APPENDIX B
JOHN DAY RESERVOIR
MINIMUM OPERATING POOL

US ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

APRIL 1994

EXECUTIVE SUMMARY

General: This report presents the results of a reconnaissance study of a proposal to operate John Day at its minimum operating pool (MOP) for the benefit of migrating juvenile anadromous fish. This study is being conducted as part of the overall System Configuration Study. John Day operation at MOP is in included in response to paragraph III.4.6.a.(2) of the Northwest Power Planning Council (NPPC) publication 91-31 "Amendments to the Columbia River Basin Fish and Wildlife Program (Phase Two)," dated December 11, 1991.

The proposed operation of John Day at MOP level (elevation 257), from 1 May through 31 August, has been evaluated for its benefits and impacts to the existing project, anadromous fish, the environment and other uses of the reservoir. An option to operate at MOP level year-round, to provide for partial mitigation of environmental impacts, was also evaluated.

In general, project facilities are designed for operation at MOP. However, the purpose for evacuating the pool to this level was to provide storage space to assist in controlling flooding in the Portland/ Vancouver area on a forecast basis. Because of the flood control storage space, the overall operating range of the project is 11 feet, greater than the other projects on the lower Snake and Columbia Rivers. Normal project operation does not currently involve sustained operation at the MOP level. The pool is normally operated at about elevation 265. Since the Salmon Summit, beginning in 1991, the pool has been operated during the migration season at "minimum irrigation pool" which is defined as the lowest level possible without impacting operation of agricultural irrigation pump stations on the reservoir. The intended level is 262.5, however, the level at which impacts begin is dependent on flows and the experience has been that as the flows decline the pool has had to be raised to near normal levels.

Project Modifications: Implementation of the proposed operation, would likely require modification of existing fish ladders at John Day and to ladder entrances at McNary Dam to meet established operational criteria. It appears that juvenile facilities will operate within established criteria without modifications. Potential effects of MOP operation on fish guidance is discussed below.

Impacts to reservoir uses and others: Reservoir users, particularly agricultural irrigation pump stations, would be impacted by the proposed operation. Modifications to restore pumping capability are anticipated at 23 of 24 pump stations on the reservoir. Most appear to be relatively straightforward measures to extend intakes, however several stations, including some of the larger stations, likely will require the addition of new low-head pumping facilities.

Municipal water supplies would also be impacted as well as groundwater users in the project area. Over 2,000 groundwater wells have been identified in the area. Less than 10 percent of these are projected to be impacted to the point of requiring modifications, however a monitoring program will be needed to identify problems.

The Umatilla and Irrigon Hatcheries' water supplies do not appear to require supplementation during the 4-month operation at MOP. Under the year-round operation a shortfall is projected requiring new sources of supply or other measures such as water recycling.

The majority of the 16 recreation sites on the pool would require modifications to extend boat ramps, swimming beaches and dock facilities. Three of the sites (LePage, Sundale, and Quesnel parks) also are treaty fishing access, which would need to be maintained. Several marinas would require dredging and at two sites maintaining channel depths would require costly rock removal. Evaluation of alternative mitigation opportunities and incremental justification will be required in subsequent studies. Economic losses due to reduced recreational visitation with John Day at MOP were estimated to be $6 million annually in the System Operation Review study, assuming no mitigation. Other potential impacts include utility pipeline crossings and an existing landslide area have been identified.

Environmental Impacts: Resident fish and wildlife habitat will be impacted by the proposed operation. The annual 4-month operation at MOP will impact a projected 8,400 acres of shallow water habitat including 2,100 acres of marsh-riparian zones throughout the reservoir. The existing shallow water habitat is also believed to be important to rearing juvenile anadromous fish. The Umatilla National Wildlife Refuge and two state-managed wildlife areas contain a significant portion of the affected areas. Year-round drawdown would be expected to provide replacement habitat area for about 25 percent of the losses after a period of recovery. No other opportunities to mitigate resident fish impacts have been identified to date. Off-site mitigation would likely be required for wildlife impacts.

