality in the Columbia, Snake, and Clearwater Rivers. The effects would primarily be associated with turbidity plumes caused by the dredging and in-water disposal, re-suspension of materials, and ammonia. Dredging the navigation channels, access channels to ports and moorages, public recreation areas, and irrigation intakes would have little measurable effect on long-term water quality. In-water disposal of this material is also expected to have a minor, short-term impact, and may cause temporary turbidity plumes.

As noted in Section 3.9, since there are no uniform freshwater sediment quality criteria that provide definitive numerical standards for evaluation of dredged material, the Corps is developing a Mid-Columbia and Lower Snake Region Sediment Testing Framework. Until the Mid-Columbia and Lower Snake River Framework is completed, the Dredged Material

Evaluation Framework: Lower Columbia River Management Area will be used by the Corps to evaluate the potential effects of dredging and dredged material management activities.

4.9.1.1.1 Impacts of Dredging

Salinity

Dredging may cause an increase in salinity because re-suspension of sediments can put more of the major ion and cation salts into solution. Freshwater biota that are not used to sudden changes in dissolved salt concentration could be negatively impacted by such changes because they lack the capacity to osmoregulate in even a small increase of salinity.

Turbidity

The proposed dredging in areas close to the streambank, in port areas and boat basins, at the Snake/Clearwater Rivers confluence area in Lower Granite reservoir, and backwater areas of McNary reservoir are expected to have the most impact on turbidity since the sediments in these areas are expected to be fine-grained material. The Corps anticipates that dredging operations may create a detectable plume extending about 1,000 feet (304.8 m) downstream. Best management practices would be used to prevent a 5-NTU increase over background (or a 10 percent increase over background when background is over 50 NTUs at a point more than 300 feet (91.4) downstream. Small or short duration turbidity exceeding water quality protection objectives would trigger the Corps to scale back dredging operations until the turbidity management goals are obtained. Gross turbidity exceeding limits that would generally be considered harmful to aquatic life would not be permitted. Should turbidity levels continue to be exceeded, the Corps would stop the dredging and review the excavation methods and practical turbidity management measures before allowing the dredging to continue. It is anticipated that small episodic turbidity plumes would dissipate when dredging ceases for the day or when the dredge is moved to a new location.

Dredging the main navigation channel and the navigation lock approaches is not expected to create a significant turbidity plume. This is because the sediment in the navigation channel is predominantly sand and the material in the navigation channels is predominantly river cobble with some large rocks. Neither of these materials contains large quantities of fine materials.

Dissolved Oxygen

The proposed dredging activities under this alternative are expected to have a negligible effect on dissolved oxygen concentration because all dredging would occur during cold-weather months. Dissolved oxygen concentration is higher at lower water temperature for several physical reasons including the solubility of oxygen in the gaseous phase and pressure effects on the solubility of the partial pressures of gases. Data collected during previous winter dredging activities indicated there was little change in dissolved oxygen. Dissolved oxygen readings were at less than saturation only when there was very high background turbidity.

Temperature

The potential for dredging under this alternative to affect water temperature is negligible. All dredging would be performed in the winter when both water temperature and air temperature are low. The overall effect on reservoir temperature would be immeasurable.

pH

Dredging activities may affect pH levels in the work area and in the turbidity plume that would extend downstream of the work area. Water quality data collected in the last 5 years indicates the Snake River is alkaline most of the year. Average pH for all months ranges from 7.9 to 8.6 with average winter measurements ranging from 8.0 to 8.5. This is within the range of pH (6.5 to 8.5) identified by the State of Washington as having very little direct effect on the aquatic environment. However, the proposed dredging may lower or raise pH levels in the water. If the material being dredged contains a large amount of organic material and acids, the pH in the work area may be lowered. This may occur in the boat basins and some port areas where there is a large amount of silt and organics. If the dredged material contains carbonate compounds, the pH in the work area may be raised. This may occur in parts of the navigation channel although it is not likely since the material in the channel is mostly sand, which contains mostly silica, not carbonate. Should the pH be lowered to below 6.0 or raised to 9.0 or above, it could create lethal conditions for fish. The Corps does not have data on how previous dredging activities affected pH in the water. The Corps proposes to monitor pH during the next few dredging activities to determine if there is an effect on pH and to determine if the Corps needs to make changes in its dredging procedures.

Dredging activities in the Columbia and Clearwater Rivers would be expected to have impacts to pH similar to those in the Snake River.

Chemicals of Concern

Dredging activities have the potential to affect concentrations of compounds in study area reservoirs, primarily from dredging and movement of sediments that may have some level of contamination. Fine sediment is the only dredged material that is potentially contaminated. Sands and cobbles are not expected to contain contaminants. However, review of the Corps' sediment sampling data indicates little if any contamination exists in fine river sediments in the areas proposed to be dredged. There is a low risk of changes to water quality because of release of chemicals of concern from the sediments.

Additional sampling for chemicals of concern is recommended prior to dredging to verify the conditions have not significantly changed. Sediments will be evaluated in accordance with the adopted Dredged Material Evaluation Framework. Sediments with ambient elutriate test levels above water quality criteria should be addressed prior to the beginning of the dredging activity to determine if the concentrations in the sediment plume would violate water quality criteria.

As described in section 3.9.2.6, any radioactive material (if present) within McNary reservoir would most likely have been introduced in the 1940's, 1950's, or early 1960's. In that case, it should be buried under sediments that have accumulated since that time. Because Corps dredging operations would not extend down into original riverbed material or would go no deeper than post-1970 dredging activities in the same area, any buried radioactive material should remain undisturbed. Although the possibility of disturbing radioactive material during a dredging operation is small, the Corps plans to evaluate each dredging activity in the McNary reservoir for this potential and determine if and what type of further pre-dredging sediment testing and analysis may be necessary.

Phosphorus

Dredging may result in small releases of phosphorus, but this should not pose a problem to water quality or the aquatic environment. Because the dredging would occur during the winter in-water work window when cooler temperatures and reduced photoperiod decrease plant growth, the release of phosphorus should not lead to excessive blooms of aquatic flora in any of the reservoirs.

Ammonia

Dredging in the Snake River reservoirs has the potential to raise ammonia levels in the water column since ammonia is present in some of the sediments that would be dredged. Actual ammonia contamination levels that would be released into the water are site specific, dependant upon temperature and pH of the water, and vary considerably due to particle size of the material being dredged. Finer-grained sediment (i.e., silt) would be expected to have higher ammonia concentrations and would be more likely to release larger amounts of ammonia (both ionized and un-ionized) into the water. The amount of ammonia that would be released is unknown. The amount of un-ionized ammonia, which can have toxic effects on aquatic organisms, is also unknown. The Corps would monitor ammonia levels in the water during dredging. If the levels reached critical concentrations (see the critical concentration levels presented in appendix H, Water and Sediment Quality), the Corps would modify its dredging operation to try to lower the ammonia levels in the water.

Dredging in McNary reservoir may have a similar potential to raise ammonia levels in the water column. Dredging silt-laden sediments in the reservoir may have similar impacts as dredging silt in the Snake River reservoirs. The Corps would also monitor for ammonia when dredging in McNary reservoir.

4.9.1.1.2 Impacts of Disposal

Salinity

The re-suspension of sediments during disposal operations is expected to have effects similar to those of the dredging operations.

Turbidity

The discharge of the dredged material in-water is expected to cause definable turbidity plumes. The plumes are expected to be of short duration since the discharge from a bottom-dump barge is a singular event as opposed to the continuous operation of the dredge. Previous discharges of such materials suggest the material tends to stay in a clump as it drops from the barge to the riverbed, further minimizing the size of the plume. The plumes at the shallow to mid-depth habitat in-water disposal sites are expected to be smaller since the material to be disposed of in these areas would be primarily composed of sands. The plumes at the deep-water sites are expected to be larger since the material to be disposed of in these sites would be primarily silt. The turbidity plume is expected to visible as much as 1,000 feet (304.8 m) downstream. Based on monitoring data from previous dredging and disposal activities, turbidity would not be expected to exceed state water quality standards.

Dissolved Oxygen

The proposed winter disposal activities under this alternative are expected to have a negligible effect on dissolved oxygen concentration because all dredging would occur during cold-weather months. The water is colder during the winter and has higher dissolved oxygen levels than in the warmer months when the water is warmer. There is also less biological demand for oxygen in the winter. Even though some of the sediments being disposed of would contain organic material, the demand for oxygen for decomposition of those materials would not cause a noticeable decrease in dissolved oxygen.

Temperature

The potential for the in-water disposal action under this alternative to affect water temperature is negligible. All dredging would be performed in the winter when both water temperature and air temperature are low. The overall effect on reservoir temperature would be immeasurable.

After the shallow-water or mid-depth habitat is created, a localized temperature increase would be expected. This is because the river bottom would be raised to the photic zone, allowing the substrate to absorb more radiant energy and, thereby, warm the water. This warming would have a negligible effect on the water temperature of the entire reservoir.

pH

The impacts of disposal on pH of the affected river water are assumed to be similar to those of dredging.

Chemicals of Concern

The impacts of disposal regarding chemicals of concern may be similar to those of dredging. A review of sediment and water quality data has indicated that levels of contamination in sediments would probably not preclude the disposal in-water in the winter. Based on analysis of sediment samples taken from the Columbia, Clearwater, and Snake Rivers, there may be a portion of the sediments containing contaminants in concentrations that may preclude in-water disposal. The location of the contaminated sediments (if there are any) would be identified prior to the dredging action. Those sediments would be disposed of in an appropriate upland location.

Phosphorous

The impacts of disposal on phosphorous in the river environment would be similar to those of dredging.

Ammonia

The impacts of disposal on ammonia (both ionized and un-ionized) in the river environment would be similar to those of dredging except that the severity would likely be less for the disposal operation. When the barge dumps the dredged material during in-water disposal, it should fall through the water column in a mass with significant exchange limited to the material around the outer edges of the mass. This would result in less of the sediment being exposed to the surrounding water than during the dredging operation.

4.9.1.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Under alternative 2, most dredging would be performed during the winter in-water work window using mechanical methods; however, this alternative also includes the possibility of using hydraulic dredging for irrigation intakes and using summer dredging for off-channel sites such as irrigation intakes, boat basins, and swimming beaches on a case-by-case basis. The proposed dredging is expected to have a temporary, direct negative effect on water, mostly because of turbidity plumes caused by the dredging and in-water disposal. Dredging the navigation channels, access channels to ports and moorages, public recreation areas, and irrigation intakes should have little effect on long-term water quality.

4.9.1.2.1 Impacts of Dredging

Dredging impacts would vary depending on the time of year when dredging takes place and the method of dredging. For mechanical dredging in the winter, the impacts on water quality parameters are expected to be the same as the impacts discussed under alternative 1 (section 4.9.1.1). Hydraulic dredging, regardless of time of year, would be expected to have little impact on water quality since the dredged material would be captured by suction with little interaction with the water column. Summer dredging would be confined to off-channel areas and could impact the water quality parameters of dissolved oxygen and ammonia differently than winter dredging in those areas. Summer dredging in the small and confined areas would have little overall water quality impacts to the reservoirs depending upon the duration of the dredging and the integrity of any barriers (e.g., silt curtains) used to keep turbidity and potential contaminants within the off-channel area. Any flow of contaminated water into the main river channel would be miniscule compared to the amount of flow in the river. Because the water would be warm, the dissolved oxygen levels would be lower than in the winter when the water is colder. Resuspension of organic material in the silt may increase the demand for oxygen for decomposition and further reduce the amount of dissolved oxygen in the water. In the immediate area of the dredging operation, high, localized water quality degradation is expected to occur with high concentration of un-ionized ammonia possibly exceeding the acute level of contamination for many species of aquatic life. As described in alternative 1, the Corps would monitor the amount of ammonia released into the water column during dredging and adjust the dredging operation if necessary to reduce the amount of ammonia being released.

4.9.1.2.2 Impacts of Disposal

For dredged material disposal in the winter, the impacts on water quality parameters are expected to be similar to the impacts outlined under alternative 1 (section 4.9.1.1). If the material were suitable, the focus would be creating shallow-water fish habitat. The impacts of this placement would be similar to those described for the mid- and shallow-water disposal in alternative 1.

Any hydraulic dredging at irrigation intakes would pump slurry onto the land and would have minimal impacts to water quality. The water in the slurry would be expected to percolate into the soil or evaporate.

Disposal of dredged material from summer dredging would have little or no impact to water quality. This is because all material dredged in summer would be disposed of at an upland location. The material would be placed in a location where the water would percolate into the soil or evaporate, or the material would be placed within a holding area and the effluent would be allowed to re-enter the river. The effluent would be monitored before it is discharged back into the river.

<u>Joso Contingency Site</u>

When developed sometime in the future, the Joso contingency site would be used for disposal of silt in excess of that allowable for building the base of shallow-water habitat areas, for disposal of some or all of the material dredged in the summer, and for disposal of moderately contaminated material unsuitable for in-water disposal. In-water work for the construction of the Joso site would be expected to have similar impacts to water quality as dredging in any other backwater, as mentioned under alternative 1.

The disposal facility at the Joso site would be set back approximately 600 feet (182.8 m) from the Snake River, minimizing potential water quality impacts from construction and operation of the facility. Direct, temporary, minor impacts due to erosion may occur as a result of construction and disposal operations. A containment berm would be constructed on the perimeter of the permanent disposal area and would minimize water quality impacts associated with runoff and erosion. Most impacts are expected to be minimal and to occur in a localized area. The process of removing silt and placing it upland would eliminate any impacts associated with in-water disposal, however minor.

Levee Construction

Construction of the levees at Lewiston could result in short-term, minor water quality impacts due to runoff and erosion. These concerns would be minimized with the implementation of a site-specific Erosion/Sedimentation Control (ESC) Plan and BMPs. The levees would be stabilized by hydroseeding immediately after construction. All construction activities associated with this project are subject to the phase 2 stormwater runoff rules. Catchments, flow prevention, BMPs and monitoring would be used. Permits to discharge stormwater runoff would be required from the contractor.

4.9.1.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative is expected to have the same dredging, levee construction, and Joso Contingency Site construction impacts as described in alternative 2; however, all disposal of material would occur upland at the Joso site. Impacts would be similar for upland disposal but there would be no impacts occurring from in-water disposal.

4.9.1.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

This alternative would have the same impacts for dredging and levee construction as described for alternative 2. Impacts due to beneficial use of the dredged material could vary depending on the use and would be the responsibility of either the Corps or the local sponsor (if there is one). In-water disposal for fish habitat and upland disposal at the Joso site would have the same impacts as alternative 2.

4.9.1.5 Mitigation

As described above, water quality impacts would be short-term in nature and would be mitigated by any or all of the following methods:

- Monitoring during dredging/disposal activities, as described in section 4.9.1.1, appendix J - Dredged Material Evaluation Framework, and appendix M – Monitoring Program. If monitored water quality parameters are exceeded, dredging would be suspended and/or altered until the exceeded parameters return to acceptable levels.

- Implementing site-specific ESC and BMPs.

- Stabilizing material placed at the Joso site by hydroseeding or other appropriate methods.

- Hydroseeding/restoring levees immediately after construction.

4.9.2 Wetlands

4.9.2.1 Alternative 1 - No Action (No Change) – Maintenance Dredging With In-Water Disposal

This alternative would continue maintenance dredging with in-water disposal. There are no foreseeable wetland impacts as a result of alternative 1.

4.9.2.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Alternative 2 would dispose of dredged material in-water, raise some existing levees 3 feet (0.9-m), and include roadway raises associated with levee modifications. The levees or roadway improvements, as currently proposed, would not substantially increase the footprints of either the levee or the roadway, or encroach on undeveloped land. Minor, short-term, indirect impacts to wetlands adjacent to the levees or roadway could occur during construction of these improvements. Long-term impacts are not expected as a result of the levee raise.

Dredged material unsuitable for in-water disposal would be disposed of at the Joso site. Impacts would be similar to those described in Alternative 3 for upland disposal of all dredged material. No wetland impacts are expected to result from in-water disposal of dredged material.

4.9.2.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative would raise the levees and roadways as in Alternative 2, but would dispose of dredged material upland at the Joso site. The levee and roadway modifications, as proposed, would not substantially increase the footprints of either the levee or the roadway, or encroach on undeveloped land. Minor, short-term, indirect impacts to wetlands adjacent to the levees or roadway could occur during construction of these improvements. Long-term impacts are not expected as a result of the levee raise.

The proposed Joso upland disposal site, as designed, is anticipated to have a minor, indirect impact on the two southwestern wetland parcels. The impacts would result from the unloading of dredged material that would occur approximately 400 feet (121.9 m) to the north of the wetlands. The barge unloading and sediment movement may disrupt wetland function through wildlife displacement and sediment movement. There is expected to be no impact to the third wetland parcel to the northeast of the Joso site.

4.9.2.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Beneficial uses would be expected to generally affect wetland resources positively if dredged material were used for enhancement or creation of aquatic and wildlife habitat. Beneficial uses could potentially improve wetland size, function, and quality. Specific wetlands in the vicinity of a proposed beneficial use would require identification prior to commitment for the beneficial use project. A wetland area approximately one acre (0.4 hectare) in area is adjacent to the area at Chief Timothy HMU where woody riparian habitat development is proposed in winter 2002-2003. This wetland area would be minimally impacted by the proposed habitat development. The wetland is a low area where ponding occurs; it holds water only at extremely high pool elevations, and dries out during most years. Under the proposed beneficial use, an inlet channel to the pond would be constructed, which should increase flows into the pond at lower reservoir elevations. It will also have an exit (outlet) constructed so there will be some flow through, thus improving the water quality.

4.9.2.5 Mitigation

Potential mitigation measures for road and levee improvements, if needed, include minimizing impacts during construction by avoidance and adherence to any local or state erosion control policies. The Corps would conduct a wetland delineation as part of the planning process. Refinement of designs would seek to avoid and minimize wetland impacts to the extent practicable. Any wetland parcels that may be filled during construction would be mitigated in accordance with regulatory authorities.

Erosion control and avoidance of wetlands are planned at the Joso site.

4.9.3 Floodplains

4.9.3.1 Alternative 1 - No Action (No Change) – Maintenance Dredging With In-Water Disposal

This alternative would continue maintenance dredging with in-water disposal. A change in water surface elevation at the in-water disposal sites is not anticipated. As a result, there are no foreseeable floodplain impacts as a result of alternative 1.

4.9.3.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Alternative 2 would dispose of dredged material in-water, raise some existing levees 3 feet (0.9 m), and include limited roadway modifications. The levees or roadway improvements, as currently designed, are not expected to encroach on undeveloped land and, therefore, would not impact the 100-year floodplain.

The Joso site has been identified as a site for upland disposal for unsuitable material, if needed. This site would potentially be used under alternatives 2, 3, and 4. The proposed containment and disposal facility is not located in the 100-year floodplain. There would be no long-term impact to the floodplain. Based on the conceptual site layout, approximately 11,000 square feet [1 021.9 square meters (m^2)] of the temporary storage area would encroach on the 100-year floodplain. This would present minor short-term impacts to the floodplain since this use would be temporary and the fill is not expected to change the water surface elevation.

A significant change in water surface elevation at the in-water disposal sites is not anticipated. As a result, there are no foreseeable floodplain impacts as a result of the in-water disposal portion of Alternative 2.

4.9.3.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative would raise the levees and roadways as in alternative 2, but dispose of dredged material upland at the Joso site. The levee and roadway modifications, as currently designed, would not substantially increase the footprints of either the levee or the roadway, or encroach on any undeveloped land. The permanent upland disposal site at Joso would not be located in the 100- year floodplain and would not affect the floodplain. Approximately 360,000 square feet (33 445.1 m^2) of the temporary storage area for dredged material would encroach on the 100-year floodplain. There would be minor short-term impacts to the floodplain during the time that the material is stored. However, the fill is not expected to change the water surface elevation and would not pose long-term effects on the 100-year floodplain.

4.9.3.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Beneficial uses considered by the Corps are not anticipated to present significant impacts to floodplain areas. The proposed woody riparian habitat creation would involve placement of fill in shoreline areas, which may include some areas within the 100-year floodplain. This fill would not change the water surface elevation, nor have impact on the 100-year floodplain. Specific areas considered for placement of dredged material under beneficial use would require analysis of floodplain issues.

4.9.3.5 Mitigation

Anticipated effects to floodplains are expected to be minor and temporary. Therefore, no mitigation of floodplain impacts is proposed.

4.10 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Potential land-based HTRW concerns associated with upland disposal sites considered in this DMMP/EIS are discussed in this section. Findings and evaluations of potential environmental effects are based upon Phase I Environmental Site Assessments conducted for the Joso site. The handling and disposal of dredged materials as hazardous is not anticipated to be required.

Potential HTRW concerns associated with the sediments to be dredged are discussed in section 4.9.1.

4.10.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

There are no HTRW impacts since this alternative does not involve upland disposal.

4.10.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

The proposed disposal of dredged material that may be unsuitable for in-water disposal at the Joso site would not have significant effects related to management of HTRW. The findings of the Phase I Environmental Site Assessment of the Joso site indicated the presence of limited and localized tire burning and asphalt dumping activities on the site. These findings do not indicate HTRW concerns that would require further site investigation. Unsuitable (contaminated) dredged materials would be isolated and appropriate confinement measures taken (e.g., an impervious liner installed to prevent leaching). Disposal of dredged material at the Joso site is anticipated to have no effect regarding management of HTRW.

4.10.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

The proposed disposal of dredged material at the Joso site would not have significant effects related to management of HTRW as described in alternative 2. Disposal of dredged material at the Joso site is anticipated to have no effect regarding management of HTRW.

4.10.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

The proposed woody riparian habitat creation area at Chief Timothy HMU does not pose any known HTRW concerns. Beneficial use of dredged materials could have minor positive effects on HTRW if dredged material were used for cover or fill at the Hanford Reservation. In general, beneficial uses that involve upland handling of dredged materials would not be expected to have HTRW effects, given the quality of the sediments. Site assessment of proposed disposal/use areas would be necessary to confirm no HTRW concerns are associated with the area.

4.10.5 Mitigation

If alternative 3 were selected as the preferred alternative, prior to development of an upland dredged material disposal facility at Joso, the tire remnants and asphalt that were found during site reconnaissance should be removed and disposed of off-site in accordance with Federal, state, and local solid waste regulations.

4.11 AIR QUALITY

4.11.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Under this alternative, mechanical dredging and in-water disposal would be continued to maintain the navigation channels of the lower Snake River reservoirs and McNary reservoir, access channels to port and moorages on an as-needed basis, public recreation areas (swimming beaches and boat basins), irrigation intakes for wildlife HMUs, and flow conveyance capacity of the Lower Granite reservoir. No modification would be made to the levees that protect

Lewiston, Idaho, and Clarkston and Asotin, Washington. Dredging, transport, and in-water disposal activities typically do not generate fugitive dust or minor diesel fuel emissions. No air quality impacts are anticipated within the study area.

4.11.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

As described under alternative 1, dredged material disposed of in-water would be wet and not subject to wind entrainment. Construction activities associated with raising the west Lewiston levee could generate dust. As discussed in section 3.11, fugitive dust control requirements are in the IDAPA 58.01.01, Section 650 through 651, and reasonable precautions would be taken to prevent the generation of fugitive dust. Reasonable precautions that would be most applicable would include, but are not limited to, the following:

- Use of water or chemicals to abate airborne particles (dust) during construction.
- Application of dust suppressants to cover exposed soil (dirt roads, material stockpiles).
- Covering of trucks during transportation of materials (e.g., it is assumed covering stockpiles on barges would not be needed since the material would be wet).

The Joso upland disposal contingency site would be used for dredged material that is unsuitable for in-water disposal (e.g., elevated ammonia levels, etc.) to create shallow-water fish habitat. Any material generated during the construction of the 3-foot (0.9-m) levee raise that cannot be used to create shallow-water fish habitat would be transported to the Joso site. All materials transported to the Joso site would be managed for the control of fugitive dust as discussed in alternative 3 below.

4.11.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

This alternative considers the same dredging activities as alternatives 1 and 2, but with upland disposal instead of in-water disposal. The 3-foot (0.9-m) levee raise described as a part of alternative 2 would be included with this alternative. Thus, the primary air quality regulatory focus would be on prevention of material from becoming airborne during transport, off-loading, and upland placement at the Joso site (and/or other sites, if applicable), and during levee and roadway construction. The BMPs that would be implemented to control dust are summarized as follows:

- Soil stockpiles would be covered during construction phase.
- Dredged material would be covered during transportation to upland disposal sites.
- Unpaved haul roads would be treated with a soil-stabilizing chemical or wetted with water to reduce airborne particulates from tire entrainment during construction.
- Containment berms at upland disposal sites would be covered with geotextile to prevent erosion and reduce permeability and would then be covered with topsoil and seeded.

- Upland disposal site restoration would be achieved by placing topsoil on final slopes and re-seeding with native grasses as part of a continuing restoration program.