The drawdown could have an impact on migrating Umatilla River adult salmon due to blockages at the mouth of that river. Monitoring and periodic dredging may be required. Significant cultural resources exist on the project. No reliable estimate of mitigation costs can be projected at this time. A monitoring program would be implemented in conjunction with the drawdown operation.

Biological Effects: Operating John Day at its minimum operating pool will reduce water particle travel time. In the pool itself, the reduction is about 12-15 percent. From the Granite pool on the Snake River or from the Wells pool on the mid-Columbia to below Bonneville, the change in average water travel time with John

Day at MOP ranges from 2-5 percent. This would reduce average water travel time under average spring flow conditions from 15 to 14.5 days. During lower summer average flows, as in August, the reduction is calculated to be 1.7 and 1.5 days from base condition water travel times of 56 days from Granite and 30 days from Wells, respectively.

Flow/survival relationships, in general, are uncertain. Studies underway or planned on the Snake River are intended to further understanding of this relationship. Because it would provide a relatively smaller change in flow relative to the drawdowns being considered on the Snake and because of its location in the system, the results of these studies may not contribute to resolving uncertainties with regard to MOP operation at John Day. Modeling of survival benefits using regional fish passage models has yielded varied results. Estimates using CRiSP passage modeling of representative mid-Columbia stocks for the proposed MOP operation showed virtually no change from basecase survival for any of the stocks (absolute survival changes ranged from -1% to +1%). PAM modeling resulted in a potential increase in relative survival of 7 percent for mid-Columbia spring chinook (absolute survival calculated by the Corps based on this result is 3 percent). The differences in results from the two models are likely related to each models' assumptions regarding the relationship between flow and fish travel time and the stochasticity of the CRiSP model.

The CRiSP model was also used to estimate changes in survival through the John Day pool alone (from McNary tailrace to John Day forebay). This modeling for John Day pool alone (not system survival) yielded a 2 percent (absolute) change in survival for mid-Columbia sub-yearlings and -2 percent for yearlings.

Other potential effects on migrating juveniles due to operation of John Day to MOP have been qualitatively identified. These include changes in fish guidance and/or orifice passage efficiencies, turbine mortality, shallow water habitat (rearing areas) and predation. These effects were not included in the modeling due to uncertainties or because the models cannot address the effects (as is the case with changes in shallow water habitat). While the effects are unknown it is a concern that changes in these factors could potentially offset any benefit derived from the reduced travel time.

Construction and O&M costs: The construction costs to mitigate impacts due to the 4-month drawdown is currently estimated to be $65 million. The year-round option construction cost is estimated to be $99 million. The higher cost of the year-round option is substantially a result of the impacts to hatchery water supplies. Annual O&M costs for the options are $0.6 and $2.1 million for the 4-month and year-round options, respectively.

Economic Impacts: Economic impacts for the proposed operation are substantially derived from lost hydropower generation. For 4-month drawdown this is estimated to be about $3.8 million. For the year-round option the estimate is $12.3 million.

Current Status: In response to Congress and regional interests, the Corps of Engineers has initiated advance planning and design. The scope includes feasibility level biological and impact studies and expedited preparation of designs to mitigate for impacted facilities in anticipation of an early decision to implement the proposed operation. The current schedule provides for a decision document and draft Environmental Impact Statement in 1996, with potential implementation of drawdown by 1999.

The results of Phase I provide little information to reduce uncertainties surrounding the biological effectiveness of the proposed MOP operation. This uncertainty results from general flow/survival issues as well as the magnitude of the physical change in pool levels and water travel time which would be achieved. Operation of John Day at MOP may not provide a sufficient benefit to justify the costs and impacts that have been preliminarily identified, uncertainties aside. There appear to be two courses of action that may be pursued beyond Phase I for this alternative; 1) continue the AP&D process now underway, or 2) discontinue study of John Day operation at MOP as an alternative. These study results, preliminary conclusions and potential courses of action are presented for regional consideration.