- Site restoration would be achieved by re-establishing vegetation similar to the plant species present in surrounding areas that will enhance wildlife habitat development.

Potential impacts associated with levee construction in the Lewiston area would be the same as those described under alternative 2. With the implementation of dust control measures, activities associated with alternative 3 levee construction activities are not anticipated to adversely affect air quality.

There is potential for short duration air quality impacts in the immediate area (Lyons Ferry Hatchery and Marina) of the Joso site from fugitive dust and odor of decomposing organic matter in wet sediment material; however, these impacts would be abated due to placement of dredged materials in the temporary de-watering area in the winter and early spring when temperatures and wind are not conducive to creating airborne particulates.

4.11.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Air quality conditions are anticipated to be similar to those described for the other alternatives. No additional impacts associated with implementation of alternative 4 are anticipated.

4.11.5 Mitigation

Minor air quality impacts are anticipated. Mitigation measures detailed in sections 4.11.2 and 4.11.3 above could be implemented as needed.

4.12 NOISE

4.12.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Under this alternative, mechanical dredging and in-water disposal would be continued. No modifications would be made to the levees that protect Lewiston, Clarkston, and Asotin. As discussed in section 3.12, existing dredging, transport, and disposal activities are exempt from noise regulations. It is anticipated that future activities would also be exempt from applicable regulations (see section 3.12.3). Minor, direct, short-term impacts are anticipated to result from construction activities.

4.12.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

As described for alternative 1, existing dredging, transport, and disposal activities are not anticipated to have significant noise impacts. Transport via water would be monitored. It is anticipated that continued maintenance dredging activities would also be consistent with applicable regulations and would have a minor, direct, short-term effect. Construction and operation of the Joso upland disposal contingency site would generate noise, primarily during daylight hours. However, the site is remote and there should not be significant noise impacts. Levee construction would occur primarily during daytime hours. Typical construction noise would be exempt from regulation as discussed in section 3.12.3 and are anticipated to be localized , minor short-term impacts.

4.12.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Potential impacts from maintenance activities would be the same as those described for alternative 2. Upland disposal would occur primarily during daytime hours and would have minor, direct, short-term effects during site work and disposal activities.

4.12.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Noise conditions are anticipated to be similar to those described for the other alternatives. Construction and maintenance activities would be exempt from regulation as discussed in section 3.12.3 of this document. No impacts associated with implementation of alternative 4 are anticipated.

4.12.5 Mitigation

Only minor impacts are anticipated; thus, no mitigation is proposed.

4.13 AESTHETICS

4.13.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Alternative 1 involves dredging to maintain the navigation channel, access channels to ports and moorages, public recreation areas, irrigation intakes for HMUs, and flow conveyance capacity of the Lower Granite reservoir with in-water disposal of dredged material. This alternative is anticipated to have a direct impact on aesthetics in the area where dredging and disposal operations are taking place. This effect would result from the presence of dredging equipment in the river and the turbidity plume from in-water disposal. This impact would occur during the duration of the dredging operation and would have a minor effect on the visual quality of the project area, but would occur on a regular basis over a 20-year period as dredging and disposal activities are undertaken. This alternative is not expected to change viewing patterns for the aesthetic resources in the project area.

4.13.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Alternative 2 involves dredging as described in alternative 1 and a 3-foot (0.9-m) levee height increase in the Lewiston-Clarkston area, with in-water disposal of dredged material to create shallow-water fish habitat. This alternative is anticipated to have a direct impact on the aesthetics of the project area, both where the dredging and disposal operations are occurring and in the areas of the levee modification. Impacts due to levee modification are expected to be both short-term (due to construction activities) and long-term (due to raising of the levees). As with alternative 1, this effect would occur during the dredging operations. Levee modifications would affect the riverfront park facilities and would present moderate impacts to both visual quality and viewing patterns. Levees would be revegetated.

Disposal of unsuitable material at the upland Joso site, if required, would have aesthetic impacts discussed in section 4.13.3 below. Effects would be minor and the aesthetic qualities of the site would be restored in part by proposed site restoration following disposal operations.

4.13.3 Alternative 3 -Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Alternative 3 involves dredging as described in alternatives 1 and 2, a 3-foot (0.9-m) levee height increase in the Lewiston-Clarkston area, with upland disposal of dredged material. This alternative is anticipated to have a temporary, direct impact on the aesthetics of the project area, both where the dredging and disposal operations are occurring and in the areas of the levee modification. Levee modifications that affect the riverfront park facilities would affect both visual quality and viewing patterns. However, these impacts would be temporary and localized and are not significant.

Under this alternative, the dredged material from all reservoirs would be disposed of at the Joso site in the Lower Monumental reservoir. Disposal activities would have a direct, long-term effect on the aesthetics of the disposal site and the areas immediately surrounding the site from which the site can be viewed. Portions of the Joso site are visible from SR 261, and the site can also be viewed by boaters, fishermen, and other recreational users in that portion of the river. Disposal operations on the site would be set back 600 feet (182.9 m) from the shoreline, thus lessening the visual impacts to river users. When completed, the area filled by dredged material would be restored by covering it with topsoil and by planting native plant species, thereby restoring some of the aesthetic values of the site. While the proposed disposal operations would directly impact the aesthetic quality of the Joso site, the effects would be minor due to the fact that the site is not highly visible to viewers and would be restored upon completion of disposal operations.

4.13.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

Alternative 4 would have similar impacts to aesthetics as alternatives 1 and 2. In addition, beneficial use of dredged material would potentially have a long-term positive effect on aesthetic resources if the material were used for wetlands or habitat restoration. Proposed woody riparian habitat creation along the lower Snake River would have a long term, beneficial effect on the aesthetics of the shoreline area.

4.13.5 Mitigation

Since anticipated effects to aesthetics are considered minor and temporary, no mitigation is proposed for alternatives involving dredging and in-water disposal. Landscaping and site restoration is planned for levee modifications and upland disposal activities.

4.14 NATIVE AMERICAN TRIBES AND COMMUNITIES

Although DMMP actions would occur in the five study area reservoirs over its 20-year life, most dredging activities and the majority of any in-water disposal would occur in the Lower Granite reservoir. Therefore, any direct effects stemming from the DMMP would most likely be generated within Nez Perce ceded lands.

By contrast, any effects to other resources are expected to be limited to the study area. Impacts to terrestrial wildlife and habitats are expected to be indirect, short-term, and minor since DMMP actions would not be continuous or confined to a given location. Important habitat attributes such as avian perch trees would not be removed. No socioeconomic effects to regional populations, employment, or income are anticipated and no changes to reservoir uses are expected under the DMMP.

Water quality impacts from DMMP activities are expected to be temporary, but would result in direct negative effects due to turbidity plumes caused by dredging and in-water disposal. Greater sediment plumes are expected from dredging operations. Although no significant changes in water quality from toxic substances are anticipated, monitoring is recommended to address the potential presence of toxic substances and ambient elutriate in sediments prior to dredging.

Dredging and in-water disposal of dredged materials could result in habitat changes that are beneficial, neutral, or even detrimental to different aquatic species depending on given species responses and needs (Bennett et al., 1997 and1998). Constructing more shallow water habitat could change water quality factors. Shallow-water temperatures, currently below optimum for the growing season of resident game fish, would be increased and possibly enhance resident game fish habitat conditions and population numbers.

Concerns over potential impacts to cultural resources would be focused on damage to cultural sites from dredging actions or covering sites with too much sediment as a result of disposal activities. As now planned, dredging would be limited to existing navigation channels and/or would not go below accumulated sediments into original riverbed. Likewise, disposal activities either upland or in-water would avoid known sites. (However, sediment drift from in-water disposal could result in the eventual covering of sites with too much material.) Such actions would help to reduce the chances of impacting cultural sites.

4.14.1 Alternative 1 - No Action (No Change) - Maintenance Dredging With In-Water Disposal

Dredging and disposal activities are expected to have short-term, minor effects on aquatic species. These effects are described in greater detail in sections 4.1 and 4.3. The Corps has determined alternative 1 "may effect and would likely adversely affect" six of the seven ESA-listed salmonid ESUs. Macroinvertebrates, a food source for fish, would be removed by dredging but would recolonize both dredging and in-water disposal locations. These food species would be available during the following anadromous fish out-migration season.

Water quality would not be diminished and, given Van Oosten's (1945) literature survey, sediment plumes created by DMMP actions would be harmless to fish.

It is not anticipated that dredging actions would impact cultural resources (see section 4.5). Cultural resources associated with in-water disposal areas could potentially experience minimal and indirect effects over the long term due to uncertainty associated with how dredged material deposits may be redistributed by reservoir currents. Unknown cultural properties would not be protected from DMMP activities and, consequently, cultural values may be impacted.

4.14.2 Alternative 2 - Maintenance Dredging With In-Water Disposal to Create Fish Habitat and a 3-Foot (0.9-m) Levee Raise

Impacts from dredging would be similar to alternative 1. The impacts of in-water disposal of dredged materials on water quality and cultural resources would also be similar to alternative 1. However, the overall change to study area tribal fisheries is fundamentally uncertain.

4.14.3 Alternative 3 - Maintenance Dredging With Upland Disposal and a 3-Foot (0.9-m) Levee Raise

Dredging activities under this alternative would be the same as for alternative 2. The primary difference is using upland disposal at Joso instead of in-water disposal. This alternative would limit risks to fish habitats caused by in-water disposal operations. No aquatic benefits are expected to accrue from upland disposal and terrestrial benefits would be limited to the restoration of the large existing borrow pit at the Joso upland disposal area. This alternative would provide the greatest protection to cultural properties and be the least likely to impact undocumented properties.

4.14.4 Alternative 4 - Maintenance Dredging With Beneficial Use of Dredged Material and a 3-Foot (0.9-m) Levee Raise

This alternative would have effects similar to alternative 2 except there would be an emphasis on beneficial uses of dredged materials, including constructing shallow-water fish habitat. Decisions for disposing of dredged materials would be made for each dredging action.

4.14.5 Mitigation

Mitigation would be the same as discussed in sections 4.1.8, 4.3.1.3, and 4.5.2.

4.15 CUMULATIVE EFFECTS

The National Environmental Policy Act and the Council on Environmental Quality's regulations require Federal agencies to consider the *cumulative impacts* of their actions on the natural and human environment. Cumulative effects are those environmental consequences that result from the incremental impact of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of the agencies or individuals that may undertake them. Cumulative impacts can also result from individually minor, yet collectively substantial, actions that take place over a period of time.

4.15.1 The DMMP/EIS Cumulative Effects

This DMMP/EIS considers alternative strategies for long-term management of the navigation channel of the lower Snake River and McNary reservoirs, the potential impacts of recurring cycles of dredging and dredged material management activities over a 20-year period. It also considers modifications to the existing levees in the vicinity of Lewiston, Idaho, to provide enhanced flow conveyance capacity.

The cumulative effects analysis considered whether the proposed action and other past, present, and reasonably foreseeable future actions, when considered over the 20-year term of the DMMP could potentially have cumulative impacts on environmental resources. The scope of this analysis includes the resource areas described in sections 4.1 through 4.14.

Cumulative impact analyses have been incorporated throughout the DMMP/EIS. The documentation of existing environmental conditions in Section 3 describes each environmental resource area with respect to current and historic conditions and activities that have contributed to the current status of the resource. The existing conditions of environmental resources, particularly in a highly modified system such as the lower Snake River and McNary Reservoirs, largely result from past and present actions. In particular, the lower Snake and mid-Columbia river systems have been significantly changed since the construction of the McNary and lower Snake River lock and dam projects.

The geographic scope of this cumulative effects analysis is generally consistent with that of the overall environmental analysis for this DMMP/EIS. Actions outside the DMMP project study area have the potential to impact some resources within the lower Snake and McNary reservoirs and, as such, are considered in this cumulative effects analysis. Similarly, the actions proposed under this DMMP have the potential to impact resources outside of the study area, and this is likewise considered in the cumulative effects analysis.

As noted above, the lower Snake and mid Columbia river systems have been substantially altered by construction of dams and levees, as well as through other human activities such as agriculture and urban development. Consideration of the historic actions that have modified the river system is important in establishing the baseline for the evaluations undertaken for this DMMP/EIS. These baseline conditions are presented in Section 3 of this EIS. The temporal scope, or timeframe, of this cumulative effects analysis begins with the construction of the McNary and lower Snake River lock and dam projects, and spans the 20-year planning horizon of the DMMP. Since this DMMP evaluates dredging and dredged material management over a 20-year timeframe, the cumulative effects analysis considered whether the potential effects on resources from repeated activities over 20 years would be cumulatively significant. That is, would individually minor impacts recurring regularly over 20 years potentially result in significant environmental effects. In addition, relevant past and present activities, and reasonably foreseeable future actions within and, if appropriate, beyond the study area, were considered to determine whether impacts from DMMP alternatives would have cumulative environmental effects when added to those actions.

Past, present, and reasonably foreseeable projects or actions that could, when added to the proposed plan alternatives, result in cumulative impacts include:

- Construction of McNary Dam and the four lower Snake River dams and the formation of the reservoirs behind the dams
- Agricultural practices and urban and industrial development within and adjacent to the study area
- Past and present dredging and dredged material disposal activities, including dredging undertaken by the Corps for navigation maintenance or flow conveyance, as well as other dredging including ports, commercial, and recreational facilities within the study area.
- Levee construction and modification.
- Re-licensing of dams within the Columbia/Snake River system.
- The Lower Snake River Juvenile Salmon Migration Feasibility Study recommendations, and other salmon recovery efforts in the study area.
- Columbia River Channel Improvement Project.

4.15.1.1 Construction of the Five Corps Dams

As stated previously, construction of McNary Dam and the four lower Snake River dams changed portions of the Columbia and Snake Rivers from free-flowing rivers to a series of slack water reservoirs. The formation of the reservoirs altered most of the resource areas that are discussed in Sections 3 and 4 of this DMMP/EIS. For example, the reservoirs flooded farmland and wildlife habitat, provided public access to the shoreline, altered transportation to include shipment by barge, provided for additional port and industrial development, required relocation of some communities, and required construction of levees to protect other communities. These effects are expected to continue for McNary dam and reservoir over the 20-year period of the DMMP. These effects are also expected to continue for the lower Snake River dams over the 20-

year period pending any decisions made through the Lower Snake River Juvenile Salmon Migration Feasibility Study (see Sections 1.6 and 4.15.1.6).

4.15.1.2 Land Use Practices

Land use practices within and adjacent to the study area have changed somewhat since construction of McNary Dam and the lower Snake River dams. Prior to the dams, much of the land adjacent to the rivers was used for crops, orchards, or grazing. There were several small communities along the rivers as well as the larger communities such as Lewiston, Clarkston, and the Tri-Cities. The reservoirs eliminated most agricultural use of the lower Snake River canyon and McNary project lands along the mid-Columbia River. Dryland farming and grazing continued on land adjacent to the Corps property. In recent years, some of that land has been converted to irrigated crops, orchards, and fiber farms. Agricultural practices often involve the use of pesticides and chemicals and can result in soil erosion. Runoff from agricultural lands can deposit sediment and chemicals in the reservoirs. Agriculture will likely continue to be a major land use adjacent to the study area during the 20-year period.

Urban and industrial development has occurred mainly in the Lewiston/Clarkston area and the Tri-Cities area with some additional industrial development occurring at port sites. Urban development has created a demand for use of waterfront property for commercial and recreational purposes. Urban development has also resulted in more stormwater runoff, much of which is discharged into the reservoirs. Industrial development has involved placement of fill material and pilings to create docking facilities. Some industrial facilities discharge their wastewater into the reservoirs as permitted by state and federal regulatory agencies. These types of activities are expected to continue in these areas during the 20-year period.

4.15.1.3 Dredging and Dredged Material Management

Previous Corps dredging of the lower Snake River and McNary reservoirs is summarized in table 1-1. Dredging events have ranged from a few thousand cubic yards to almost 1 million cy (764 555 m^3). Between 1996 and 1998, the Corps dredged 313,636 cy (239 791.9 m^3) of sediments, primarily from Lower Granite reservoir. Other, smaller-scale dredging and disposal activities have taken place within the study area as well. This DMMP/EIS considers future dredging scenarios of roughly this order of magnitude [approximately 340,000 cy (259 948.7 m^3) every 2 years]. The Corps has conducted a series of studies to evaluate appropriate in-water and upland disposal sites for dredged material and the effectiveness of habitat creation with dredged material deposited in-water in shallow and mid-depth areas.

Plan alternatives considered in combination with past and present dredging and disposal activities are not anticipated to cumulatively have significant effects on the resources analyzed in this DMMP/EIS.

Historically, some port facilities and recreational marinas on the lower Snake River and McNary reservoirs have used dredging to maintain adequate depths at the ports or marinas (e.g., moorages, turning basins, etc.) or the access channels from port facilities to the authorized navigable channel (see Table 1-1). The Corps has conducted dredging for the ports, generally on a cost-reimbursable basis. Additional port and marina facilities would, most likely, require some level of dredging over the 20-year timeframe covered by the DMMP/EIS.

Future dredging of port and marina facilities, in combination with the dredging and disposal scenarios considered in this DMMP/EIS, is not expected to have significant cumulative environmental effects. While additional port and marina dredging would increase dredging activities and dredged material quantities requiring disposal, it is not anticipated that these factors would result in substantially greater amounts of dredging or dredged material. Environmental effects are expected to be of the same scope and magnitude as those documented in this DMMP/EIS, and are not anticipated to be cumulatively significant when considered in combination with other actions.

4.15.1.4. Levee Construction and Modification

The proposed nominal 3-foot (0.9-m) levee raise (alternatives 2 through 4) involves raising the elevation of the existing levees in the Lewiston area to provide enhanced flow conveyance capacity through this portion of Lower Granite reservoir. The proposed levee raise would add 3 feet (0.9 m) (maximum) in elevation to the top of the existing levee in some locations. At most points along the levees, the raise would be much less than 3 feet (0.9 m). The proposed levee raise is not anticipated to result in environmental effects (particularly aesthetic effects) that are significant when considered cumulatively with the existing levees, or with other actions of the DMMP.

4.15.1.5 Dam Re-licensing

The Hells Canyon Complex Dam on the Snake River, upstream of the study area, will require re-licensing by the Federal Energy Regulatory Commission in 2005. Re-licensing could potentially include requirements that would change operations of that dam, particularly with respect to fish passage and endangered species concerns. At this time, any changes brought on by dam re-licensing that could contribute to cumulative environmental effects are unknown and cannot be considered in this analysis.

4.15.1.6 Lower Snake River Juvenile Salmon Migration Feasibility Study Recommendation

Several river drawdown scenarios were studied by the Corps in the Lower Snake River Juvenile Salmon Migration Feasibility Study. The Corps (Portland District) also studied drawdown of John Day Dam on the mainstem Columbia River downstream of McNary Dam. These studies were in response to the listing of several salmon species as endangered under the ESA. The study of management of the lower Snake River system, including drawdown, is discussed in section 1.6 of this DMMP/EIS. The Corps has issued a final EIS which documents a recommended plan of system improvements to facilitate "adaptive migration."

The preferred alternative that has resulted from the Lower Snake River Juvenile Salmon Migration Feasibility Study process will affect management of the lower Snake River and McNary reservoirs. This DMMP/EIS incorporated several assumptions regarding the future operations of the study area reservoirs, including continuing navigation within the 20-year planning horizon for the DMMP/EIS. The outcome of the Feasibility Study process (to this point) would be consistent with these assumptions while furthering salmon recovery goals. Programmed future "checkpoints" will evaluate the progress made on salmon recovery, and changes to recovery efforts may be made based on these evaluations. Based upon reasonably foreseeable future actions with respect to salmon recovery, no significant cumulative effects are expected.

4.15.1.7 Columbia River Channel Improvement Project

The Columbia River Channel Improvement Project was originally presented in the Final *Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement*, dated August 1999. In December 1999, Congress authorized the deepening of the Columbia and Lower Willamette Rivers Federal Navigation Channel to 43 feet [Section 101(b)(13) of the Water Resource Development Act of 1999]. The authorized plan modifies the existing federal navigation project for the Columbia and Willamette Rivers and provides for construction of ecosystem restoration features. Several additional ecosystem restoration features and research actions are proposed for implementation to benefit the recovery of listed salmonids and other fish and wildlife resources, to avoid impacts to marine resources at the Deep Water Ocean Disposal Site, and to retain sand in the estuary. Creating these restoration features will use sand that would have been disposed of in the Deep Water Ocean Disposal Site. Under the revised plan, no ocean disposal is proposed until 10 years after construction. Construction volumes were updated using December 2001 and January 2002 hydrographic survey data. Other items updated include a reduction in rock excavation, utility relocations, information for smelt and sturgeon gained from research data collection conducted with the federal and state resource agencies, and modification to some of the upland disposal sites to avoid impacts to resources and habitat. The Corps published a Draft Supplemental Integrated Feability Report and Environmental Impact Statement in July 2002.

The NMFS and USFWS May 2002 Biological Opinions discuss such potential development and its potential impacts (e.g. increased localized demand for electricity, water and buildable land with indirect effects to water quality; and, the increased need for transportation, communication and other infrastructure;) on listed species, as well as state, local, tribal and private actions to benefit listed species. The NMFS and USFWS cumulative effects analyses are incorporated herein by reference (Chapters 6 and 8, respectively, of the USFWS and NMFS Biological Opinions). Given the large geographic area involved and the uncertainties associated with state, local, tribal and private actions, the precise nature and timing of future development, and its environmental impact, are extremely difficult to predict. However, given the minimal adverse effects (if any) anticipated for the entire Columbia River channel improvement project as described in this document (i.e. including the ecosystem restoration features and mitigation measures), with the exception of anticipated losses of agricultural lands discussed in the Final IFR/EIS, the project is not anticipated to contribute significantly to any adverse cumulative effects resulting from unrelated development projects. Further, all significant future development will likely be subject to additional independent environmental reviews by state and federal agencies under NEPA, the Clean Water Act, the ESA and similar state programs.

Other ongoing projects directly affect the Columbia River and its environment. These include operation of the Federal Columbia River Power System (FCRPS) and maintenance of the Mouth of the Columbia River federal navigation project (MCR). The potential effects of these projects have been studied in detail. Information on the FCRPS can be found in the December 2000 Biological Opinions issued by NMFS and USFWS for that program. As noted above (Section 7.5.5), the NMFS May 2002 Biological Opinion for channel improvement expressly refers to reasonable and prudent measures from the FCRPS Biological Opinion in order to better integrate compliance measures for the two projects.

In January 2002, the Corps submitted the BA (December 2001) for the Columbia River channel improvement project to the NMFS and USFWS. The BA included actions associated with dredging and deepening, including compliance measures to minimize incidental take of listed species; monitoring actions to ensure deepening and disposal have minimal effects on listed fish and their habitats, and adaptive management to respond to impacts discovered through the monitoring program. Ecosystem restoration features and research actions involve numerous proposals to improve existing habitat conditions in the lower Columbia River and estuary, and research activities to increase knowledge of the river and estuary ecosystem.

On May 20, 2002, the NMFS and the USFWS transmitted their final Biological Opinions to the Corps. These opinions determined that the channel improvement project, including dredging, disposal, monitoring, adaptive management research, and ecosystem restoration, is not likely to jeopardize the continued existence of 13 listed and one proposed fish species, bald eagles, or Columbian white-tailed deer. In addition, the services concurred that the project is not likely to adversely affect Steller sea lions. As discussed in the Channel Improvment documents, the compliance measures, ecosystem research actions and ecosystem restoration features that are part of the channel improvement project are intended to not only avoid and minimize any adverse environmental effects, but also to provide net environmental benefits for several environmental resources. Accordingly, channel improvement is not anticipated to contribute to any cumulative adverse environmental effects associated with FCRPS, MCR, or the DMMP/EIS related activities.

4.15.2 Cumulative Effects Findings

The likely cumulative effects of the resource areas examined in this DMMP/EIS, within the context of both the 20-year timeframe of the plan and other past, present, and reasonably foreseeable future actions are summarized below. The cumulative effects of each of the four alternatives are expected to be similar except as noted.

- *Aquatic Resources* – A substantial number of major changes have occurred to the aquatic resources since dam construction. In addition to the changing of free flowing rivers to a more lacustrine system, the dams have also changed temperature regimes, although currently the high water temperatures of concern are greatly influenced from operations upstream of the lower Snake reservoirs. Anthropogenic activities (including, but not limited to sport fisheries management) have increased the number of non-native species, many of which (bass, walleye, crappie, etc.) now prey upon other small native fish, including migrating and rearing salmonids. In addition, industry in the project area has increased the amount of point source pollution, and increased urban development, forestry and agricultural practices have increased non-point source pollution as well. Construction of railroads, roadbeds and levees has changed the interactions of the hydrologic zone including the hydrologic functioning of the flood plain and the development and maintenance of a healthy riparian zone.

Future actions associated with dredging and other anticipated activities in the near term include environmental restoration through the removal of levees, developing riparian shoreline areas and building up mid-depth benches to shallow depth for better salmonid habitat. However, urban development is anticipated to continue, the lower Snake River dams are expected to stay in place at least through their economic life, and sedimentation from the various activities in the upper watershed is expected to continue.

Recurring dredging and management activities proposed in the DMMP would have repeated, minor resource impacts, but these impacts would not be cumulatively significant. Creation of riparian and submerged habitat areas could have cumulative benefits to aquatic resources. Upland disposal at the Joso site would have no cumulative effects on aquatic resources.

- *Terrestrial Resources* – The effects of plan alternatives on terrestrial resources would be minor, and may be cumulatively positive over the long-term if beneficial uses of dredged material involve substantial efforts to restore terrestrial ecosystems (such as those of the proposed woody riparian program).

- *Endangered Species* – Plan alternatives would not have cumulatively significant adverse impacts on currently listed threatened or endangered species. Proposed beneficial uses of dredged material may have beneficial long-term effects for listed anadromous fish species, particularly when considered in combination with other current and proposed salmon recovery efforts.

- *Recreation* – The plan alternatives are anticipated to result in minor, short-term impacts to recreation resources. Some positive effects (such as maintaining recreational boat basins) would result from the proposed alternatives. No adverse cumulative effects on recreation are expected to result from the DMMP alternatives.

- *Cultural Resources* – Cumulative impacts to cultural resources could occur over the term of the DMMP through repeated placement of dredged material on potential submerged cultural resources sites. However, these impacts are not anticipated to be significant since known cultural resource sites will be avoided and the Corps would conduct on-going coordination with tribal and state cultural resources authorities. Upland disposal of dredged material would not be expected to have cumulative effects on cultural resources as dredged material would not be placed on cultural sites.

- *Socio-economics* - In general, positive socio-economic effects are expected to result from the DMMP alternatives. No substantial changes to existing socio-economic conditions or trends are anticipated to result from the DMMP alternatives when considered with other actions.

- *Transportation* – The DMMP alternatives would all result in continued commercial navigation on the lower Snake River and McNary Reservoirs. No substantial changes to the regional transportation are anticipated to result from the DMMP alteratives.

- *Geology and soils* – DMMP alternatives would have cumulative effects on soils based on repeated dredging and management of dredged sediments, particularly if beneficial uses dredged materials are maximized for purposes, such as the proposed woody riparian program. Such cumulative effects would not be significant and, in some cases, may be beneficial, through stabilization of shoreline areas. Also worth noting is the opportunity presented through the DMMP process (and, in particular, through the Local Sediment Management Group) to begin addressing sediment sources and contributions to the lower Snake River system and McNary reservoir.

- *Water Quality/Water Resources* – Each dredging cycle would have minor short-term adverse impacts on water quality and sediment resulting from dredging and management of dredged materials. However, dredging and dredged material management impacts would not result in cumulatively significant adverse impacts to water quality from the plan alternatives. Other past, present, and future activities, including continued and future wastewater and stormwater discharges would affect water quality. However DMMP water quality and water resources impacts, when considered in combination with other actions, are not anticipated to result in significant adverse cumulative effects.

- *Hazardous, Toxic, and Radioactive Wastes (HTRW)* – The DMMP alternatives would not have adverse HTRW impacts, and no cumulative effects with respect to HTRW are anticipated to result from implementation of DMMP.

- *Air Quality* – No cumulatively negative air quality impacts would result from the DMMP alternatives. Proposed dredging and dredged material management activities and the proposed levee modifications would result in short-term increases in emissions. However, neither the repeated dredging and disposal activities nor the combination of DMMP-related activities and other actions would have cumulatively significant adverse air quality impacts.

- *Noise* – Noise impacts associated with DMMP alternatives would be localized and short-term. No cumulative noise impacts are expected to result from DMMP alternatives.

- *Aesthetics* – The proposed alternatives would have a cumulative, yet localized, impact on aesthetics with respect to the proposed levee raise. Historically, construction of the levees in the Clarkston/Lewiston area as an upstream extension of Lower Granite Dam has resulted in changes to the aesthetics of riverfront areas in the surrounding communities. The proposed levee raise would involve a portion of the existing levee system and would result in a maximum levee raise of three feet (less than one meter). The proposed levee raise would not result in significant cumulative impacts on study areas aesthetics. Creation of woody riparian habitat in any of the reservoirs would expand or restore riparian vegetation to the shoreline. Shoreline restoration along any of the reservoirs would eliminate eroding cutbanks and provide a sloping, vegetated bank.

- *Native American Tribal Communities* –The DMMP alternatives, while maintaining the navigation channel, also feature opportunities to restore previously affected elements of the river systems, particularly that restore ecosystem features. The recommended plan, for example, features maximization of beneficial use of dredged material which would benefit endangered fish species that are of profound cultural and spiritual importance to Native American communities, as well as an important food source. Beneficial uses and other means of dredged material management proposed in the DMMP would represent positive steps to aid the resources valued by these communities.

4.15.3 Mitigation

No cumulatively significant adverse environmental effects are anticipated to result from the alternatives considered. Therefore, no mitigation specific to cumulative impacts is proposed at this time. Proposed beneficial uses and mitigation measures outlined in the DMMP would avoid, reduce, or otherwise mitigate environmental impacts of the proposed action that could result in cumulative impacts. If changes in the conditions or assumptions of this cumulative effects analysis were to change over the planning timeframe of 20 years, the potential for cumulative environmental effects would be revisited by the Corps.

SECTION 5
COMPLIANCE WITH APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This DMMP/EIS is in compliance with environmental laws and Executive Orders as described, but not limited to those listed below:

5.1 FEDERAL STATUTES

5.1.1 American Indian Religious Freedom Act (AIRFA)

The AIRFA of 1978 (42 U.S.C.A. 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' interests before undertaking actions that might harm those interests. The Corps will continue to coordinate with affected Native American Tribes on this study and future implementation plans.

5.1.2 Archeological Resources Protection Act

The Archeological Resources Protection Act (16 U.S.C. 470aa-470ll) provides for the protection of archeological sites located on public and Indian lands, establishes permit requirements for the excavation or removal of cultural properties from public or Indian lands, and establishes civil and criminal penalties for the unauthorized appropriation, alteration, exchange, or other handling of cultural properties.

The Corps will continue to protect archeological resources and sites on its lands. The Corps will configure its maintenance dredging and dredged material disposal activities to avoid known cultural properties.

5.1.3 Clean Air Act

The Clean Air Act (CAA) (42 U.S.C. 7401 et seq.), amended in 1977 and 1990, was established "to protect and enhance the quality of the nation's air resources so as to promote public health and welfare and the productive capacity of its population." The CAA authorizes the EPA to establish the NAAQS to protect public health and the environment. The CAA establishes emission standards for stationary sources, volatile organic compound emissions, hazardous air pollutants, and vehicles and other mobile sources. The CAA also requires the states to develop implementation plans applicable to particular industrial sources.

Upland disposal of dredged material and levee construction both have the potential to generate dust. With the implementation of BMPs, activities associated with the alternatives are not anticipated to adversely affect air quality.

5.1.4 Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451-1564) requires that Federal actions be consistent, to the maximum extent practicable, with approved state coastal zone management programs. A state coastal zone management program (developed under state law and guided by the Act) sets forth objectives, policies, and standards to guide public and private uses of lands and waters in the coastal zone. The coastal zone as defined in the Act extends inland as far as necessary to account for factors that influence shorelines. Washington and Oregon have approved coastal zone management programs, both of which list seven types of Federal activities directly affecting the coastal zone. The upper boundary of the coastal zone is downstream of Bonneville Dam.

The DMMP/EIS alternatives would have little effect on water levels or river uses downstream of Bonneville Dam and, therefore, all alternatives are in compliance with the Act.

5.1.5 Endangered Species Act (ESA)

The ESA (16 U.S.C. 1531-1544), amended 1988, established a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a) of the ESA requires Federal agencies to consult with the USFWS and NMFS, as appropriate, to ensure that 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 that Federal agencies prepare BA's of the potential effects of major actions on listed species and critical habitat. The Corps has been and continues to consult with USFWS and NMFS concerning listed species that could be affected by the actions addressed in this DMMP/EIS.

The Corps has consulted with the USFWS and NMFS regarding listed species in the study area. The BA's have been prepared (see appendix F - Biological Assessment for Anadromous Fish Species and appendix G - Biological Assessment for Non-Anadromous Fish and Terrestrial Species) and forwarded to both agencies to address species and habitat impacts where applicable. USFWS concurrence with the BA's findings regarding the following listed species: Bull trout, bald eagle, McFarlane's four-o'clock, water howellia, and Ute ladies' tresses is located in Appendix G. Those endangered or threatened species expected to be adversely affected include the Snake River steelhead, Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River sockeye salmon, Upper Columbia Basin steelhead, Middle Columbia Basin steelhead, and Upper Columbia Basin spring run chinook salmon. NMFS determined no jeopardy to listed species would occur if reasonable and prudent measures were taken.

5.1.6 Farmland Protection Policy Act

The Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) requires Federal agencies to identify and take into account the adverse effects of their programs on the preservation of farmlands. None of the alternatives in this study would cause physical deterioration and/or reduction in productivity of farmlands.

5.1.7 Federal Water Pollution Control Act (Clean Water Act)

The Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.) is more commonly referred to as the Clean Water Act (CWA). This act is the primary legislative vehicle for Federal water pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The CWA was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA sets goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment. The Act has been amended numerous times and given a number of titles and codifications.

Water Quality Certification for the recommended plan/preferred alternative will be requested from the regulating agencies for the States of Washington, Idaho, and Oregon for each dredging activity, as appropriate. Corps actions involving the discharge of dredged or fill materials into the waters of the United States will be in accordance with guidelines promulgated by the EPA in conjunction with the Secretary of the Army under the authority of Section 404(b)(1) of the CWA. A Section 404(b)(1) Evaluation has been prepared to address proposed in-water disposal actions on a programmatic basis and is included as appendix I in the DMMP/EIS. Separate 404(b)(1) evaluations will be prepared for each dredging and in-water disposal activity and submitted to the appropriate state(s) along with a request for water quality certification.

5.1.8 Federal Water Project Recreation Act

In the planning of any Federal navigation, flood control, reclamation, or water resources project, the Federal Water Project Recreation Act (16 U.S.C.A. 4612 et seq.) requires that full consideration be given to the opportunities that the project affords for outdoor recreation and fish and wildlife enhancement. The Act requires planning with respect to development of recreation potential. Projects must be constructed, maintained, and operated in such a manner if recreational opportunities are consistent with the purpose of the project.

Recreation sites have been developed at all of the Federal projects involved in the proposed action and are operated by a variety of entities. Alternatives 2, 3, and 4 would have short-term, minor impacts on recreational trails due to levee modifications. None of the alternatives considered in this DMMP/EIS are expected to have a significant, long-term impact on recreation facilities, activities, or use patterns. There would be a positive effect on small boat harbors by continuance of maintenance dredging.

5.1.9 Fish and Wildlife Coordination Act (FWCA)

The FWCA of 1980 (16 U.S.C. 661 et seq.) requires consultation with USFWS when any water body is impounded, diverted, controlled, or modified for any purpose. The USFWS and state agencies charged with administering wildlife resources are to conduct surveys and investigations to determine the potential damage to wildlife and the mitigation measures that should be taken. The USFWS incorporates the concerns and findings of the state agencies and other Federal agencies, including NMFS, into a report that addresses fish and wildlife factors and provides recommendations for mitigating or enhancing impacts to fish and wildlife affected by a Federal project. The Corps is not required to consult with the USFWS for existing water resource projects with standard operation and maintenance.

The USFWS prepared an August 1988 Evaluation Report entitled "Lower Granite Reservoir Dredging Alternatives - Snake River, Washington-Idaho." The USFWS provided comments on construction of a levee raise and dredge and disposal operations that have been incorporated into this DMMP/EIS.

This DMMP/EIS has been coordinated with the USFWS and other Federal and state resource agencies. The Corps will continue to consult with wildlife agencies through the adoption and implementation of the DMMP/EIS.

5.1.10 Fishery Conservation and Management Act of 1976

The Fishery Conservation and Management Act of 1976 (16 U.S.C. 1801-1882; 90 Stat. 331; as amended), also known as the Magnuson Fishery Conservation and Management Act, established a 200-mile (321.9-km) fishery conservation zone, effective March 1, 1977, and established the Regional Fishery Management Councils consisting of Federal and state officials, including the USFWS. The fishery conservation zone was subsequently dropped by amendment and the geographical area of coverage was changed to the Exclusive Economic Zone, with the inner boundary being the seaward boundary of the coastal States. Columbia River salmon and steelhead are found in this zone. Therefore, the potential effects of the alternatives on the fisheries in this zone have been examined in section 4, Environmental Effects of Alternatives.

5.1.11 Land and Water Conservation Fund Act

The Land and Water Conservation Fund Act (LWCFA) (16 U.S.C.A. 4601-11) assists in preserving, developing, and ensuring accessibility of outdoor recreation resources. The LWCFA establishes specific Federal funding for acquisition, development, and preservation of lands, water, or other interests authorized under the ESA and National Wildlife Refuge Areas Act. Funds appropriated under the Act are allocated to Federal agencies or as grants to states and localities. Recreation facilities on the lower Snake River as evaluated in the DMMP/EIS are not LWCFA-funded facilities.

5.1.12 Migratory Bird Conservation Act

The Migratory Bird Conservation Act (16 U.S.C. 715 et seq.) requires that lands, waters, or interests acquired or reserved for purposes established under the Act be administered under regulations promulgated by the Secretary of the Interior. This act involves conservation and protection of migratory birds in accordance with treaties entered into between the United States and Mexico, Canada, Japan, and the former Union of Soviet Socialist Republics. It protects other wildlife, including threatened or endangered species, and restores or develops adequate wildlife habitat. The migratory birds protected under this Act are specified in the respective treaties. In regulating these areas, the Secretary of the Interior is authorized to manage timber, range, agricultural crops, and other species of animals, and to enter into agreements with public and private entities.

Section 4.2, Terrestrial Resources, addresses affected avian species as well as other terrestrial species of concern.

5.1.13 National Environmental Policy Act (NEPA)

This DMMP/EIS was prepared pursuant to regulations implementing the NEPA (42 U.S.C. 4321 et seq.). The NEPA provides a commitment that Federal agencies will consider the environmental effects of their actions. It also requires that an EIS be included in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The EIS must provide detailed information regarding the proposed action and alternatives, the environmental impacts of the alternatives, potential mitigation measures, and any adverse environmental impacts that cannot be avoided if the proposal is implemented. Agencies are required to demonstrate that these factors have been considered by decision makers prior to undertaking actions. Development of this programmatic DMMP/EIS is in compliance with NEPA requirements for the proposed action. The NEPA compliance will be considered complete with the signing of a Record of Decision, currently anticipated in the summer of 2002.

5.1.14 Native American Graves Protection and Repatriation Act (NAGPRA)

The NAGPRA (25 U.S.C.A. 3001) addresses the discovery, identification, treatment, and repatriation of Native American and Native Hawaiian human remains and cultural items (associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony). This Act also establishes fines and penalties for the sale, use, and transport of Native American cultural items. Consistent with procedures set forth in applicable Federal laws, regulations, and policies, the Corps will proactively work to preserve and protect natural and cultural resources, establish NAGPRA protocols and procedures, and allow reasonable access to sacred sites.

5.1.15 The National Historic Preservation Act (NHPA)

Section 106 of the NHPA (16 U.S.C. 470) requires that Federal agencies evaluate the effects of Federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking. The first step in the process is to identify cultural resources included in (or eligible for inclusion in) the NRHP that are located in or near the project area. The second step is to identify the possible effects of proposed actions. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects. Historic properties are referred to as cultural properties in this DMMP/EIS to make more clear to the reader that the term includes prehistoric, historic, and traditional age-related resources. Cultural resource field investigations and literature searches have been conducted. The Corps' preliminary determination found that DMMP/EIS dredging and disposal actions potentially could affect cultural properties. The Corps has consulted with the SHPOs of Washington, Idaho, and Oregon, and other consulting parties, to determine the effects of the recommended action on cultural properties on a programmatic basis and in developing measures that may be taken to avoid, minimize, or mitigate potential effects. The Corps proposes to consult with the SHPOs and consulting parties each time a dredging activity is planned. The Corps has received programmatic concurrences from Washington, Idaho, and Oregon SHPOs. Also, Washington and Idaho SHPOs have provided concurrences with the proposed 2002-2003 dredging& dredged material management activities.

The following cultural resource protection laws were also considered in the preparation of this DMMP/EIS:

- The Antiquities Act of 1906 (16 U.S.C. 431).
- Historic Sites Act of 1935 (16 U.S.C. 461).
- Reservoir Salvage Act of 1960 (16 U.S.C. 469).
- Archeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1).

5.1.16 Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act)

The Northwest Power Act was passed by Congress on December 5, 1980 (16 U.S.C. 829d-1). This law created the eight-member Northwest Power Planning Council (NPPC), an interstate agency whose members are appointed by the Idaho, Montana, Oregon, and Washington governors. The NPPC was entrusted with adopting a Fish and Wildlife Program for the Columbia River Basin by November 1982 and preparing a 20-year Regional Electric Power and Conservation Plan by April 1983. These plans are periodically updated and amended.

The NPPC's Fish and Wildlife Program established a number of goals for restoring and protecting fish and wildlife populations in the basin. These goals led to changes in the operation of the Coordinated Columbia River System during the mid-1980s. One of the most notable changes resulted in the Water Budget, which provides for the release of specific amounts of water in the upper Columbia and Snake Rivers to help juvenile salmon migrate downstream in the spring. More recently, the NPPC developed its own proposals to protect threatened and endangered salmon stocks. The NPPC has completed amendments to its Columbia River Basin Fish and Wildlife Program. The amendments adopted to date include main stem survival, harvest, production, habitat, and flow measures that can be used to increase salmon and steelhead runs, and resident fish and wildlife measures. The Corps takes these amendments into consideration when making operating plans.

The alternatives considered in the DMMP/EIS to maintain the existing authorized navigation channel and provide flow conveyance capacity will have no long-term, adverse impacts on generation of electrical power in the Northwest or on fish and wildlife populations present in the study area.

5.1.17 Pollution Control at Federal Facilities

In addition to their responsibilities under NEPA, Federal agencies are required to carry out the provisions of other Federal environmental laws. To the extent applicable to an alternative presented in this DMMP/EIS, compliance with the standards contained in the following legislation was included in this evaluation:

- The Safe Drinking Water Act, as amended (42 U.S.C. 300F et seq.).
- The Solid Waste Disposal Act (42 U.S.C. 6901 et seq.).
- Oil Pollution Act (33 U.S.C. 2701 et seq.).
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended (42 U.S.C. 9601 [9615] et seq.).
- The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended (7 U.S.C. 136 et seq.).
- The Resource Conservation and Recovery Act (RCRA) of 1976, as amended (42 U.S.C. 6901 et seq.).
- Toxic Substances Control Act (TSCA), as amended; Title 40 CFR Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions" (15 U.S.C. et seq.).
- The Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.).
- Occupational Health and Safety Act (29 U.S.C. 651 et seq.).

5.1.18 River and Harbor Act of 1899

Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 401-418) regulates structures or work in or affecting navigable waters of the United States including discharges of dredged or fill material. The planning of this proposed action has taken into consideration the ability of boat/barge traffic to continue unobstructed.

Implementation of the proposed action would have a long-term beneficial effect on navigation in the study area. The public will be notified each time the Corps proposes to perform in-water work in navigable water as part of the DMMP/EIS.

5.1.19 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (16 U.S.C. 1278 et seq.) designates qualifying free-flowing river segments as wild, scenic, or recreational. The Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers system, as well as rivers designated on the National Rivers Inventory. Discharges into streams, impoundments, diversions, channel alterations, and other measures can alter the stream discharge, velocity, and channel dimensions. These hydraulic changes may cause modifications to the free-flowing character of the stream, resulting in loss or diminution of its environmental values. The Act requires consideration of the impacts and consultation with the responsible agency prior to implementation of a project.

Several rivers upstream of the study area are designated as Wild and Scenic Rivers, including portions of the Snake River, the Grande Ronde River, and the Middle Fork of the Clearwater River. The Wild and Scenic portion of the Snake River extends from Hells Canyon Dam (upstream) to the eastward extension of the north boundary of Section 1, Township 5 North, Range 47 East, Willamette Meridian (downstream), approximately 67 miles (107.8 km). None of these rivers would be affected by the actions recommended in this DMMP/EIS. Additionally, in 1988, through Public Law 100-677, Congress prohibited the construction of dams "on the Snake River…from the eastward extension of the north boundary of Section 1, Township 5 North, range 47 East, Willamette Meridian to the pool formed behind Lower Granite Dam…in order to further the purposes of the Wild and Scenic Rivers Act."

5.1.20 Wilderness Act

The Wilderness Act of 1964 (16 U.S.C.A. 1131 et seq.) established the National Wilderness Preservation system. Areas designated as wilderness under the original Act and subsequent wilderness legislation are to be administered for the use and enjoyment of the public in such a manner as to leave them unimpaired as wilderness. Development activities are generally prohibited within wilderness areas, and Federal agencies proposing actions must consider whether the effects of those actions would impair wilderness values. Although there are Wilderness Areas in this basin, none are located on the lower Snake River.

5.2 EXECUTIVE ORDERS

5.2.1 Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 13, 1971

Executive Order 11593 outlines the responsibilities of Federal agencies to consider effects to historic properties in consultation with the Advisory Council on Historic Preservation where a Federal undertaking may adversely affect a property. Agencies are also to preserve, rehabilitate, and restore NR-listed historic properties. Agencies are encouraged to avoid, or at least mitigate, an adverse effect on listed properties. The executive order furthers the purpose and policies associated with the National Environmental Policy Act of 1969; the National Historic Preservation Act of 1966; the Historic Sites Act of 1935 and the Antiquities Act of 1906.

The Corps objective would be to avoid effects to cultural properties and make, at minimum, a no adverse effect finding as understood under NHPA. The Corps would consult with the Advisory Council on Historic Preservation as well as its other consulting parties concerning adverse effects to historic properties that could result from the DMMP/EIS.

5.2.2 Executive Order 11988, Floodplain Management Guidelines, May 24, 1977

This order outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency shall evaluate the potential effects of actions on floodplains and should avoid undertaking actions that directly or indirectly induce growth in the floodplain or adversely affect natural floodplain values. Alternatives considered in this DMMP/EIS include in-water and upland disposal, levee raise (requiring roadway modifications), and beneficial uses for dredged material. In-water disposal and the levee raise/roadway modifications are not anticipated to have any impact to the 100-year floodplain or water surface elevation. The area designed for permanent disposal at the Joso site is not located in the 100-year floodplain. The temporary storage area for dredged material (to be used for dewatering) would encroach on the 100-year floodplain and there would be minor, short-term impacts to the floodplain but it is not expected to change the water surface elevation. Beneficial uses of dredged material are not anticipated to present significant impacts to the floodplain areas but will need to be analyzed on a case-by-case basis. Woody riparian habitat development would occur in the 100-year floodplain, but is not expected to change the water surface elevation.

5.2.3 Executive Order 11990, Protection of Wetlands

Executive Order 11990 encourages Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. Minor, short-term, indirect impacts to wetlands adjacent to the levees or roadways could occur during construction of improvements. Upland disposal at Joso is anticipated to have minor, indirect impacts to two southwestern parcels resulting from unloading of dredged material. Beneficial uses are expected to generally affect wetland resources in a positive manner by using dredged material for enhancement or creation of aquatic and wildlife habitat. It has been the goal of the Corps to avoid or minimize wetland impacts in the study area for all alternatives considered in this DMMP/EIS.

5.2.4 Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994

Executive Order 12898 requires Federal agencies to consider and address environmental justice by identifying and assessing whether agency actions may have *disproportionately high and adverse human health or environmental effects on minority or low-income populations*. Disproportionately high and adverse effects are those effects that are *predominantly* borne by minority and/or low-income populations *and* are appreciably more severe or greater in magnitude than the effects on non-minority or non-low income populations.

This DMMP/EIS programmatically considers activities related to long-term management of the lower Snake River and McNary reservoirs. In particular, dredging, dredged material management, and maintenance of flood flow conveyance activities are contemplated in this plan. The effects of the categories of actions contemplated in this DMMP/EIS are not anticipated to be borne predominantly by any particular low-income or minority group such that the effects would be considered disproportionately high and adverse with respect to low-income or minority populations. Dredging would occur within the established navigation channel and at specific recreation areas and Corps HMU irrigation intakes. In-water and upland placement of dredged materials are considered in this plan; the effects from either management approach are not anticipated to specifically or disproportionately affect any particular low-income or minority population. Maintenance of flood flow conveyance would involve raising levees in the Lewiston area and is similarly not expected to disproportionately affect any particular demographic group.

5.2.5 Executive Order 13007, Native American Sacred Sites, May 24, 1996

Executive Order 13007 directs Federal agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian 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 act encourages government-to-government consultation with tribes concerning sacred sites. Some sacred sites may qualify as historic properties under the NHPA.