APPENDIX B
JOHN DAY RESERVOIR
MINIMUM OPERATING POOL

US ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

APRIL 1994

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APPENDIX B
JOHN DAY RESERVOIR
MINIMUM OPERATING POOL

US ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

APRIL 1994

1. INTRODUCTION

1.1 Study Purpose

The study of the effects of operating John Day pool at its minimum operating level (MOP) is being performed under the broader System Configuration Study (SCS). The SCS study is a reconnaissance level study to identify and screen alternatives to enhance survival of juvenile and adult anadromous fish in the Columbia/Snake River systems. Inclusion of this investigation into operating John Day pool at MOP under the SCS study is made in response to paragraph III.4.6.a.(2) of the Northwest Power Planning Council (NPPC) publication 91-31 "Amendments to the Columbia River Basin Fish and Wildlife Program (Phase Two)", dated December 11, 1991.

1.2 Study Scope

This study was conducted to determine the requirements to permit the annual operation of John Day reservoir at minimum operating pool (MOP) level, elevation 257, from May 1 through August 31. The purpose of this study is to provide a preliminary (reconnaissance) assessment of the biological benefit of the proposed operation, the impacts of the proposed operation on resevoir users and the environment, to identify potential mitigation measures and estimated costs to implement the operation.

This is a reconnaissance level study which relies on literature searches, surface inspections, existing information, engineering judgement and cost estimates for similar work. More detailed studies may uncover additional impacts and provide additional details to better estimate benefits, impacts and costs.

1.3 Area Description and Land Use

The Columbia River flows for 300 miles between the states of Washington and Oregon, and drains most of the Pacific Northwest. The reach of the Columbia River under consideration in this report extends from John Day Lock and Dam at river mile (RM) 215.6, to McNary Lock and Dam (RM 291). The body of water ponded by John Day Dam is known as Lake Umatilla. It is the second longest reservoir on the Columbia River, extending 77 miles upstream to McNary Dam. The adjoining region is mostly open country, with population centers widely scattered. The climate of the region is semi-arid. Agriculture and open space is the predominant land use, with large farms prevalent. Lands adjacent to the reservoir are used to grow grains and other crops, all of which are irrigated.

The middle Columbia River area is served by a well-developed regional transportation system consisting of highways, railroads, and navigation channels. Railroads and highways parallel the northern and southern shores of Lake Umatilla. Interstate 84 (I-84), a divided multi-lane highway, runs parallel with the Columbia River from Portland to points east. It is a major freight corridor. Washington State Route 14 (SR-14) also parallels the Columbia River from Vancouver to McNary Dam on the north shore. Umatilla Bridge at RM 290.5, just downstream of McNary Dam is the only highway bridge linking Oregon and Washington across the Columbia River in the John Day pool.

Two major railroad lines run adjacent to Lake Umatilla: Burlington Northern and Union Pacific. Burlington Northern lines run east and west along the Columbia River on the Washington shore, from Longview past McNary Dam. On the Oregon shore, Union Pacific Railway also runs parallel to the Columbia River, from Portland to Hermiston and points east.

The middle section of the Columbia River is used for shallow-draft navigation throughout its length. The Columbia-Snake Inland Waterway extends 460 miles from the mouth of the Columbia River to Lewiston, Idaho. It consists of three segments. The first is the 40-foot deep water channel for ocean-going vessels that extends for 106 miles from the ocean to Vancouver, Washington. The second is a shallow-draft barge channel that extends from Vancouver, Washington, to The Dalles, Oregon. Although that section is authorized to be 27 feet deep, it is currently maintained at 17 feet. The third section is authorized and maintained at 14 feet and extends from The Dalles, Oregon, to Lewiston, Idaho. In addition to the channel, there are numerous ports and harbors along the river.