The Corps welcomes discussion of concerns or issues involving sacred sites and invites tribes to bring concerns as a part of the consultation process for the DMMP/EIS. The few that have been identified do not lie within the DMMP/EIS study area.

5.3 EXECUTIVE MEMORANDA

5.3.1 Council on Environmental Quality Memorandum, August 11, 1990, Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA

The Council on Environmental Quality Memorandum establishes criteria to identify and consider the adverse effects of Federal programs on the preservation of prime and unique farmland, to consider alternative actions, as appropriate, that could lessen adverse effects, and to ensure Federal programs are consistent with all state and local programs for the protection of farmland.

The proposed action was determined not to have an impact on prime or unique agricultural lands.

5.4 STATE STATUTES

The CEQ regulations (40 CFR 1506.2) require consideration of the consistency of a proposed action with approved state and local plans and laws. Dredging activities proposed in this DMMP/EIS have been evaluated with regard to applicable state statutes and regulations. Compliance issues have been considered and addressed where applicable to the subject dredging activities. A few statutes considered include, but are not limited to:

- Stream Channel Alteration Permit (Idaho)
- Removal-Fill Law (Oregon)
- Hydraulic Project Approval (Washington)
- Shoreline Management Act (Washington)

SECTION 6
COORDINATION, CONSULTATION, AND PUBLIC INVOLVEMENT

In November 2001 the Corps of Engineers distributed the Draft DMMP/EIS for the Lower Snake River and McNary Reservoirs for public review. The public comment period lasted through January 7, 2002. Twenty-six comment documents (letters and e-mails) were received. The Corps also conducted two public meetings in December 2001 (in Pasco, Washington, on December 12th and Lewiston, Idaho, on December 13th) to receive comments on the DMMP/EIS. The Corps considered all public comments received throughout the planning process. In addition to the opportunities to comment on the DMMP/EIS, the Corps has undertaken efforts throughout the planning process to coordinate and consult with agencies, affected tribal groups, and interested members of the public. A brief discussion of these efforts is provided below.

6.1 SCOPING

The Notice of Intent to prepare a draft Environmental Impact Statement (DEIS) for the proposed DMMS was published on August 5, 1998. In September 1998, the Corps held two regional public scoping meetings to allow the public and interested agencies to learn about the purpose and scope of the Walla Walla District's dredging program. Discussions included ways to reduce the need to dredge for navigation, comparing dredging and disposal methods, identifying and evaluating disposal sites, and the Corps' intent to prepare a programmatic DMMP and EIS.

These public scoping meetings were held in Richland, Washington, and in Lewiston, Idaho. Meeting participants represented ports, Federal and state governmental agencies, local businesses, farming, and a member of Congress. The Corps used the input and concerns from the scoping meetings to help define and refine the scope of the plan, alternatives, and environmental documentation.

The Corps received input that included concerns/ issues regarding dredging and disposal management, alternatives to dredging, and potential beneficial uses of dredged materials. Major issues or concerns identified included impacts to waterfowl and wildlife, maintaining water quality, maintaining navigation, and planning for an annual dredging program. Some of the alternatives mentioned were implementing erosion control and soil conservation measures to keep sediment from entering the rivers, installing flow velocity devices, and annually drawing down the reservoirs to flush sediments and allow for dredging in the dry. Potential beneficial uses identified include creating islands, fish and wildlife habitat, new land for port development, and beaches.

6.2 MEETINGS WITH RESOURCE AGENCIES

Following a preliminary evaluation of alternatives, the Corps held a meeting in August 1999 with representatives of natural resource management, regulatory agencies, and tribal interests. The purpose of this meeting was to present the range of alternatives to be evaluated in the DEIS, including the recommended plan, to the agency representatives and receive their input on the alternatives and their evaluation of the DEIS.

In July 2000, the Corps hosted the first meeting of the LSMG. Representatives from Federal and state agencies, ports, and tribes attended. At the meeting, the Corps presented an overview of the DMMP and a projected schedule for its completion. The Corps also presented a summary of the results of Dr. Bennett's studies on the effects of dredging on aquatic resources.

In February 2001, the Corps hosted a second meeting of the LSMG. The purpose of the meeting was to continue discussions of dredging and dredged material disposal activities in the navigable waters within the boundaries of the Walla Walla District. The meeting included a presentation by Dr. Bennett, PhD, University of Idaho, on the results of his dredging studies in the lower Snake River, an overview of the National and Regional Dredging Teams, a status report on the DMMP, and a status report on the dredging framework for the lower Snake and Clearwater Rivers and McNary reservoir.

The LSMG met again in December 2001 to discuss the status of the DMMP process, beneficial uses of dredged material, the proposed woody riparian habitat program, the proposed 2002-2003 maintenance dredging, and the dredged material evaluation framework.

6.3 ENDANGERED SPECIES ACT CONSULTATION

To fulfill the requirements of the ESA, the Corps conducted consultation with both the USFWS and the NMFS. The Corps has prepared BAs discussing the impacts of the proposed project on listed species that may be in the project area. The Corps sent the BA for terrestrial species and non-anadromous fish species to USFWS with a request for informal consultation. The Corps sent the BA for anadromous fish species to NMFS with a request for formal consultation. The Corps has received concurrence from USFWS regarding the findings presented in the BA (and summarized in this DMMP/EIS). The NMFS determined that the proposed actions would not jeopardize the continued existence of listed fish species, contingent on the Reasonable and Prudent Measures presented in their Biological Opinion. See Appendix F and G.

6.4 TRIBAL CONSULTATION

The Corps is also following a separate consultation process with the tribes. Indian treaties, Federal statutes, executive orders, national policies, and court cases have collectively and over time caused changes in how these relationships are exercised. Federal agencies are to consult and coordinate with American Indian tribes and traditional communities about their actions. In facilitating this process, the Corps seeks to provide meaningful and timely opportunities for tribes to comment on agency policies that may have significant or unique effects on tribal interests.

6.4.1 Laws and Statutes Relating to Tribal Interests

There are many Federal laws, executive orders, policy directives, and Federal regulations that address responsibilities of the executive branch agencies regarding tribal interests. Collectively, these form the basis of how consultation is conducted and have had a profound impact on Federal-tribal relations. Examples of the statutes specifically discussing tribal interests are NHPA, Archeological Resources Protection Act, NAGPRA, and AIRFA. Summaries of these statutes can be found in section 5 of this report.

Specifically, places of cultural and religious significance to tribes are to be considered by Federal agencies in policy and project planning. The Corps is increasingly engaging and involving tribes in collaborative processes designed to facilitate the exchange of information and to effectively address effects of Federal actions and policies on tribal interests and rights.

6.4.2 U.S. Army Corps of Engineers Policy Guidance and American Indian Tribes

In February 1998, Lt. General Joe N. Ballard, Chief of Engineering, published a Memorandum for Commanders, Major Subordinate Commands and District Commands: Policy Guidance Letter No. 57, Indian Sovereignty and Government-to-Government Relations with Indian Tribes. Portions of that letter are quoted below:

> "1. Our Nation has long recognized the sovereign status of Indian tribes. The United States Constitution specifically addresses Indian sovereignty by classing Indian treaties among the "supreme Law of the land," and establishes Indian affairs as a unique focus of Federal concern. Principles outlined in the Constitution and treaties, as well as those established by Federal laws, regulations and Executive Orders, continue to guide our national policy towards Indian Nations.
>
> 2. On 29 April 1994, President Clinton reaffirmed the United States' "unique legal relationship with Native American tribal governments." In recognition of the special considerations due to tribal interests, the President directed Federal agencies to operate within a government-to-government relationship with federally recognized Indian tribes; consult, to the greatest extent practicable and permitted by law, with Indian tribal governments; assess the impact of agency activities on tribal trust resources and assure that tribal interests are considered before the activities are undertaken; and remove procedural impediments to working directly with tribal governments on activities that affect trust property or governmental rights of the tribes…."
>
> "3. ….I want to ensure that all Corps Commands adhere to principles of respect for Indian tribal governments and honor our Nation's trust responsibility. To this end I have enclosed U.S. Army Corps of Engineers Tribal Policy Principles, for use as interim guidance until more detailed statements are developed. These Principles have been developed with the Office of the Assistant Secretary of the Army (Civil Works) and are consistent with the President's goals and objectives…."

"U.S. ARMY CORPS OF ENGINEERS
TRIBAL POLICY PRINCIPLES

TRIBAL SOVEREIGNTY - The U.S. Army Corps of Engineers recognizes that Tribal governments are sovereign entities, with rights to set their own priorities, develop and manage Tribal and trust resources, and be involved in Federal decisions or activities which have the potential to affect these rights. Tribes retain inherent powers of self-government.

TRUST RESPONSIBILITY - The U.S. Army Corps of Engineers will work to meet trust obligations, protect trust resources, and obtain Tribal views of trust and treaty responsibilities or actions related to the Corps, in accordance with provisions of treaties, laws and Executive Orders as well as principles lodged in the Constitution of the United States.

GOVERNMENT-TO-GOVERNMENT RELATIONS - The U.S. Army Corps of Engineers will ensure that Tribal Chairs/Leaders meet with Corps Commanders/Leaders and recognize that, as governments, tribes have the right to be treated with appropriate respect and dignity, in accordance with principles of self-determination.

PRE-DECISIONAL AND HONEST CONSULTATION - The U.S. Army Corps of Engineers will reach out, through designated points of contact, to involve tribes in collaborative processes designed to ensure information exchange, consideration of disparate viewpoints before and during decision making, and utilize fair and impartial dispute resolution mechanisms.

SELF RELIANCE, CAPACITY BUILDING, AND GROWTH - The U.S. Army Corps of Engineers will search for ways to involve Tribes in programs, projects and other activities that build economic capacity and foster abilities to manage Tribal resources while preserving cultural identities.

NATURAL AND CULTURAL RESOURCES - The U.S. Army Corps of Engineers will act to fulfill obligations to preserve and protect trust resources, comply with the Native American Graves Protection and Repatriation Act, and ensure reasonable access to sacred sites in accordance with published and easily accessible guidance."

In August 2001, Clifton P. Jackson, Jr., Executive Assistant for the Commander, published CENWD-NA Regulation No. 5-1-1, Management Native American Policy for the Northwestern Division, covering the policy, responsibilities, and implementation of the U. S. Army Corps of Engineers Tribal Policy Principles. This regulation applies to all Northwestern Division commands having responsibility for Civil Works, military, and Hazardous, Toxic, and Radioactive Waste functions. The policy and responsibilities associated with this regulation are reproduced here:

"POLICY. It is the policy of the Northwestern Division to apply the USACE Tribal Policy Principles into all division activities that may impact any federally recognized Indian Tribe. In those activities where consultation is warranted, it is the policy of the Northwestern Division to consult on a government-to-government level consistent with guidance found in White House Memorandum, Government-to-Government Relations, 29 April 1994; CECW PLG 57, Indian Sovereignty and Government-to-Government Relations with Indian Tribes, 18 February 1998, and USACE Tribal Policy Principles; DA Pamphlet 200-4, Cultural Resources Management, Appendix G, Guidelines for Army Consultation with Native Americans, 30 October 1997; DOD American Indian and Alaska Native Policy, 20 October 1998; and Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

RESPONSIBILITIES.

a. Division Commander Responsibilities.

(1) The Division Commander is responsible for integrating the USACE Tribal Policy Principles into all division activities that may impact any federally recognized Indian Tribe.

(2) The Division Commander will provide regional interface with Tribal governments for activities or issues involving multiple districts and refer appropriate actions to the affected district(s).

(3) The Division Commander will develop a Tribal account management plan to guide business development and outreach opportunities that promote USACE capabilities while fostering Tribal self reliance, capacity building and growth.

(4) The Division Commander will formally designate and train a Native American Coordinator(s) with primary or collateral duties to provide quality assurance of district Native American programs and activities.

b. District Commander Responsibilities.

(1) The District commander is responsible for integrating the USACE Tribal Policy Principles into all district activities that may impact any federally recognized Indian Tribe.

(a) **TRIBAL SOVEREIGNTY** - The district will affirm the sovereign status of Tribal governments, and work to develop and enhance a relationship which acknowledges the right of federally recognized Tribes to set their own priorities, develop and manage tribal trust resources.

(b) **TRUST RESPONSIBILITY** - The district will work to meet Tribal needs related to district activities and work to protect trust resources.

(c) **GOVERNMENT-TO-GOVERNMENT RELATIONS** - The District Commanders and their designated staff representatives shall meet with Tribal governments at the government-to-government level and observe tribal protocols and standards of dignity."

(d) **PRE-DECISIONAL AND HONEST CONSULTATION** - "Commanders and designated staff shall consult with Tribal governments following the general concepts of the Guidelines for Army Consultation with Native Americans and DOD American Indian and Alaska Native Policy.

(e) **SELF-RELIANCE, CAPACITY BUILDING, AND GROWTH** - The district will actively promote USACE capabilities, business development and outreach opportunities with Tribes. The district will involve Tribes in district programs that foster self-reliance, build economic capacity and growth such as training, cultural and natural resources, recreation, watershed planning, environmental restoration, emergency management and contracting opportunities.

(f) **NATURAL AND CULTURAL RESOURCES** - Consistent with procedures set forth in applicable federal laws, regulations and policies, the district will proactively work to preserve and protect natural and cultural trust resources, establish Native American Graves Protection and Repatriation Act (NAGPRA) protocols and procedures; and allow reasonable access to sacred sites.

(2) The District Commander will formally designate and train a Native American Coordinator with primary or collateral duties to assist the Commander and other functional staff elements in ensuring that Tribal policy principles and consultation are integrated into all district activities. The District Commander shall ensure Native American issues, activities and contacts with Tribal governments are coordinated with the Native American Coordinator.

c. Servicing District. Coordination of Native American activities will be the responsibility of the servicing district consistent with established civil works, regulatory and military boundaries."

6.4.3 Government-to-Government Consultation Status

The Corps has made a number of efforts to inform affected tribes of the DMMP/EIS and invite their participation. These have included invitations to participate in the multi-agency resource meeting in August 1999 and the LSMG meeting in July 2000. Tribes were mailed preliminary draft copies of the DMMP/EIS Chapters 1 and 2 in June 2000 and a draft cultural resources appendix in October 2000 for technical staff reviews. Specific project information and evaluation along with the Feasibility Study and its appendices on Cultural Resources and Tribal Consultation and Coordination, which are incorporated by reference, were included in the DMMP/EIS. To reduce duplication of information, the appendix on Cultural Resources was not published with the Final DMMP/EIS. A presentation was given to the Payos Kuus Cuukwe cultural resources cooperating group in October 2000 describing the DMMP and EIS alternatives. Similar presentations were given during meetings hosted by representatives of the Confederated Tribes of the Umatilla Indian Reservation in December 2000, the Confederated Tribes of the Colville Reservation in February 2001, and the Nez Perce Tribe in April 2001. Those informational meetings were intended to develop technical staff understanding and elicit comments.

The Corps is conducting formal consultation meetings with affected tribes to discuss pertinent aspects of the DMMP. The Corps will complete consultation prior to a final decision and issuance of a Record of Decision.

6.5 PUBLIC REVIEW

As noted above, the Draft DMMP/EIS was distributed for public review and comment. A notice of availability was published in the Fed Register on November 23, 2001. Distribution included local and state governments, local and regional business interests, public libraries in the study area, affected tribes, Federal regulatory agencies, and members of the general public. All public comments received were considered and have been addressed in the Final DMMP/EIS.

Appendix O presents the documents that were received during the public comment period. In total, 26 comment letters and e-mails were received from local, state, and federal agencies, tribes, organizations (including environmental and transportation groups), and citizens. Appendix O also presents the Corps' responses to the public comments. Where appropriate, the Corps reconsidered its planning process and analyses and modified its documentation in response to public comments.

This Final DMMP/EIS has been distributed to the public and at least 30 days after the Notice of Availability of the Final is published in the Federal Register, the Corps plans to sign a Record of Decision for this DMMP/EIS.

SECTION 7
LIST OF PREPARERS

The Corps was assisted in preparing this DMMP/EIS by HDR Engineering, Inc., a consulting firm under contract to the Corps. HDR was assisted by Northwest Economic Associates, Inc., and Northwest Archaeological Associates, Inc. Contributions by individual preparers were subject to revision during the internal review process. The Corps also contracted with David H. Bennett, Ph.D., for input to this DMMP/EIS.

Individuals responsible for preparing this DMMP/EIS are listed in tables 7-1 (Corps) and 7-2 (Consultant Team). Because of the number of people involved in coordinating this study, the information presented in these tables is limited to the names, education/years of experience, experience and expertise, and general roles these individuals had in developing the DMMP/EIS.

Table 7-1. List of Preparers - U.S. Army Corps of Engineers, Walla Walla District.

Name and Job Title	Education/Years of Experience	Experience and Expertise	Role in DMMP/EIS Preparation
Scott Ackerman Wildlife Biologist	M.S. Geography B.S. Wildlife Management 19 years	Wildlife Biology Habitat Management/ Evaluation	Habitat Evaluation Wetlands Mitigation
Robert Berger Civil Engineer	M.E. Civil Engineering B.S. Civil Engineering 18 years	Civil Design Geotechnical Engineering Materials	Coordinating Engineering Studies
Les Cunningham Hydraulic Engineers	M.S. Civil Engineering B.S. Civil Engineering 28 years	Sediment Transport River Mechanics	Hydrology
Julie Davin Cost Estimator	A.A.A.S. Civil Engineering 10 years	Cost Estimating Surveying and Mapping Geographic Information System (GIS) Computer Aided Design and Drafting (CADD)	Cost Estimator
Lori Farrow (Huxley College)	M.S. Terrestrial Ecology B.A. Environmental Studies 12 years	Wildlife Habitat Management Terrestrial Ecology Endangered Species Act Compliance NEPA Compliance	Terrestrial Ecology Non-Anadromous Fish
Russ Heaton Water Quality Technician	M.S. Biology B.S. Biology 8 years	Chemistry Ecology Limnology	Water Quality
Robert Hynek Cost Estimator	A.A. Business Engineering 40 years	Cost Estimating Contract Administration Construction Management	Lead Cost Estimator
Mary Keith Archeologist	B.A. Anthropology 18 years	Cultural Resource Compliance Ethno-Archeology	Cultural Resource Compliance
John Leier Environmental Resources Specialist	B.A. History/Anthropology B.A. Anthropology M.A. Anthropology 23 years	Cultural Resource Compliance	Cultural Resource Compliance
Chris Pinney Fishery Biologist	M.S. Aquatic Ecology B.S. Zoology 16 years	Fish Passage Evaluation Fish Habitat Evaluation ESA Consultation	Anadromous and Resident Fish
Paul Ocker Fishery Biologist	B.S. Biological Science 10 years	Fish Passage Evaluation Fish Habitat Evaluation Instream Flow	Anadromous and Resident Fish
Bridgett Read Programmer/Analyst	B.A. Physics-Environmental Studies 2 years	GIS	GIS Support
Jack Sands Hydraulic Engineer	B.S. Civil Engineering 17 years	Plan Formulation Open-Channel Hydraulics Hydrology	Project Manager
Sandra Simmons Environmental Resources Specialist	B.S. Wildlife Science 20 years	Environmental Compliance and Coordination Wildlife Biology	Environmental Coordination
Gene Spangrude Hydraulic Engineer	M.S. Civil Engineering B.S. Civil Engineering 20 years	Fluvial Geomorphology Sediment Transport	Hydrology and Sedimentation

Table 7-2. List of Preparers - Consultant Team.

Name and Organization	Education/Years of Experience	Experience and Expertise	Role in DMMP/EIS Preparation
Ryan Birdseye (HDR)	AICP Air Quality and Noise M.S Urban and Regional Planning 9 years	Environmental Analyses Preparing Documentation Consistent with SEPA and NEPA	Air Quality, Noise
Amy S. Connors (HDR)	B.S. Ecology, Ethology, and Evolution M.S. Environmental Engineering 4 years	Surface Water Quality/ Temperature and Wildlife/ Botanical Inventorying and Analysis	Wetland and Floodplain Identification and Analysis
David Des Voigne (HDR)	Ph.D. Water and Air Resources, Civil Engineering 25 years	Environmental Documentation; Evaluation of Impacts on Natural Systems	Terrestrial Environment; Biological Assessment for Non-Anadromous Fish and Wildlife, Endangered Species
J. Steven Foster, P.E. (HDR)	B.S. Civil Engineering 33 years	Planning and Managing Water Resource Projects Including Navigation, Flood Damage Reduction, Beach Erosion Control, Hydropower, Ecosystem Restoration and Water Supply with Corps-Seattle District	Project Manager, Alternatives Analysis, Transportation
Gretchen Greene (NEA)	Ph.D. Economics 8 years	Economic Modeling, Natural Resource Economics, Benefit-Cost Analysis	Economic Impacts of Alternatives
James Gregory (HDR)	B.S. Biology M.A. Urban and Environmental Planning 10 years	Environmental Planning and Management, Preparation of Environmental Documents, Water Resources Planning, Land Use, Transportation	EIS Coordinator/ Manager, Local Involvement, Comparison of Alternatives, Mitigation, Recommended Plan, Recreation, Cultural Resources, Aesthetics, Cumulative Effects
Wallace Hickerson, P.E. (HDR)	B.S. Civil Engineering M.S. Civil Engineering 40 years	Project Management, Marina Design	Program Manager, Beneficial Uses
Bonnie Lindner (HDR)	B.S. Business Administration 11 years	Environmental and Regulatory Review/Compliance	Document Coordination, Compliance with Federal Environmental Statutes and Regulations, Technical Editing

Table 7-2. List of Preparers - Consultant Team (continued).

Christian J. Miss (NAA)	MA Anthropology 27 years	Archaeologist	Contributed to Cultural Resource Sections
Margaret A. Nelson (NAA)	Ph.D. 14 years	Archaeologist	Prepared Upland Disposal Cultural Resources Site Survey
Ronald Owes, P.E. (HDR)	M.S. Civil Engineering 30 years	Civil/Environmental Planning and Engineering	Conceptual Design for Upland Disposal Sites
Lise Pederson (HDR)	M.S. Chemical/ Environmental Engineering 13 years	Water Treatment, Hydraulics, Hydrology	Phase I Environmental Site Assessment, Upland Disposal Options
Ann Quenzer (HDR)	B.S. Civil Engineering M.S. Environ. Engineering 2 years	Civil/Environmental Engineering	Water Quality, Sediment Quality, Levee Analysis, and Geology Soils
Stan Schweissing (HDR)	B.S. Civil Engineering 18 years	Hydrology and Hydraulic Design	Integration of Hydrologic Information with the Economic and Risk Analysis
Richard Weller, P.E. (HDR)	M.S. Geotechnical Engineering 30 years	Geotechnical and Civil Engineering	Geology and Soils; Lead Engineer in Lewiston Levee Raise Study (DO #27)
Daria Wightman (HDR)	MS Civil and Environmental Engineering 18 years	Civil/Environmental Planning and Engineering	Water Quality
HDR – HDR Engineering, Inc. NAA – Northwest Archaeological Associates, Inc. NEA – Northwest Economic Associates, Inc.			

SECTION 8
DISTRIBUTION LIST

The Corps has distributed the Executive Summary of the draft DMMP/EIS, the entire draft DMMP/EIS, or requested parts of the draft DMMP/EIS to the following:

Mr. Martin Bensky

Mr. John Russell

Mr. William Provost

Mr. and Mrs. Paul and Suzanne Sullivan

Mr. Don Sleight
AgriNorthwest

Ms. Kelley Beverly
Agri-Times Northwest

Mr. Daniel E. Hart
Almota Elevator Company, Inc.

American Rivers

Mr. Gerald McMahon
American Waterways Operators

Asotin County

Mr. Don Scheibe
Asotin County

Asotin County Library

Mr. Don Watson
Association of Northwest Steelheaders

Mr. Dave Geist
Battelle Pacific Northwest Laboratories

Mr. Alton Haymaker

Ms. Lynn A. Brown

Mr. Dean Stiles

Mr. and Mrs. Scott V. Meyer
A & M Farms, Inc.

Mr. Tom Mackay
Agri-Northwest

Mr. Alan L. Mehlenbacher
ALM Farming, Inc.