1.4 Project Authorization

The John Day Lock and Dam Project was originally authorized in the Flood Control Act, May 17, 1950, Public Law 516. The general plan presented in House Document No. 531, 81st Congress, 2nd Session, provided for a dam, power plant, navigation lock, and slack-water lake extending to McNary Lock and Dam. Flood control storage of 2 million acre-feet was provided between elevations 255 and 292 feet at the dam. Due to adverse effects of the fluctuating water levels on waterside properties and installations, a review of authorized flood control features of the project was requested by the Committee on Public Works of the U.S., Senate on April 22, 1953. In response, a review report was submitted to the Congress on August 9, 1956 (Senate Document No. 10, 85th Congress, 1st Session) which recommended revision of flood storage capacity to about 500,000 acre-feet by reduced surcharge and drawdown from normal lake level at approximate elevation 262 feet. The Public Works Committees of the Senate and House adopted the recommendation in the review report as a change from the original 1950 authorization on April 22, 1956, and December 12, 1956, respectively. The General Design Memorandum (GDM) of June 1958 indicated that the most advantageous plan was to have lake fluctuation between elevations 265 and 262 feet for power generation, and 500,000 acre-feet of flood control storage between elevations 257 and 268 feet.

The John Day project authorization was later modified by Public Law 89-298 to provide authority for the aquisition of additional lands for the purposes of waterfowl management substantilly in accordance with the recommendations of the Chief of Engineers contained in Senate Document No. 28, 89th Congress, 1st Session. The recommendations cited both mitigation for the construction of the project and resourse enhancement in justification for the aquisition of the additional lands and the development of a national wildlife refuge on the project.

1.5 Existing Project

John Day Lock and Dam is one unit in the comprehensive development for multiple-purpose uses of the water resources of the Columbia River and its tributaries. Its general layout is shown on figure 1-1. Table 1-1 provides pertinent John Day project data. The dam provides approximately 77 miles of slack-water navigation from the head of The Dalles reservoir to McNary Dam, completing the slack-water navigation improvement from the Pacific Ocean to the Pasco-Kennewick area of Washington and to the Ice Harbor

Lock and Dam in the lower Snake River. The project provides approximately 2,160,000 kilowatts (kw) of nameplate rating generating capacity. Lake Umatilla is the farthest downstream reservoir on the Columbia River with authorized flood control storage. The 500,000 acre-feet of flood control storage it provides is the most effective in reducing downstream flood damages, primarily in compensation for unavoidable irregularities in operation of upstream reservoirs and regulation of flows from uncontrolled tributaries above the site.

TABLE 1-1. *John Day project data*

Description	Elevation
Maximum pool	276.5 feet
Full pool	268 feet
Normal pool	265 feet
Minimum pool	257 feet
Upstream sill block	242 feet
Spillway crest	210 feet

1.5.1 Navigation. River transportation is an important factor in the economic life of the area. Constructing John Day Dam, at RM 215.6, was a vital step in developing the authorized 460-mile Columbia-Snake River inland waterway system. Bonneville and McNary dams, at RM 145 and RM 292, and navigation