Mr. Hal Weeks
American Fisheries Society

Ms. Ginger Vanderpool
American Rivers

Mr. Stephen C. Cook
Asotin Chamber of Commerce

Mr. Karst Riggers
Asotin County

Mr. Brad Johnson
Asotin County Conservation District

Mr. Bill Critz
Asotin County Public Works

Mr. Dennis Dauble
Battelle Pacific Northwest Laboratories

Mr. and Mrs. Dan McKenzie
Bear Creek Farms

Mr. Chris Wright
Benton County

Mr. Scott Manley
Benton County Conservation District

Mr. James W. Sanders
Benton County PUD

Mr. Clark William G.
Benton-Franklin Regional Council

Mr. Matt Berg
Berg Brothers Farm

Blue Mountain Audubon Society

Mr. Alan Kottwitz
Boise Cascade

Boise Public Library

Ms. Crystal Ball
Bonneville Power Administration

Bill Maslen
Bonneville Power Administration

Mr. Keith Hatch
Bureau of Indian Affairs

Mr. William D. Gray
Bureau of Reclamation, Eph-2000

Mr. Dave Evans
Burns-Paiute General Council

Ms. Wanda Johnson
Burns-Paiute General Council

Ms. Linda Reed-Jerofke
Burns-Paiute General Council

Mr. Herbert W. Kaiser III
Cargill, Grain Division

Mr. Kenneth W. Holt
Centers For Disease Control

Mr. Bob Hagman
Central Ferry Terminal Association

Mr. and Mrs. Darrell C. Kerby
Cherrylane Ranches, Inc.

City of Asotin

Mr. Tom Prior
City of Asotin

Mr. Vertie Brown
City of Clarkston

Mr. Doug Higgins
City of Clarkston

Mr. Mark Kammers
City of Clarkston

City of Dayton

Mr. Michael L. Smith
City of Kennewick

Mr. Rick White
City of Kennewick

Mr. Jack Baldwin
City of Lewiston

Mr. Bob Bushfield
City of Lewiston

Lucia G. Cundy
City of Lewiston

Mr. Jeff Nesset
City of Lewiston

Ms. Janice Vassar
City of Lewiston

City of Pomeroy

Honorable George A. Hash
City of Umatilla

Ms. Mary Prine
Clarkston Chamber of Commerce

Mr. Daniel R. Pierce
Clearwater RC&D Area, NRCS

Mr. Thomas O. Marlin
Coalition for Anadromous Salmon and Steelhead Habitat

Mr. Brian Allee
Columbia Basin Fish & Wildlife Authority

Mr. Terry Bruegman
Columbia County Conservation District

Mr. Curtis Scholz
Columbia Grain International, Inc.

Mr. Jack Marincovich
Columbia River Fishermen's Protective Union

Mr. Jerry Grossnickle
Columbia River Towboat Association

Ms. Cyndy deBruler
Columbia Riverkeeper

Mr. Brian G. D'Aoust
Common Sensing, Inc.

Mr. Joel Ristau
City of Lewiston

City of Pasco

Mr. Bill King
City of Richland

Ms. Debra Comacho
Clarkston Chamber of Commerce

Mr. George Hinman
Clearwater Flycasters

Clover Island Yacht Club

Columbia Basin College Library

Columbia County Commissioners

Mr. Don Himmelberger
Columbia County Grain Growers

Mr. Bruce J. Lovelin
Columbia River Alliance

Columbia River Inter-Tribal Fish Commission

Ms. Melissa Finn
Columbia River United

Ms. Willetta Burns
Columbia Valley Grange

Mr. Fred Ike
Confederated Tribes and Bands of the Yakama Indian Nation

Mr. Johnson Meninick
Confederated Tribes and Bands of the Yakama Indian Nation

Mr. Randy Settler
Confederated Tribes and Bands of the Yakama Indian Nation

Mr. William White
Confederated Tribes and Bands of the Yakama Indian Nation

Mr. Matthew Dick
Confederated Tribes of the Colville Reservation

Mr. Joe Peone
Confederated Tribes of the Colville Reservation

Mr. Manfred Jaehnig
Confederated Tribes of the Umatilla Indian Reservation

Mr. Jeff Van Pelt
Confederated Tribes of the Umatilla Indian Reservation

Mr. Dirk Boettcher
Continental Grain Co

Mr. Robert G. Whitlam
Department of Community Development

Mr. Tom Ferns
Department of Energy

Paul B. and Suzanne A. Sullivan
Emerald Farms

Mr. John Malek
Environmental Protection Agency

Lucian Burns
Farm Bureau

Mr. Lonnie Selam
Confederated Tribes and Bands of the Yakama Indian Nation

Mr. Ross Sockzehigh
Confederated Tribes and Bands of the Yakama Indian Nation

Ms. Colleen Cawston
Confederated Tribes of the Colville Reservation

Ms. Adeline Fredin
Confederated Tribes of the Colville Reservation

Ms. Catherine Dickson
Confederated Tribes of the Umatilla Indian Reservation

Mr. Gary James
Confederated Tribes of the Umatilla Indian Reservation

Mr. James Bergdohl
Conservation Biology Center

Mr. Bruce Hansen
CRFPU

Mr. Paul Dunigan
Department of Energy

Mr. Steve Waddington
Direct Service Industries, Inc.

Environmental Protection Agency

Mr. and Mrs. Royce and Jean Hicks
F Bar C Ranch

Ms. Michele DeHart
Fish Passage Center

Mr. Dick Woodworth
Fish Passage Incorporated

Mr. Gaylord W. Newbry
Foss Maritime

Foss Maritime Company

Mr. Tim Fife
Franklin County

Mr. Mark Neilson
Franklin County Conservation District

Mr. Del Lathim
Franklin County PUD

Mr. Eric Espenhorst
Friends of the Earth

Garfield County

Mr. and Mrs. Rocky Goffinet
Goffinet Farms

Honorable Dirk Kempthorne
Governor of Idaho

Honorable John Kitzhaber
Governor of Oregon

Honorable Gary Locke
Governor of Washington

Mrs. Lenora Seelatsee
Grant County Public Utility District

Greater Pasco Area Chamber of Commerce

Karen Christobal
Hatfield Library - Willamette University

Mr. Stan Schweissing
HDR Engineering

Mr. Art Seamans
Hells Canyon Alliance

Mr. Jim Felton
Hells Canyon Resort

Mr. Jack Pring
Hells Canyon Resort

Mr. Mike McElhatton
Hells Gate State Park

Mr. Gerald Howard
Howard Brothers

Mr. and Mrs. Keith A. Kinzer
I.G.P.A.

Ms. Patricia Barclay
Idaho Council on Industry & the Environment

Mr. Phillip M. Mamer
Idaho Department of Agriculture

Idaho Department of Commerce

Ms. Cindy Barrett
Idaho Department of Environmental Quality

Mr. James M. Bellatty
Idaho Department of Environmental Quality

Mr. Cal Groen
Idaho Department of Fish and Game

Mr. Jerome Hansen
Idaho Department of Fish and Game

Mr. Steve Pettit
Idaho Department of Fish and Game

Ms. Yvonne S. Ferrell
Idaho Department of Parks and Recreation

Mr. Jim Carpenter
Idaho Department of Transportation

Mr. Ken Knoblock
Idaho Department of Water Resources

Mr. Gerald Jayne
Idaho Environmental Council

Mr. Steven C. Johnson
Idaho Grain Producers Association

Pamela Russell
Idaho Green Org.

Honorable Frank C. Bruneel
Idaho House of Representatives

Honorable Dan Mader
Idaho House of Representatives

Mr. Chris Randolph
Idaho Power Company

Idaho Rivers United

Mr. Charles Ray
Idaho Rivers United

Mr. Kenneth Reid
Idaho State Historical Society

Idaho State Library

Honorable Joe Stegner
Idaho State Senate

Dr. Barbara C. Williams
Idaho Water Resources Research Institute

Mr. Norm Semanko
Idaho Water Users Association

Ms. Patricia Dailey
Idaho Wheat Commission

Idaho Wildlife Federation

Mr. Mark Solomon
Inland Empire Public Lands Council

Mr. Jim Eychaner
Interagency Committee for Outdoor Recreation

Mr. Houshie Ziari
IRZ Consulting

James and Pam Follansbee
JF Micro

Mr. Ron Perry
Joint Legislative Audit and Review Committee

Mr. Jim St. Hiloire
JSA Farms, Inc.

Mr. and Mrs. Dave and Kathy Daniels
K & J Enterprise

Mr. Bob Clark
Kelly Creek Flycasters

Mr. Joe Rehder
Lamb-Weston

Ms. Melinda Harm
Land and Water Fund

Lewis-Clark Wildlife Club

Ms. Peggy M. McElfish
Lewiston City Library

Mr. Walter Littler
Littler Farm, Inc.

Mr. Roderick L. Bailey
Lyons Ferry Marina

Meridian Library District

Mr. Bob Jones
Milton-Freewater Public Library

Mr. Phillip J. Motyka
Motyka's Fishin Post

Mr. Steve Landino
National Marine Fisheries Service

Mr. Joe Miller
National Marine Fisheries Service

Ms. Sybil Ackerman
National Wildlife Federation

Bill and Carol Lampson
Neil F Lampson

Mr. Jim Soyk
Nez Perce County

Mr. Mel Johnson
Nez Perce County Emergency Management

Mr. Kyle Wilson
Nez Perce Soil and Water Conservation District

Ms. Sally J. Ledgerwood
Lewis-Clark Economic Development Association

Ms. Doreen Krabbenhoft
Lewiston Chamber of Commerce

Mr. Eugene Buck
Library of Congress

Mr. Richard Leaumont
Lower Columbia Basin Audubon Society

Mr. J. Rodney Larson
McNary Farm

Metz Marina, Inc.

Ms. Betty Morken
Morken Ranch

Mr. Dale Bambrick
National Marine Fisheries Service

Mr. Ted Meyers
National Marine Fisheries Service

Mr. David Beuke
National Recreation Task Force

Mr. Bill Bakke
Native Fish Society

Natural Resources Conservation Service

Ms. Betty Clack
Nez Perce County

Mr. JR Van Tassel
Nez Perce County

Mr. Jerry Black
Nez Perce County Roads Department

Mr. Greg Haller
Nez Perce Tribe

Mr. Rick Eichstaedt
Nez Perce Tribe

Ms. Barbara Inyan
Nez Perce Tribe

Ms. Patti Howard
Nez Perce Tribe

Mr. Samuel Penney
Nez Perce Tribe

Mr. David B. Johnson
Nez Perce Tribe

Mr. David Statler
Nez Perce Tribe

Ms. Vera Sonneck
Nez Perce Tribe

Mr. Marc Brown
North Idaho Center for the Environment

Mr. and Mrs. Joe McCollum
Northwest Environ Watch

Dr. Usha Varanasi
Northwest Fisheries Science Center

Northwest Grain Growers

Northwest Power Planning Council

Mr. Ed Chaney
NW Resource Information Center, Inc.

Mr. Clyde Cochlin
NWSSC

Ms. Joni Hammond
Oregon Department of Environmental Quality

Ms. Nancy Swofford
Oregon Department of Environmental Quality

Mr. Craig Ely
Oregon Department of Fish and Wildlife

Oregon Department of Transportation

Mr. Bob Brown
Oregon Division of State Lands

Ms. Lynn Beaton
Oregon Economic Development Department

Mr. Peter Test
Oregon Farm Bureau

Honorable Bob Jenson
Oregon House of Representatives

Ms. Diane Valantine
Oregon Natural Resources Council

Dr. Leland Gilsen
Oregon State Historic Preservation Office

Oregon State Library

Mr. Wayne Shuyler
Oregon State Marine Board

Honorable David Nelson
Oregon State Senate

Ms. Carrie Ottow
Oregon State University

Oregon Trail Library District

Oregon Trout

Ms. Jan (Boettcher) Lee
Oregon Water Resources Congress

Mr. Michael McCord
Oregon Water Resources Department

Mr. Darel Kopick
Oregon Wheat Growers League

Pacific Fishery Management Council

Mr. Darryll Olsen
Pacific Northwest Project

Pacific Northwest Waterways Association

Mr. Jonathan F. Schlueter
Pacific NW Grain & Feed Assoc.

Mr. Stan Allen
Pacific States Marine Fisheries Commission

N Henderson
Pacific University Library

Mr. Rob Bochert
Palouse Conservation District

Mr. Greg Jones
Palouse Grange

Louis Messimer
Pasco Chamber of Commerce

Ms. Dianne Ensign
Paul L Boley Law Library

Penrose Memorial Library

Mr. Brad Munson
Perkins Coie LLP

Mr. Dino Angelosante
PG&E Gas Transmission NW

Mr. Scott Rasley
Pheasants Forever

Mr. Phil Van Hoy
Phil's Sporting Goods, Inc.

Mr. RL Dirkes
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SECTION 9
GLOSSARY AND ACRONYMS/ABBREVIATIONS

9.1 GLOSSARY

This glossary defines terms that are found in this DMMP/EIS:

Anadromous Fish: Species of fish that hatch in fresh water, migrate to and mature in the ocean (salt water), and return upstream to fresh water to spawn. Salmon, steelhead, sturgeon, and shad are examples.

Archaeological Resource: See cultural resource.

Authorized Project: A project established by the authority of the U.S. Congress for the specific purposes described in the legislation (e.g., flood control, power generation, navigation, irrigation, recreation, fish and wildlife, etc.).

Buffer: Usually a natural area or open space used to divide two developed or developing areas.

Clamshell Dredging: Clamshell dredges use a bucket operated from a crane or derrick that is mounted on a barge or operated from shore. Sediment removed by the bucket is usually placed on a barge for disposal to either an upland or in-water site. Dredged material comes up virtually undisturbed, so clamshell dredges work well in silts or contaminated material, where water entrainment is a problem.

Cubic Feet Per Second (cfs): A unit of measurement (English) that can be used to describe the flow rate or discharge of water. One cfs is equal to 449 gallons per minute.

Cubic Meter Per Second (cms): A unit of measurement (SI) that can be used to describe the flow rate or discharge of water. One cms is equal to 35.31 cfs.

Cultural Resource: Evidence of human occupation or activity that is important in the history, architecture, or archaeology of a community or region.

Diadromous: Truly migratory fishes that migrate between the sea and fresh water. Included among this group are anadromous fishes (those that spend most of their life in the sea and migrate to fresh water to breed), catadromous fishes (those that spend most of their life in fresh water and migrate to the sea to breed), and amphidromous fishes (those for which migration to the sea or fresh water is not done for the purpose of breeding, but occurs regularly at some other definite stage of the life cycle)(Bond, 1979). For example, white sturgeon have been known to exhibit both anadromous and amphidromous behavior but are often simply called diadromous.

Dredged Material Management Plan (DMMP): The dredging and disposal plan that results from analyses conducted in the Dredged Material Management Study.

Dredged Material Management Study (DMMS): An analysis of dredging and disposal alternatives that address cost, engineering, and environmental factors to operate and maintain the navigation channel.

Dredging Template: A layout, diagram, or map showing the extent of the area required to be free from underwater hazards or obstructions for purposes of navigation, recreation, and irrigation intake. If material has been deposited within the template, it would require removal, usually by dredging. In the case of the navigation channel, the extent would be defined by the depth, bottom width, and side slopes of the channel as well as advance maintenance measures and allowable overdepth if specified. In the case of a boat landing or irrigation intake, the extent may be defined by the construction plans for the area. In the case of flow conveyance dredging, the defined template may extend outside the limits of the navigation channel and, in some cases, down into original riverbed material.

Easement: An interest or a privilege in land created by a provision in a deed or by an agreement that confers a right on the owner to some profit, benefit, dominion, or lawful use out of or over the estate of another.

Ecosystem: Living and nonliving components of the environment that interact or function together.

Endangered Species: Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range. Endangered Species are published in the Federal Register.

Fill: The placement, deposition, or stockpiling of sand, sediment, or other earth materials.

Flow Rate: The volume of water passing a given point per unit of time. Flow rate is often measured in cubic feet per second (English units) or cubic meters per second (SI units).

Habitat: The place or conditions where a plant or animal lives or can live. The plant or animal can be an individual organism, a population, or a taxonomic group. In the present context, habitat refers to an area that provides some portion of the requirements for the life history of a given species.

In-Water Disposal: The placement of dredged material along the riverbed in or adjacent to the navigation channel or in designated in-water sites.

Juvenile: The early stage in the life cycle of anadromous fish when they migrate downstream to the ocean.

Levee: An earthen embankment/dike constructed to prevent a water source from overflowing onto an adjacent area.

Lockage: An act or the process of passing a vessel through a lock.

Locks: A chambered structure of a waterway closed off with gates for the purpose of raising or lowering the water level within the chamber so ships can move along the waterway.

Minimum Operating Pool (MOP): The bottom 1 foot (0.3 meter) of the operating range for each reservoir. The reservoirs have an operating range of 3 to 5 feet (0.9 to 1.5 meters).

Mitigation: The use of any or all of the following actions:
- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

Monitoring: A process of collecting information to evaluate if objectives and anticipated results of a management plan are being realized or if implementation proceeds as planned.

National Ambient Air Quality Standards (NAAQS): Standards set by the Environmental Protection Agency that identify the limit of concentrations of certain air pollutants that endanger public health or welfare.

Pool/Reservoir: A body of water impounded by a dam.

Project: The broad term covering the Federally constructed and maintained channels and structures on the Columbia and Snake Rivers. A "Project" is a channel or facility constructed for variety of authorized purposes, such as, hydroelectric generation, flood control, navigation, etc.

Reach: A section of river, usually defined by River Mile.

Resident Fish: Fish species that reside in fresh water throughout their lives.

Riparian: The area immediately adjacent to streams, ponds, lakes, and wetlands that directly contributes to the water quality and habitat components of the water body. This may include areas that have high water tables and soils and vegetation that exhibit characteristics of wetness, as well as upland areas immediately adjacent to the water body that directly contribute shade, nutrients, cover, or debris, or that directly enhance water quality within the water body.

River Mile (RM): A consistent linear measurement from a particular defined place on a river. For the Columbia River, River Miles are measured from the mouth of the river at the Pacific Ocean. For the Snake River, River Miles are measured from the confluence of the Snake River with the Columbia River near Pasco, Washington.

Salmonids: Refers to fish of the family Salmonidae.

Spawning: The releasing and fertilizing of eggs by fish.

Species: A group of organisms that can interbreed in nature (a common gene pool that is biologically isolated from closely related species) and is designated by an available and valid scientific name.

Standard Project Flood (SPF): An estimated or hypothetical flood that might be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved, excluding extraordinarily rare combinations.

Threatened Species: Plant or animal species likely to become an endangered species throughout all or a significant portion of their range within the foreseeable future. Plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.

Upland: Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands.

Water Quality: The chemical, physical, and biological characteristics of water.

Wetlands: Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, under normal circumstances, a prevalence of vegetation typically adapted for life in saturated soil conditions. This does not include riparian areas, rivers, streams, and lakes.

9.2 ACRONYMS/ABBREVIATIONS

The following acronyms used within this document are defined below:

APE	Area of Potential Effect
ASTM	American Society for Testing and Materials
BA	Biological Assessment
BMP	Best Management Practice
BNSF	Burlington Northern and Santa Fe Railroad
Bonneville	Bonneville Lock and Dam
B.P.	before present
BPA	Bonneville Power Administration
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response Compensation Liability Act
cfs	cubic feet per second
cm	centimeter

Corps	U.S. Army Corps of Engineers, Walla Walla District
CPRR	Camas Prairie Railroad
CRBG	Columbia River Basalt Group
CWA	Clean Water Act
dBA	A-weighted decibels
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DMMP	Dredged Material Management Plan
DMMS	Dredged Material Management Study
DO	dissolved oxygen
DWS	domestic water supply
EC	Engineering Circular
EDNA	Environmental Designation for Noise Abatement
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
ESC	erosion sedimentation control
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
Feasibility Study	Lower Snake River Juvenile Salmon Migration Feasibility Study
FY	fiscal year
HMU	Habitat Management Unit
HTRW	Hazardous, Toxic, or Radioactive Waste
Ice Harbor	Ice Harbor Lock and Dam
ITM	Inland Testing Manual
km	kilometer
Little Goose	Little Goose Lock and Dam
Lower Granite	Lower Granite Lock and Dam
Lower Monumental	Lower Monumental Lock and Dam
LSMG	Local Sediment Management Group
LSRFWCP	Lower Snake River Fish and Wildlife Compensation Plan

m	meter
m^3	cubic meter
m^3/sec	cubic meters per second
McNary	McNary Lock and Dam
MOP	minimum operating pool
mg/L	milligrams per liter
mm	millimeter
m / s	meters per second
msl	mean sea level
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NR	National Register
NRHP	National Register of Historic Places
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity unit
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
ortho-P	ortho-phosphate
PIT	passive integrated transponder
PM	particulate matter
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RDT	Regional Dredging Team
RM	River Mile
ROD	Record of Decision
SHPO	State Historic Preservation Office
SOR FEIS	System Operational Review Final Environmental Impact Statement
SPF	Standard Project Flood
SR	State Route
TCP	traditional cultural properties
TEQ	toxic equivalency quotient
The Dalles	The Dalles Lock and Dam

TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USDOE	U.S. Department of Energy
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WES	Waterways Experiment Station
YOY	young of the year

SECTION 10
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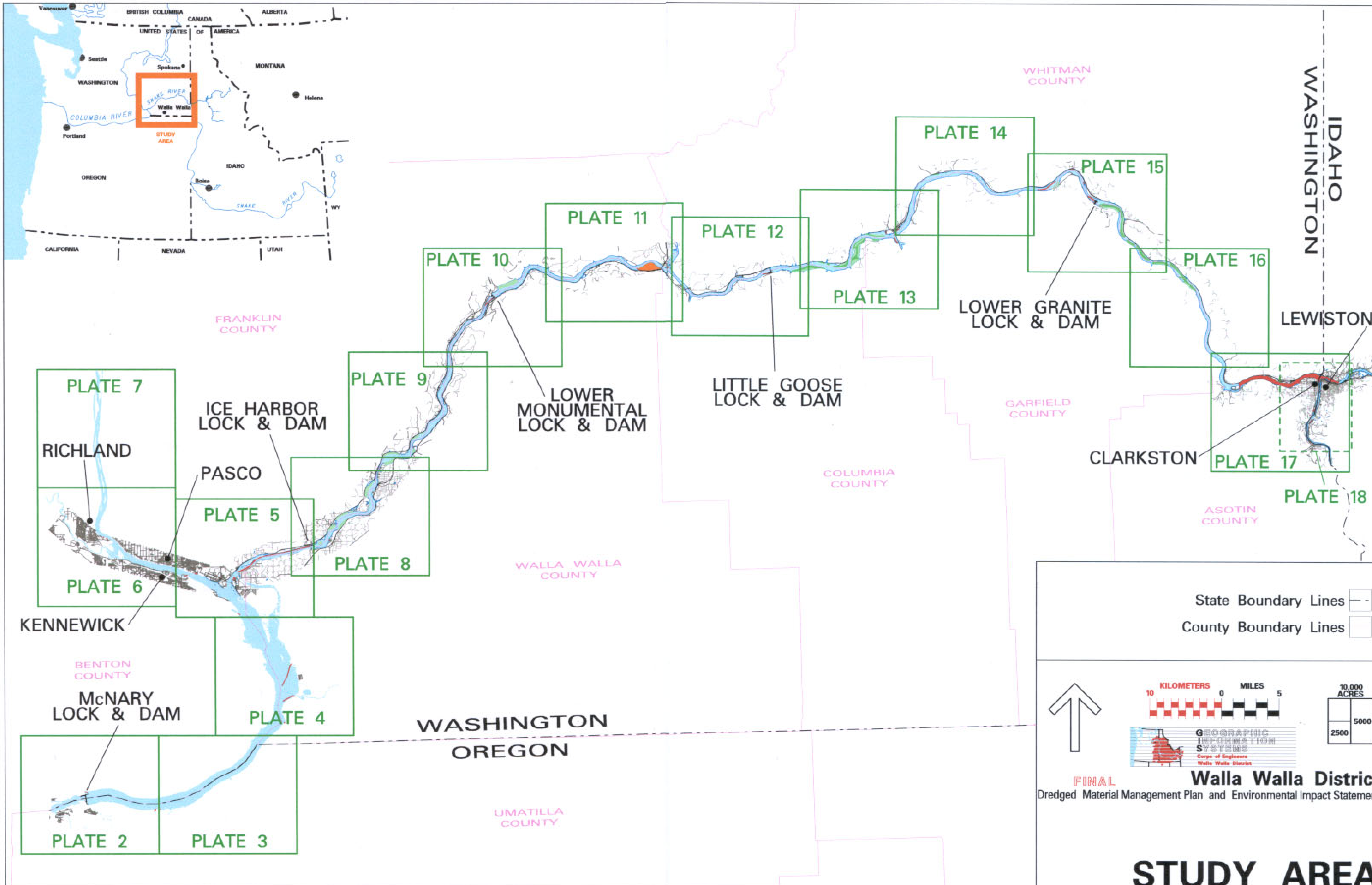
Zimmerman, M., and L. Rasmussen. 1981. Juvenile salmonid use of three Columbia River backwater areas proposed for subimpoundment. U.S. Fish and Wildlife Service, Portland Field Office. Portland, Oregon. 27 pp.

LIST OF PLATES

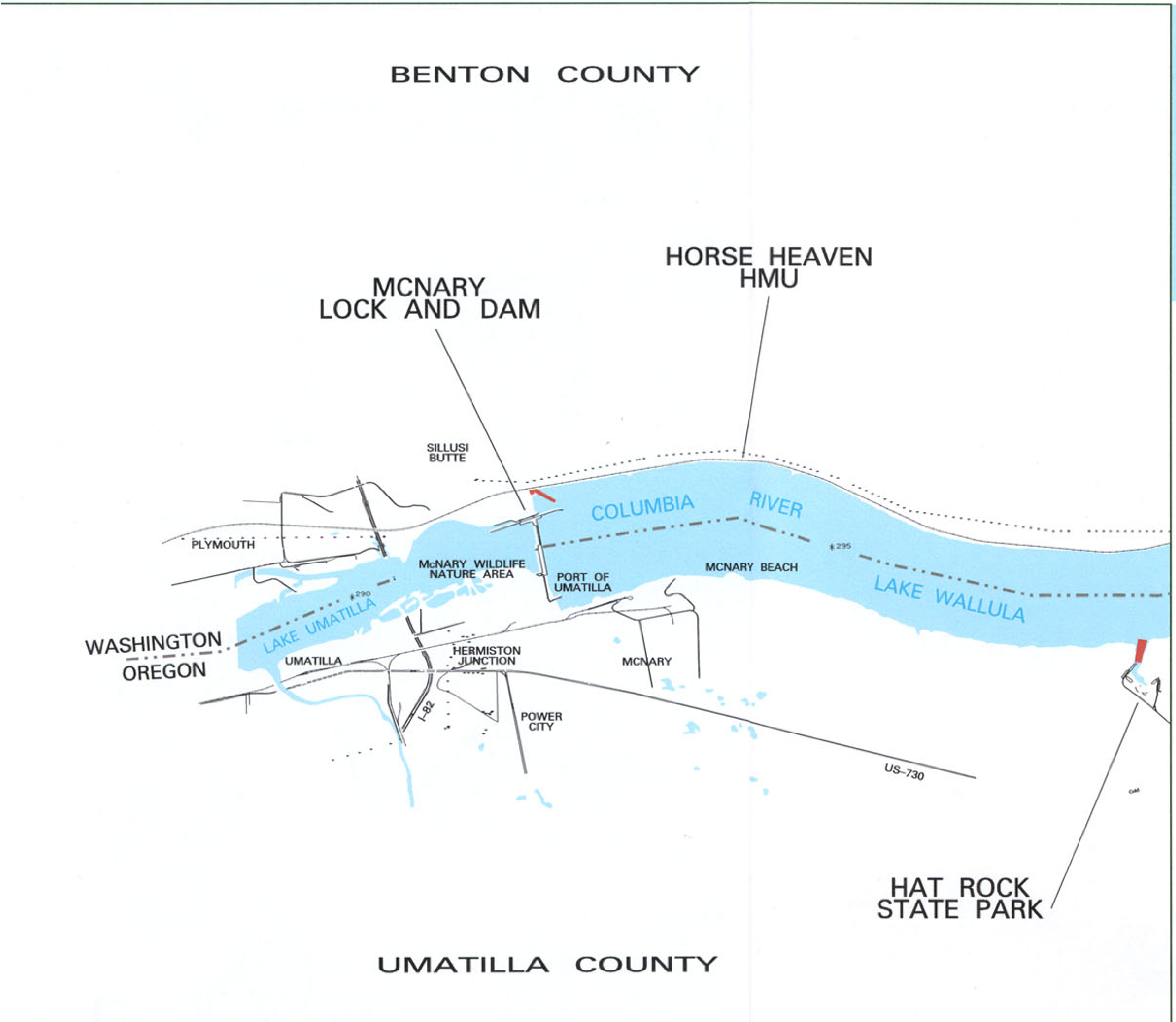
<u>**Plate**</u>

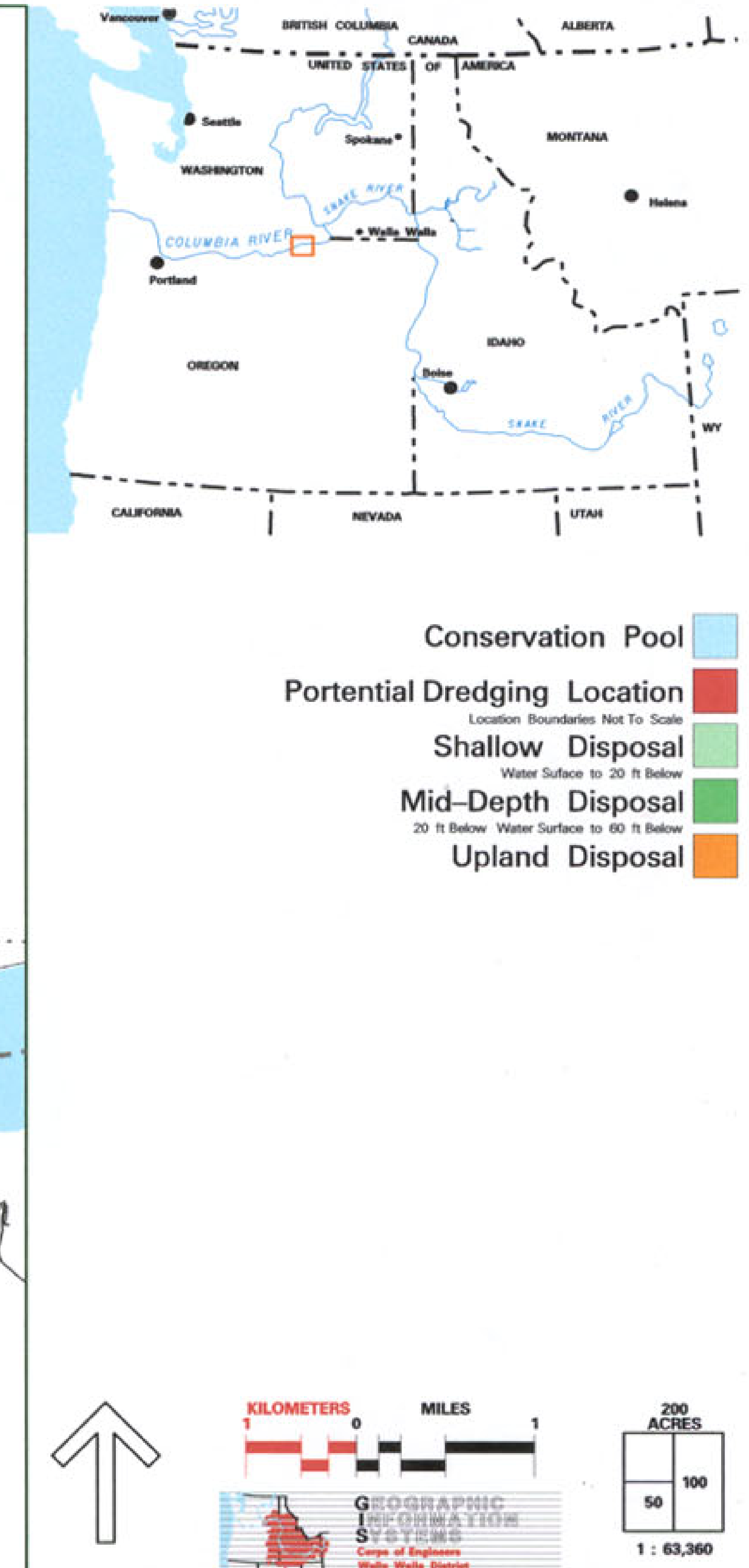


STUDY AREA

2002

PLATE 1





FINAL

Walla Walla District

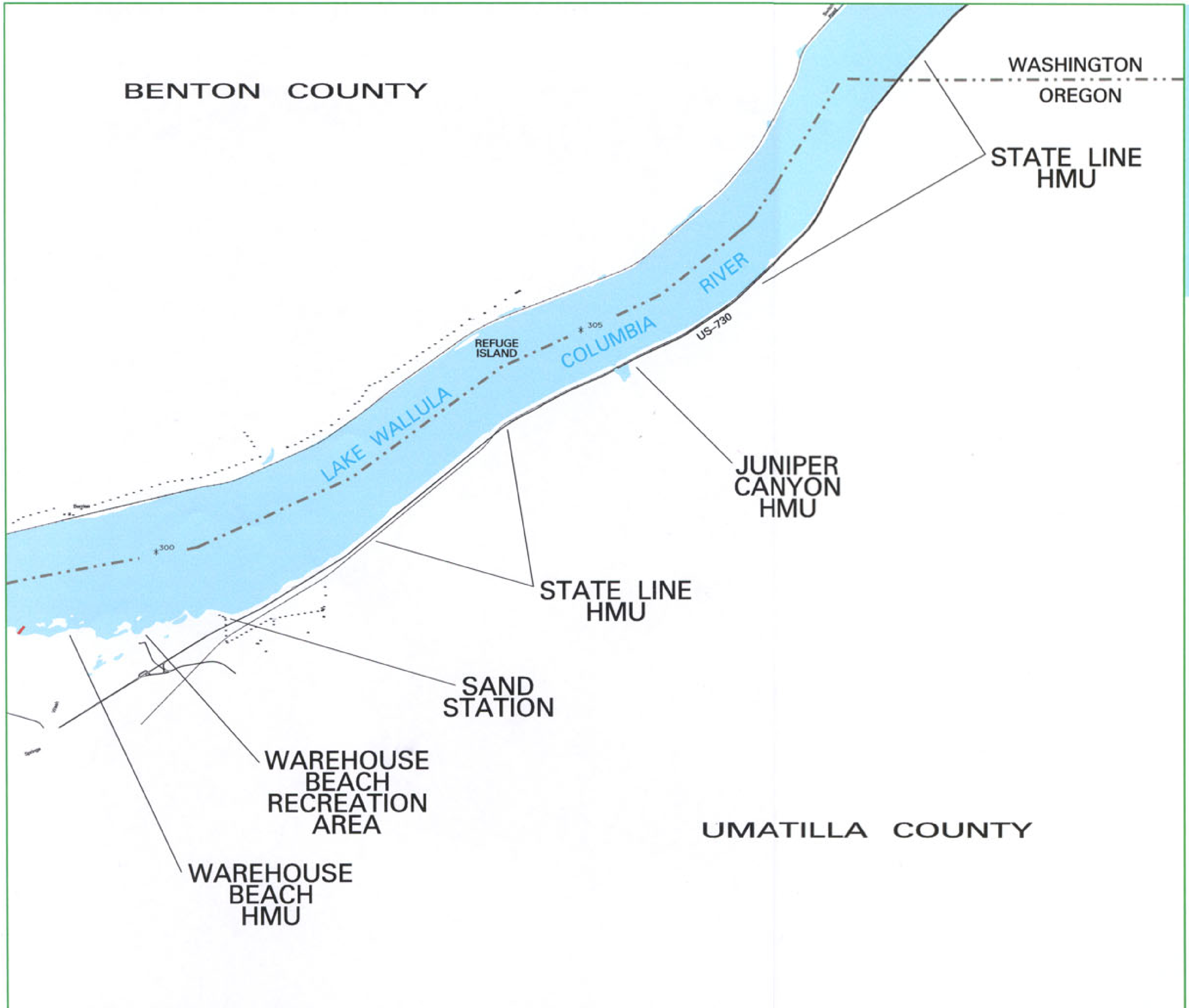
Dredged Material Management Plan and Environmental Impact Statement

McNary Dam and Reservoir: RM 289 - 298

DREDGING AND DISPOSAL SITES

2002

PLATE 2



Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Suface to 20 ft Below

Mid–Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 — MILES 1

200 ACRES — 100 — 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

McNary Reservoir: RM 299 – 310

DREDGING AND DISPOSAL SITES

2002

PLATE 3

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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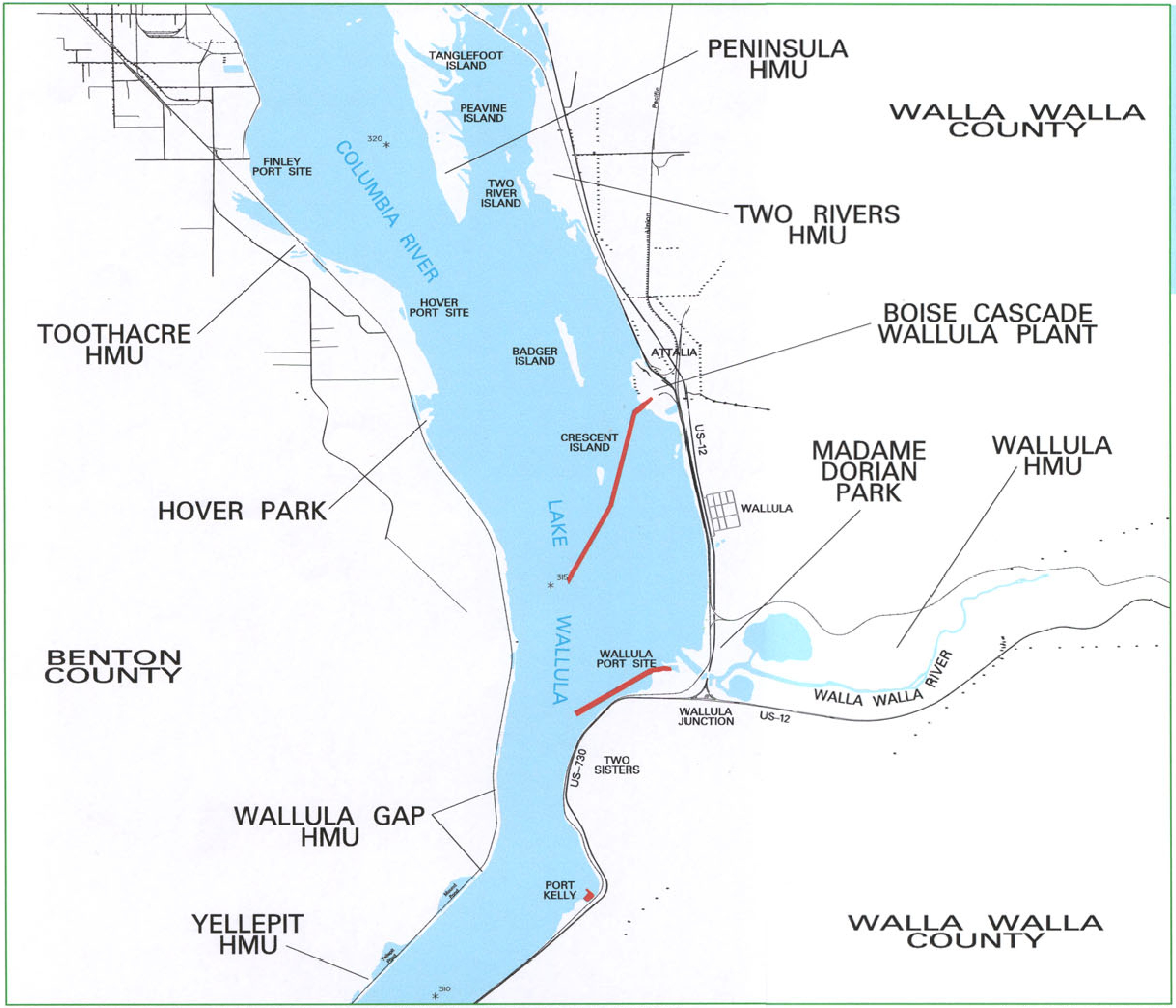


Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Surface to 20 ft Below

Mid-Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

FINAL

Walla Walla District

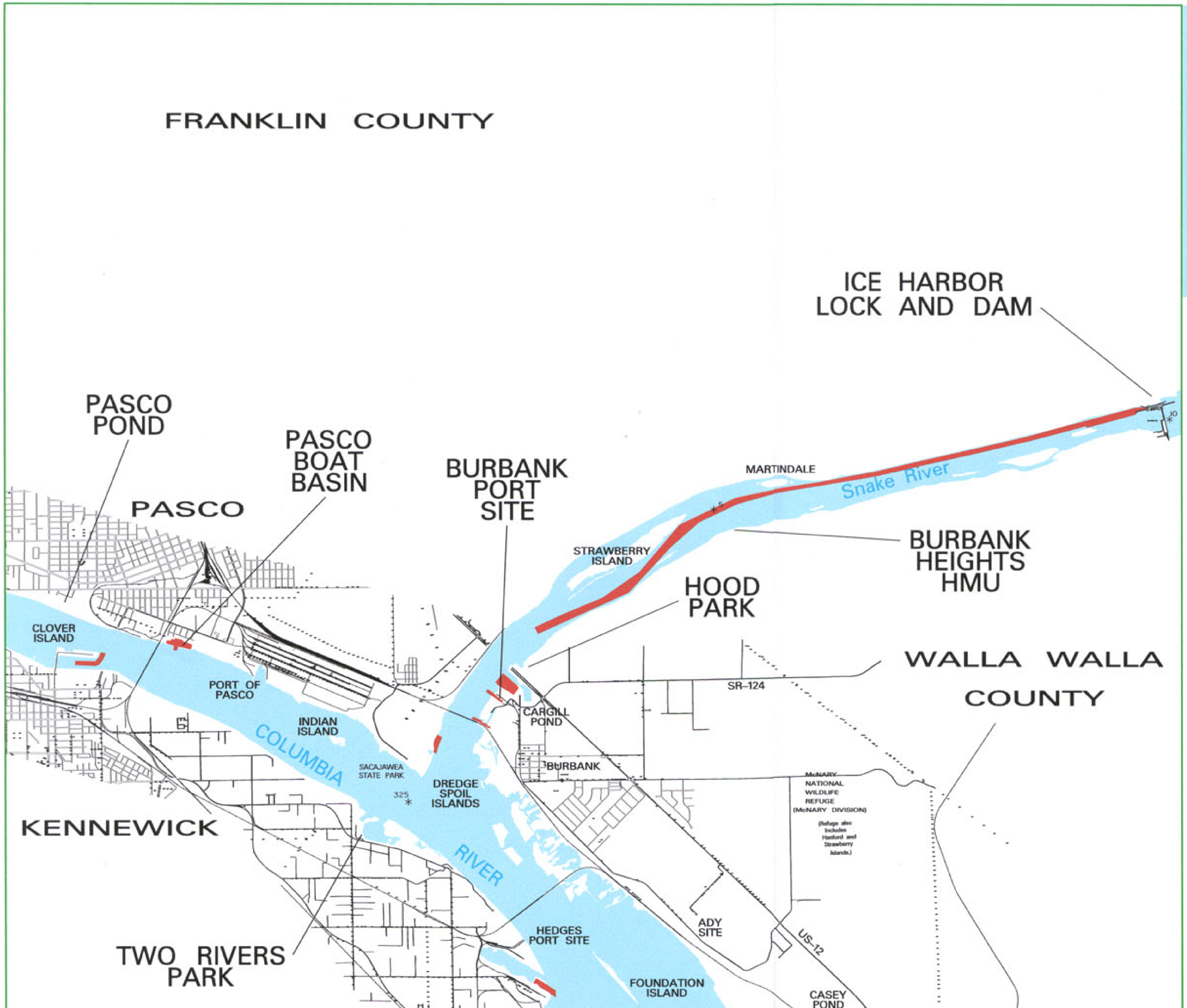
Dredged Material Management Plan and Environmental Impact Statement

McNary Reservoir: RM 310 – 321

DREDGING AND DISPOSAL SITES

2002

PLATE 4



Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Suface to 20 ft Below

Mid-Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers Walla Walla District

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

McNary Reservoir: RM 322 – 329

DREDGING AND DISPOSAL SITES

2002

PLATE 5

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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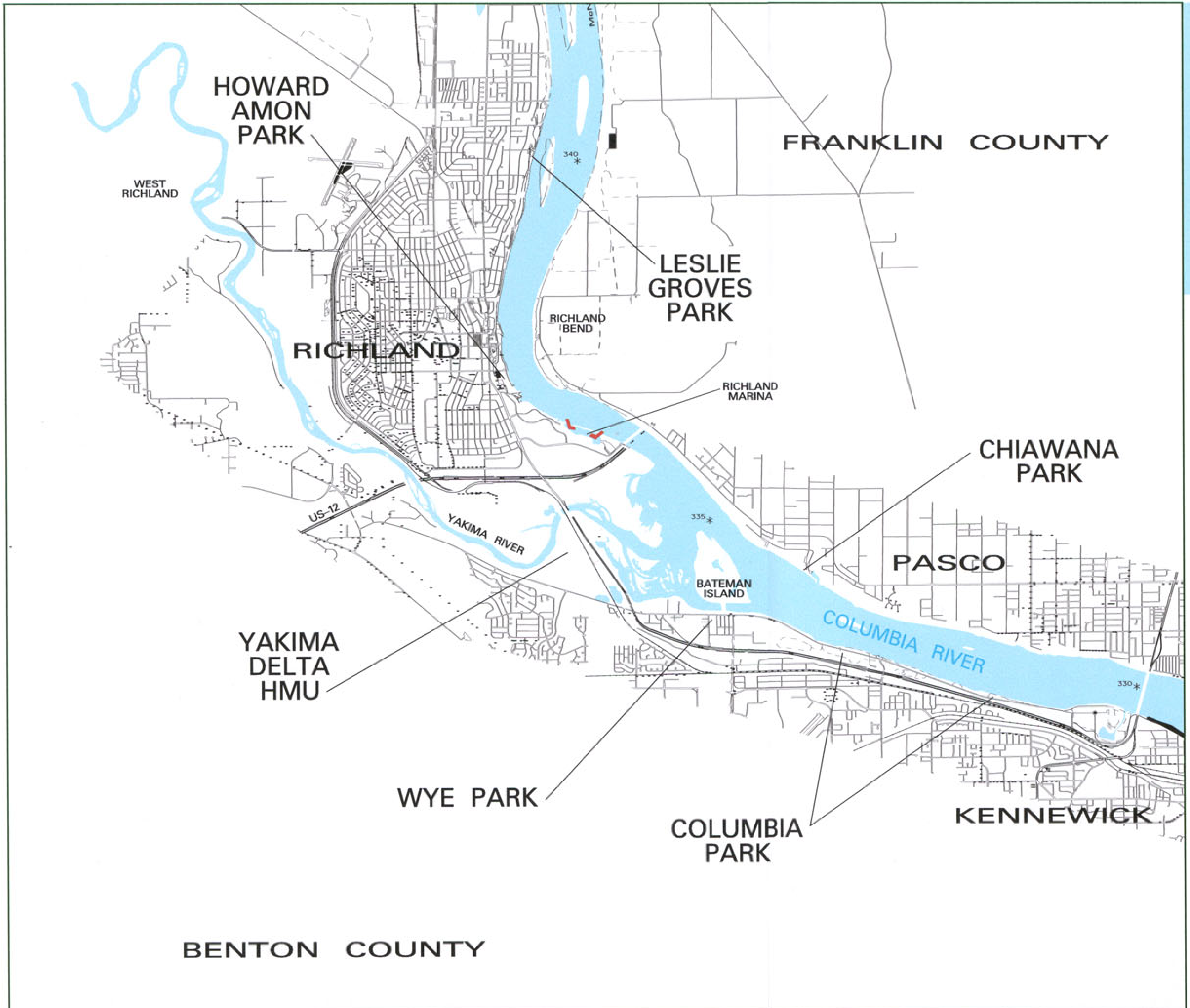

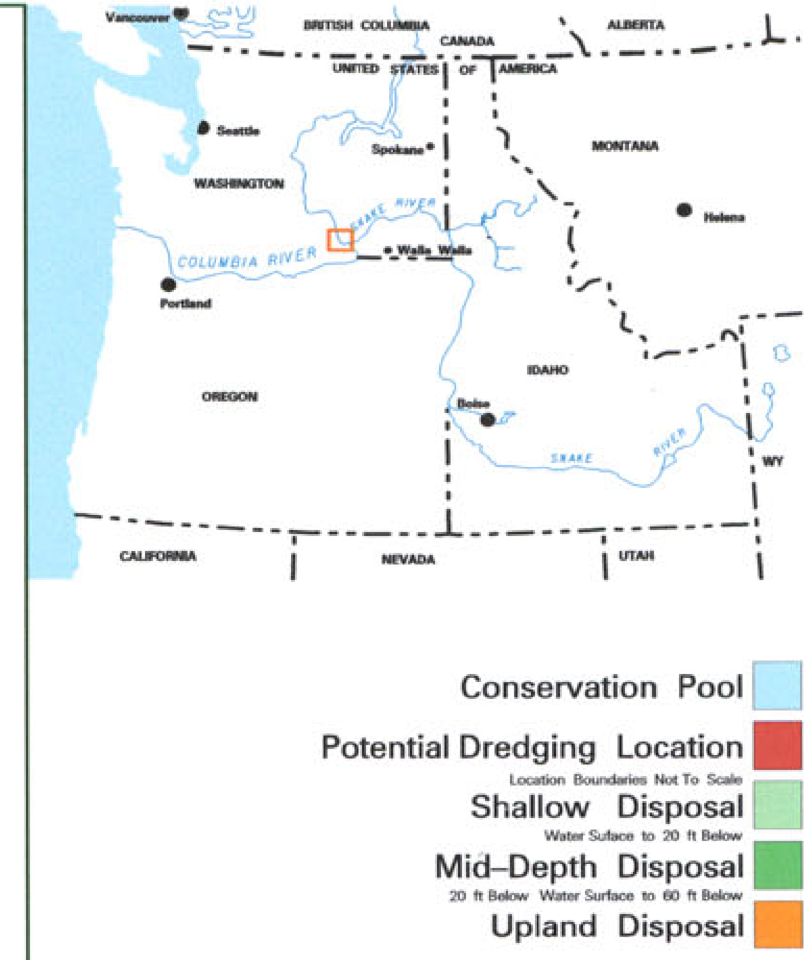

KILOMETERS 1 0 MILES 1

200 ACRES 100 50 1 : 63,360

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

McNary Reservoir: RM 330 – 341

DREDGING AND DISPOSAL SITES

2002

PLATE 6

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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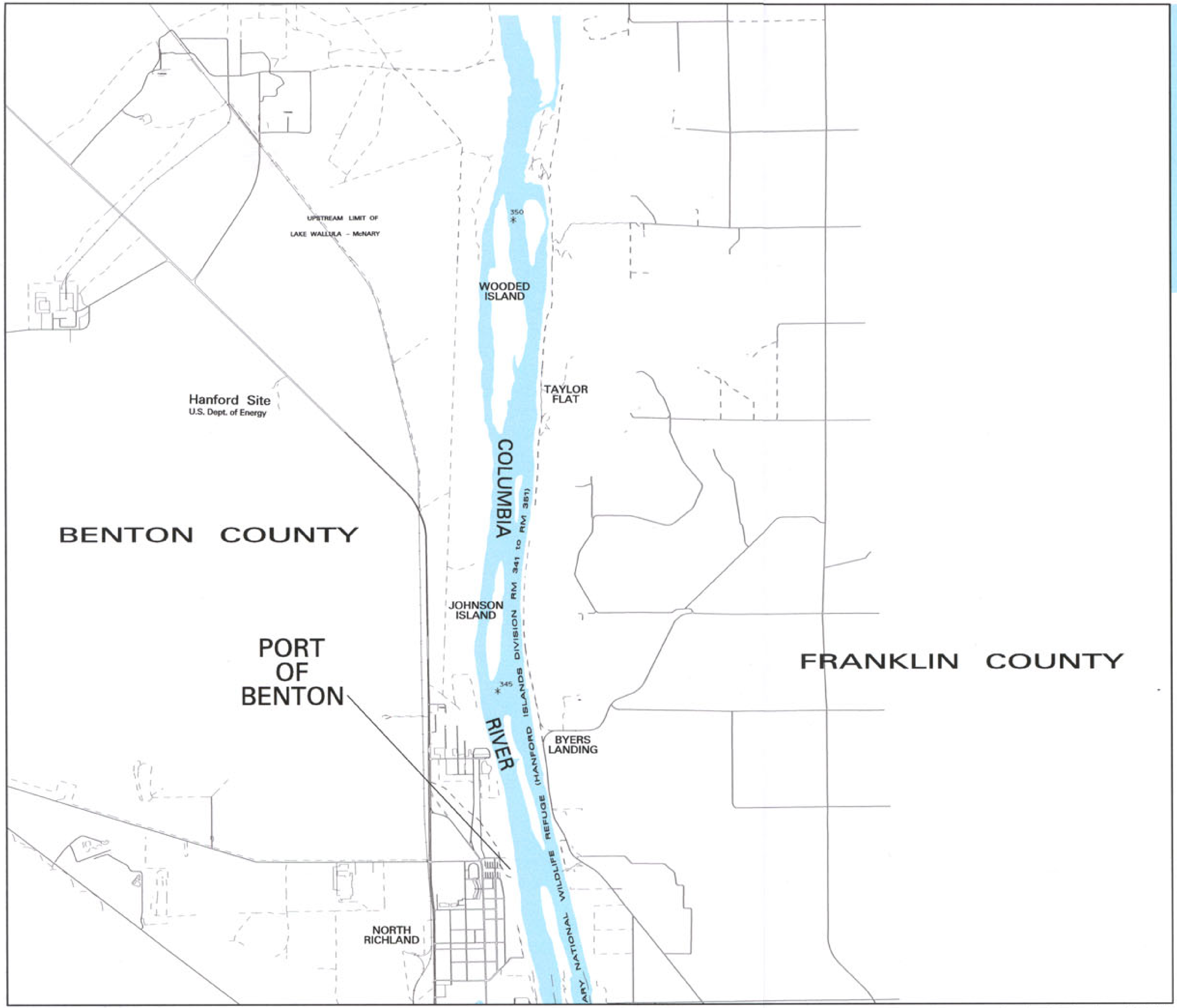

Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Suface to 20 ft Below

Mid–Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

McNary Reservoir: RM 342 – 352

DREDGING AND DISPOSAL SITES

2002

PLATE 7

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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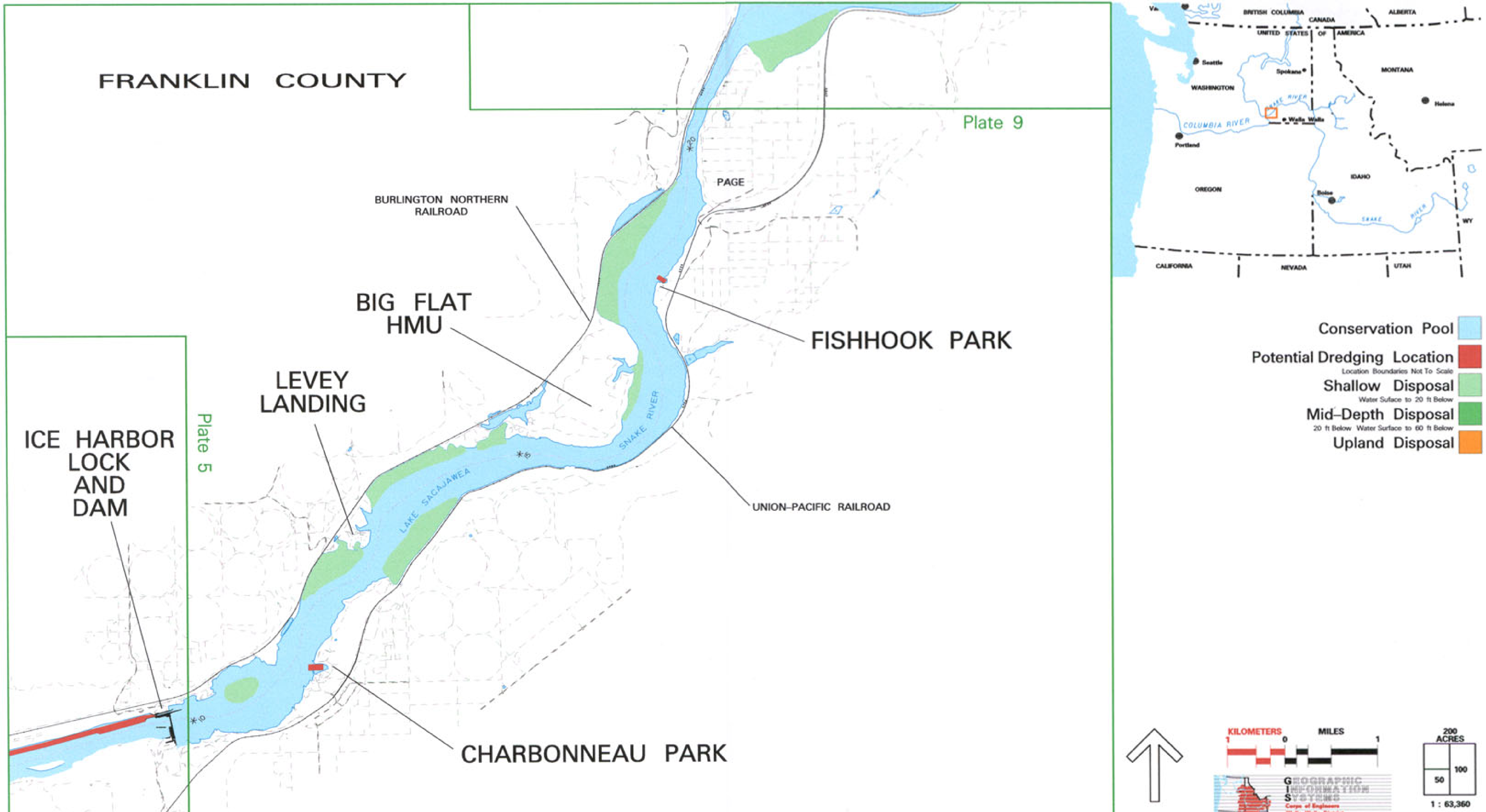

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Ice Harbor Dam and Reservoir: RM 9 – 22

DREDGING AND DISPOSAL SITES

2002

PLATE 8

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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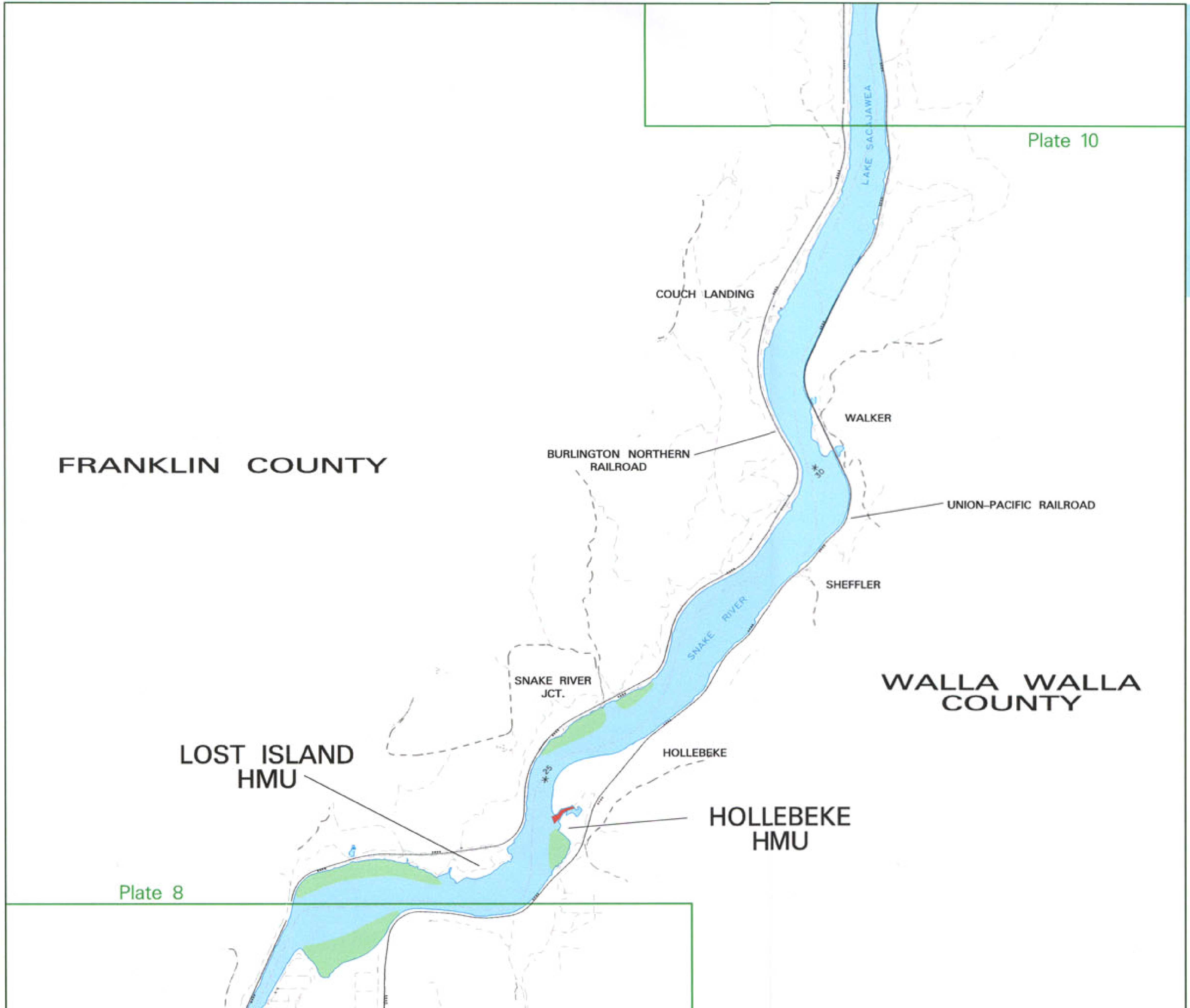

Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Suface to 20 ft Below

Mid-Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

FINAL

Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Ice Harbor Reservoir: RM 21 – 35

DREDGING AND DISPOSAL SITES

2002

PLATE 9

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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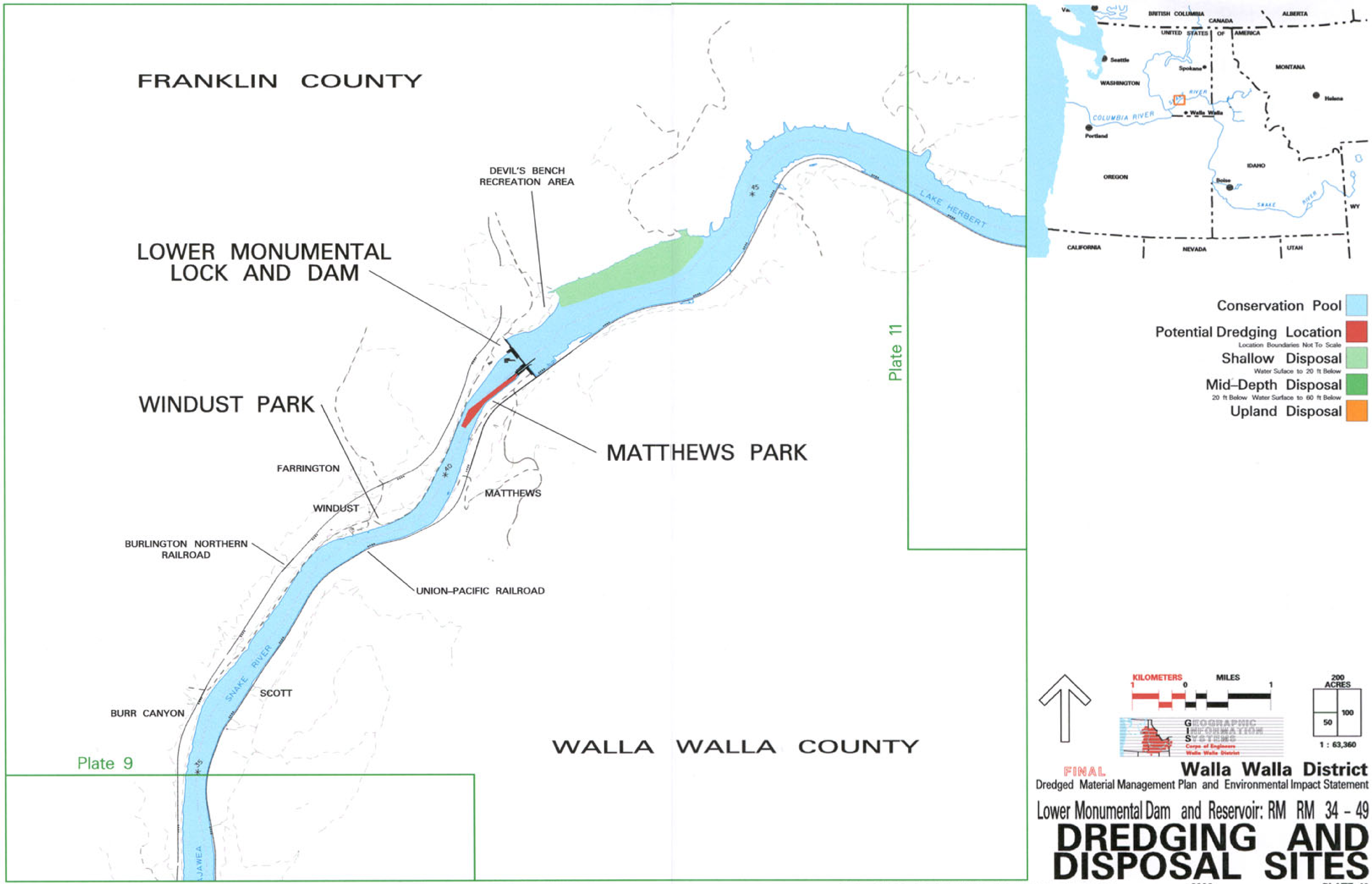

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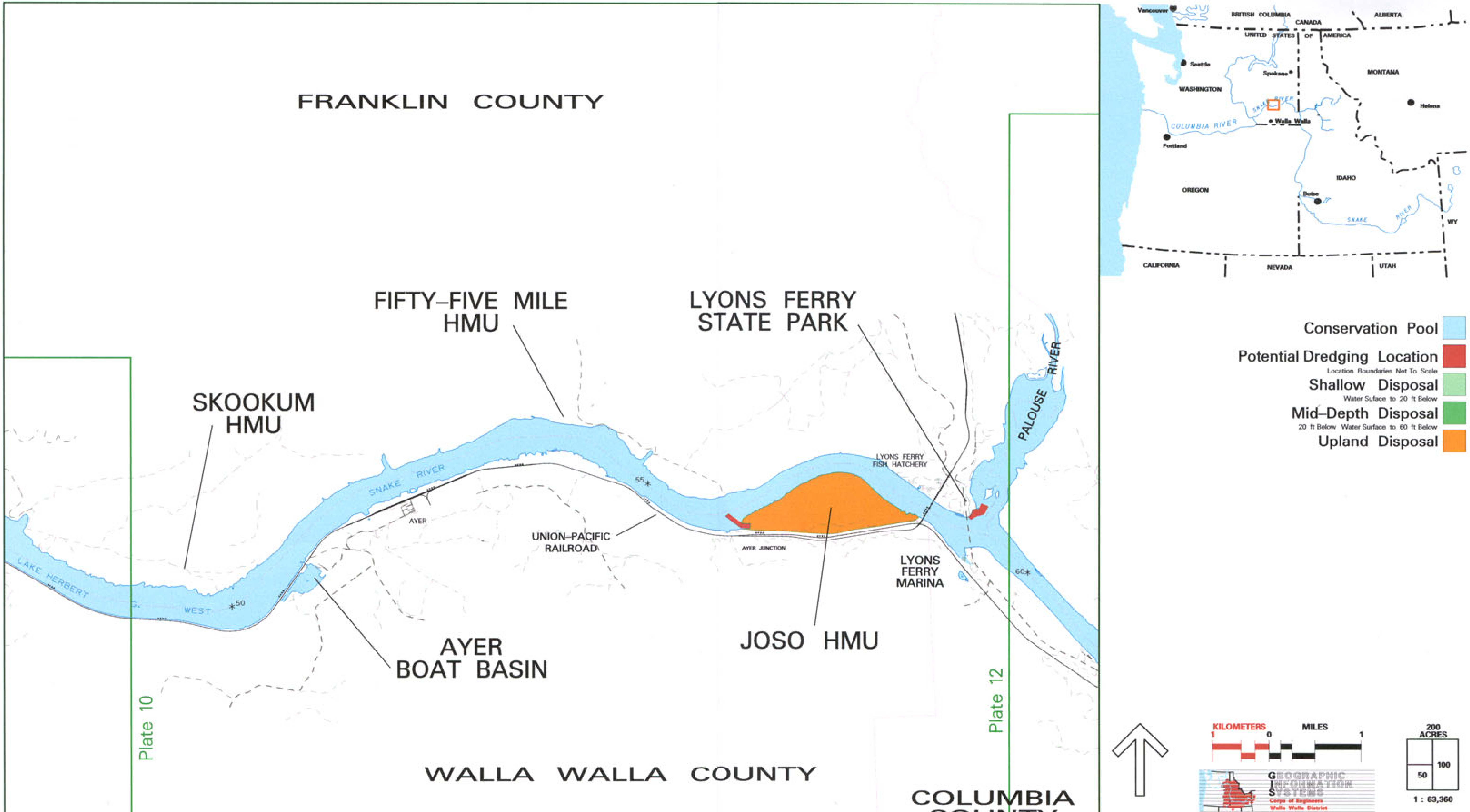

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Lower Monumental Reservoir: RM 48 – 61

DREDGING AND DISPOSAL SITES

2002

PLATE 11

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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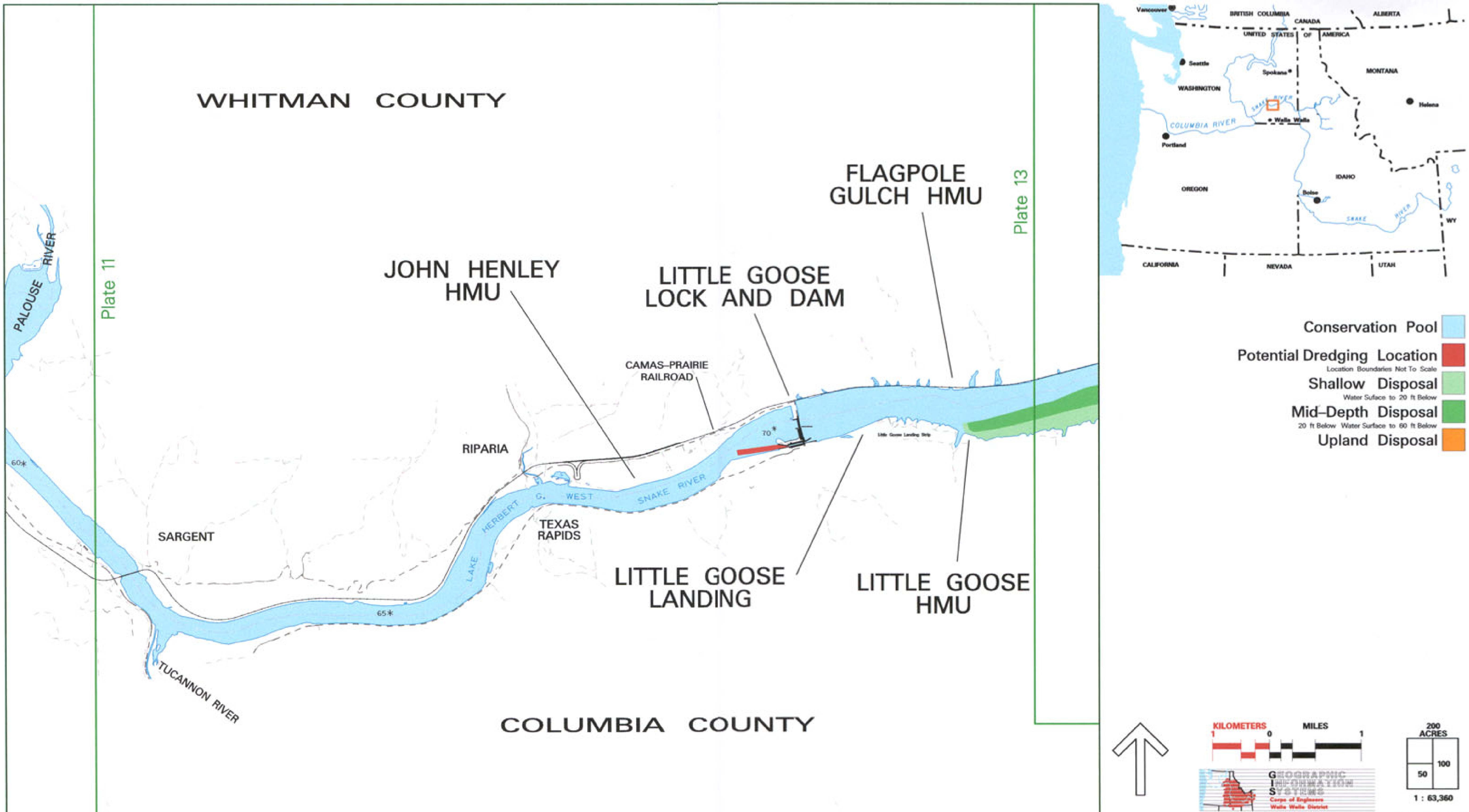

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Little Goose Dam and Reservoir: RM 60 – 74

DREDGING AND DISPOSAL SITES

2002

PLATE 12

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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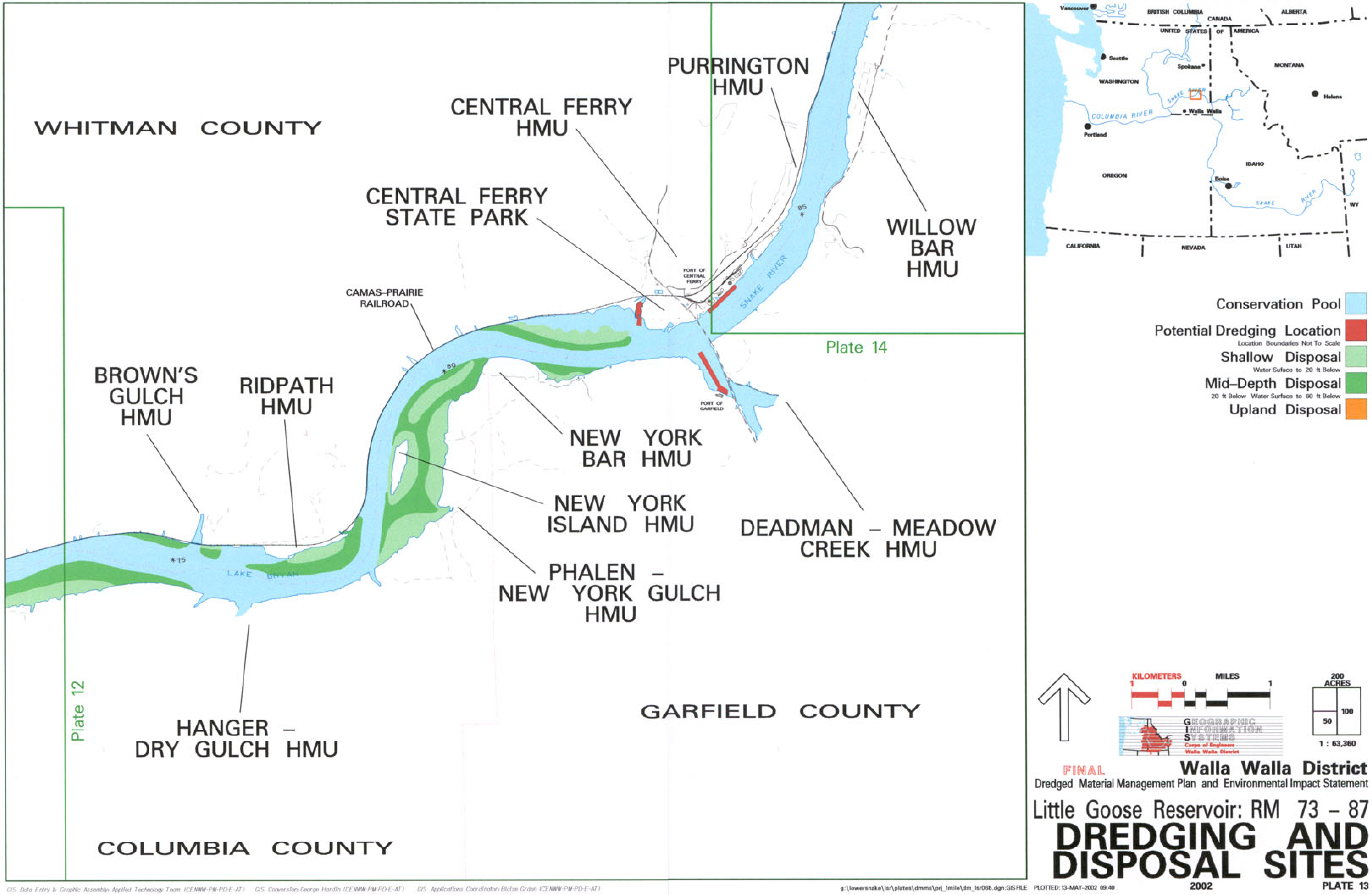
WHITMAN COUNTY
GARFIELD COUNTY
COLUMBIA COUNTY
PURRINGTON HMU
CENTRAL FERRY HMU
CENTRAL FERRY STATE PARK
WILLOW BAR HMU
CAMAS-PRAIRIE RAILROAD
PORT OF CENTRAL FERRY
PORT OF GARFIELD
SNAKE RIVER
LAKE BRYAN
BROWN'S GULCH HMU
RIDPATH HMU
NEW YORK BAR HMU
NEW YORK ISLAND HMU
DEADMAN – MEADOW CREEK HMU
PHALEN – NEW YORK GULCH HMU
HANGER – DRY GULCH HMU
Plate 14
Plate 12
75
80
85
BRITISH COLUMBIA
CANADA
ALBERTA
UNITED STATES OF AMERICA
Vancouver
Seattle
Spokane
WASHINGTON
MONTANA
Helena
COLUMBIA RIVER
Walla Walla
Portland
OREGON
IDAHO
Boise
SNAKE RIVER
WY
CALIFORNIA
NEVADA
UTAH
Conservation Pool
Potential Dredging Location
Location Boundaries Not To Scale
Shallow Disposal
Water Suface to 20 ft Below
Mid-Depth Disposal
20 ft Below Water Surface to 60 ft Below
Upland Disposal
KILOMETERS
MILES
1
0
1
200 ACRES
100
50
1 : 63,360
GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District
FINAL
Walla Walla District
Dredged Material Management Plan and Environmental Impact Statement
Little Goose Reservoir: RM 73 – 87
DREDGING AND DISPOSAL SITES
2002
PLATE 13
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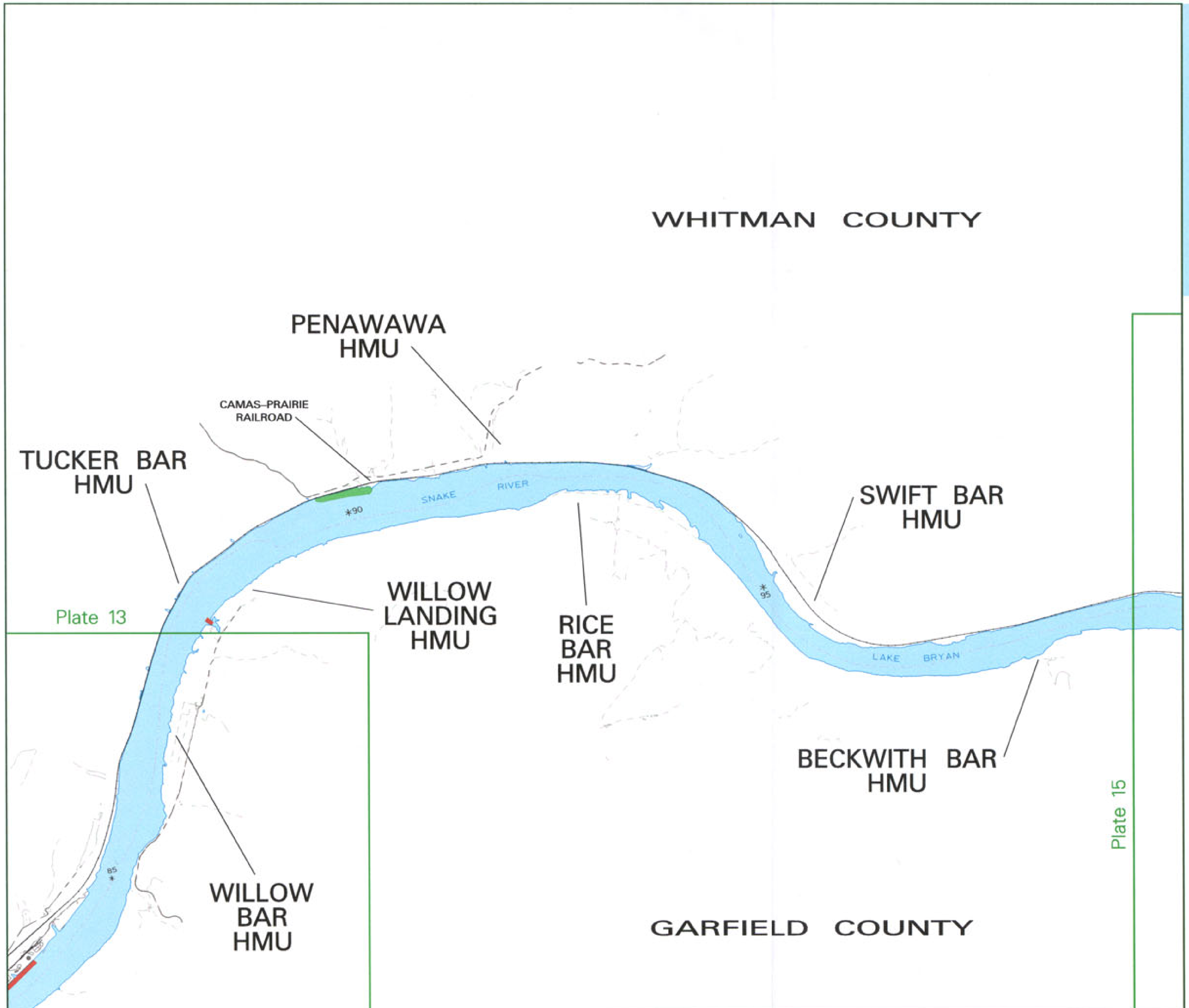

Conservation Pool

Potential Dredging Location
Location Boundaries Not To Scale

Shallow Disposal
Water Suface to 20 ft Below

Mid–Depth Disposal
20 ft Below Water Surface to 60 ft Below

Upland Disposal

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

FINAL

Walla Walla District
Dredged Material Management Plan and Environmental Impact Statement

Little Goose Reservoir: RM 84 – 99

DREDGING AND DISPOSAL SITES

2002

PLATE 14

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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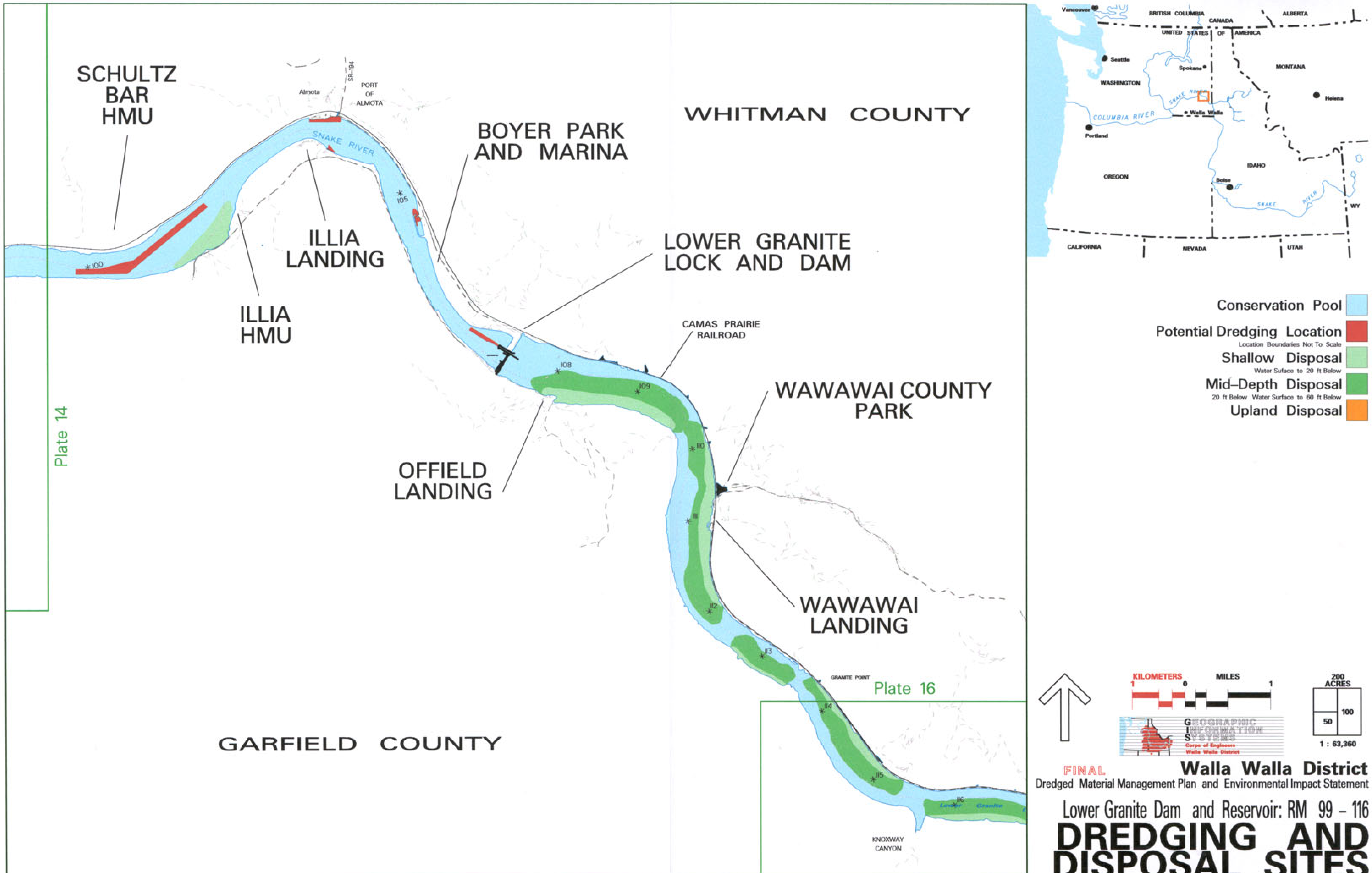

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Lower Granite Dam and Reservoir: RM 99 – 116

DREDGING AND DISPOSAL SITES

2002

PLATE 15

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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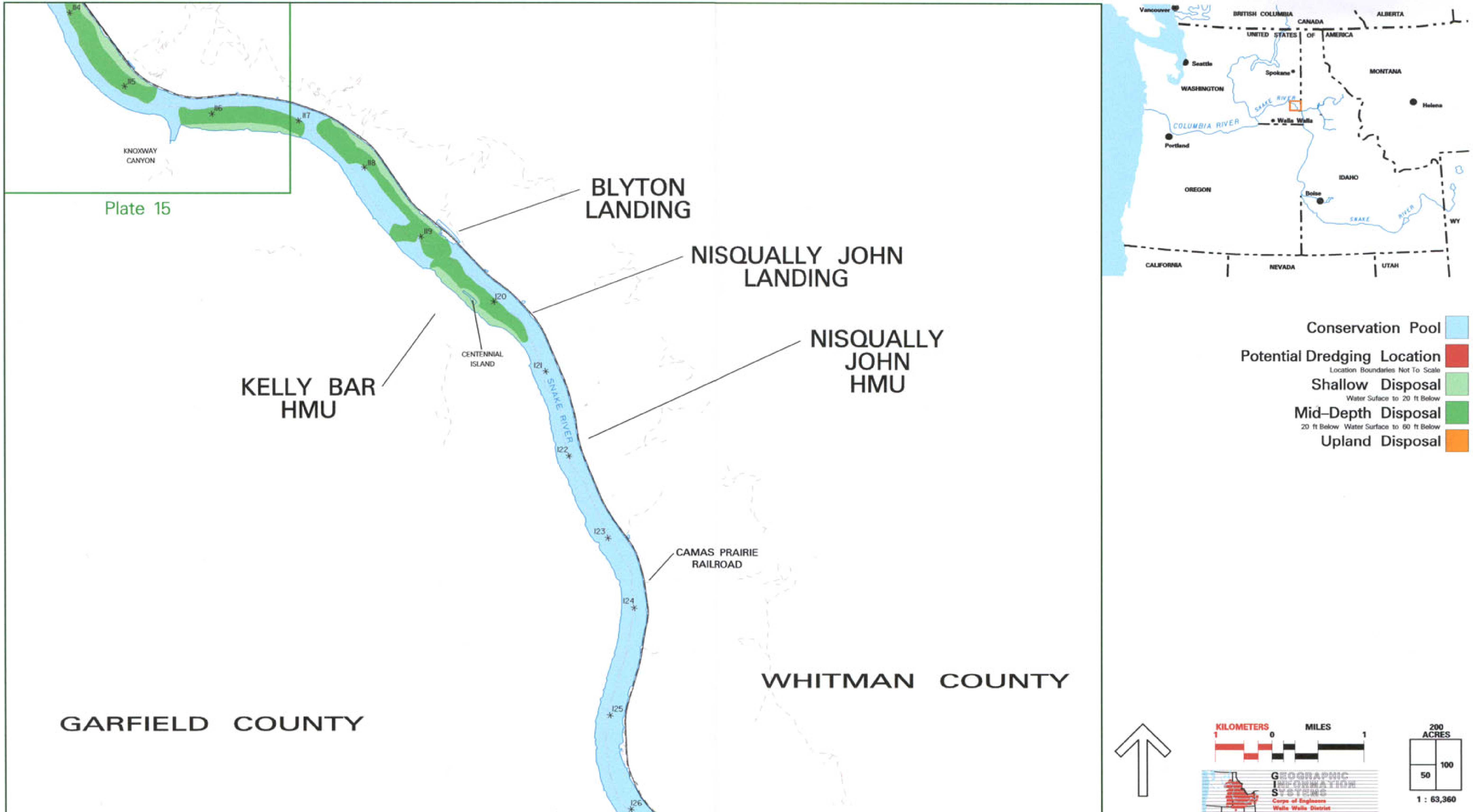

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Lower Granite Reservoir: RM 114 – 128

DREDGING AND DISPOSAL SITES

2002

PLATE 16

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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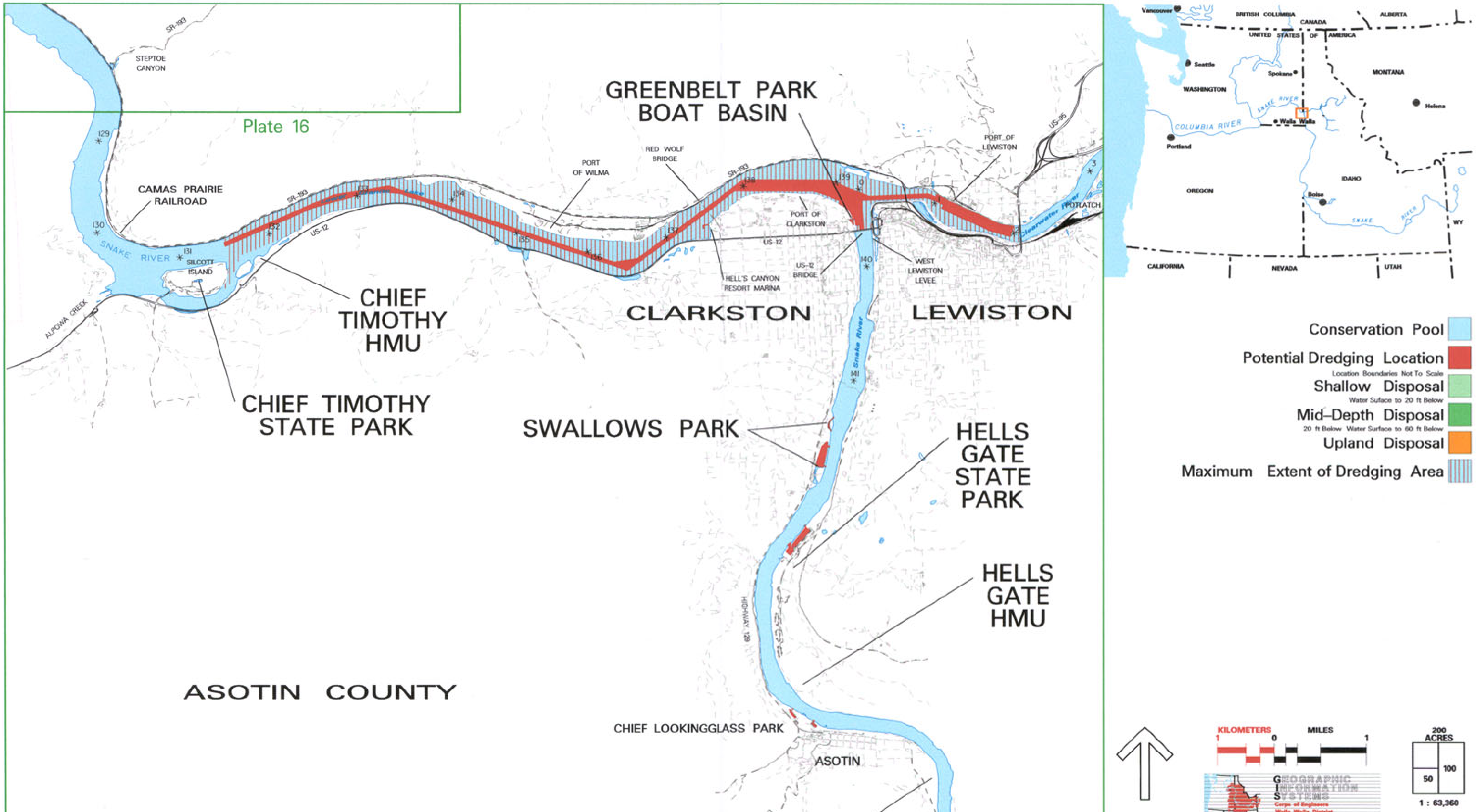

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

Lower Granite Reservoir: RM 127 – 147

DREDGING AND DISPOSAL SITES

2002

PLATE 17

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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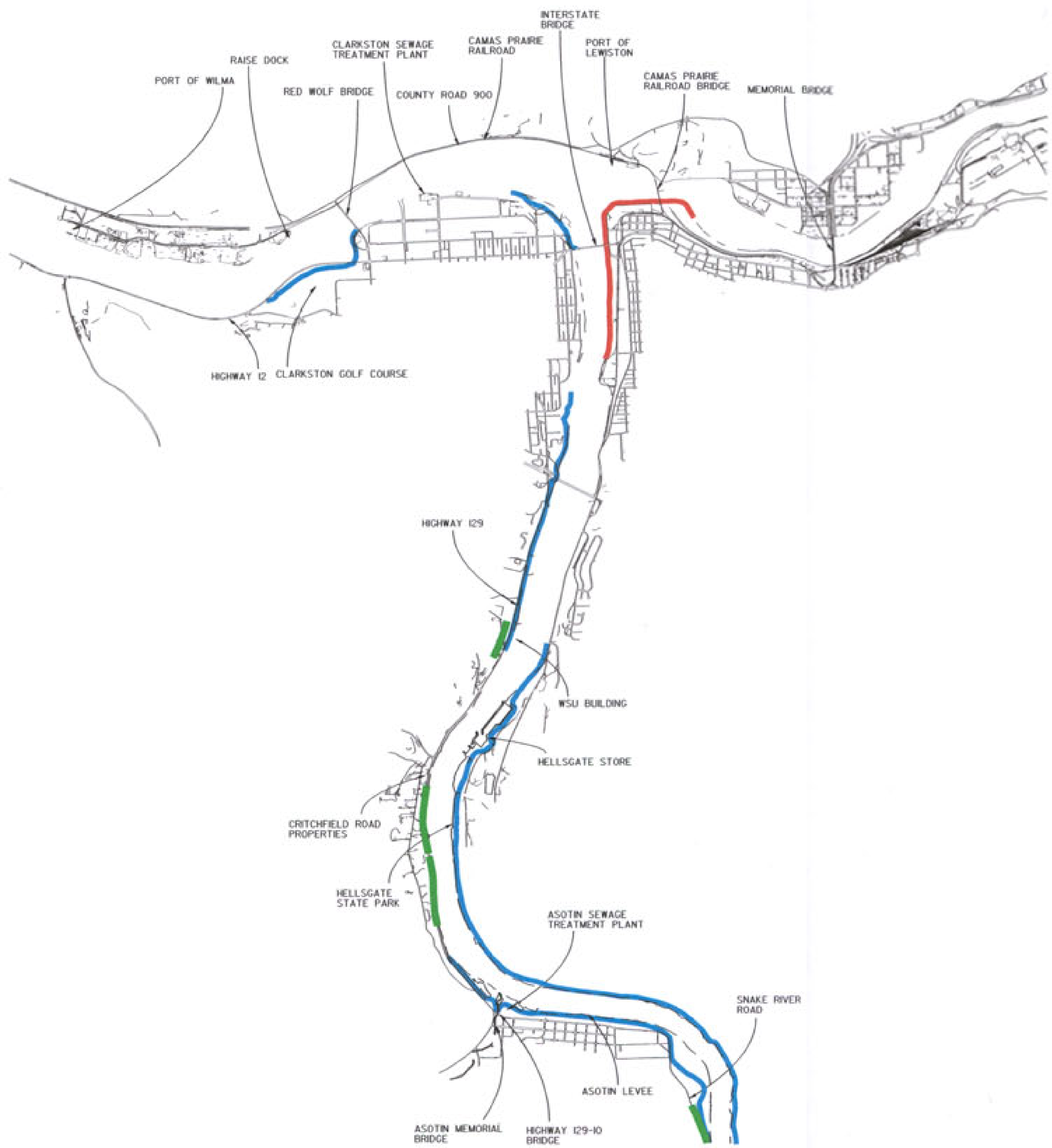

Modification/Impact

- Raise Road
- Water Line
- Raise Levee

KILOMETERS 1 0 MILES 1

200 ACRES 100 50

1 : 63,360

GEOGRAPHIC INFORMATION SYSTEMS
Corps of Engineers
Walla Walla District

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Walla Walla District

Dredged Material Management Plan and Environmental Impact Statement

3-FOOT LEVEE RAISE

2002

PLATE 18

GIS Data Entry & Graphic Assembly: Applied Technology Team (CENWW-PM-PD-E-AT) GIS Conversion: George Hardin (CENWW-PM-PD-E-AT) GIS Applications Coordinator: Blaise Grden (CENWW-PM-PD-E-AT)

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