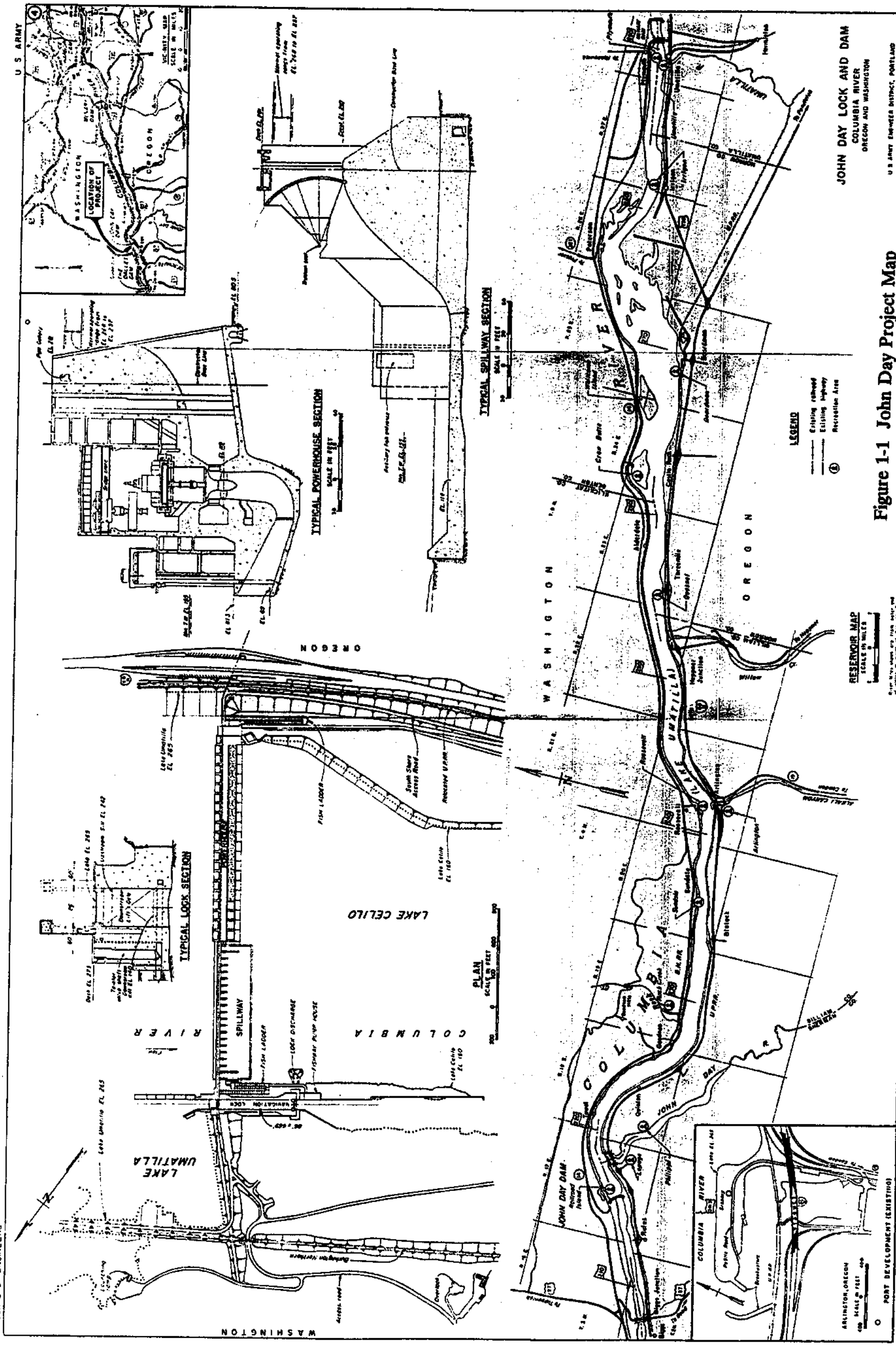


Figure 1-1 John Day Project Map

facilities at The Dalles Dam, RM 193, were placed in operation in March 1957. Bonneville Dam located at the head of tidewater, can handle barge traffic and pass deep-draft ocean-going vessels, thereby extending ocean traffic to The Dalles, a distance of 190 miles from the Pacific Ocean--if necessary channel depths are made available.

The Dalles reservoir provides slack water for barge navigation to John Day Dam. At the head of the John Day reservoir, McNary Dam provides a slack-water reach for barge transport extending to above Pasco, Washington, situated at RM 328 on the Columbia River; and approximately 10 miles up the Snake River to Ice Harbor Dam. The four locks and dams on the lower Snake River below Lewiston, Idaho, adds another 135 miles of slack water. The entire system permits operation of deep-draft vessels over the lower 190 miles of the Columbia River to The Dalles, Oregon, and barges over the remaining 270-mile distance to Lewiston, Idaho.

With the completion of the new Bonneville Navigation Lock, all locks on the Columbia and lower Snake river system will be 86 feet by 675 feet. The minimum depth over sills is 19 feet at Bonneville (new lock) and 15 feet at John Day, McNary, and The Dalles projects. The depth over sills on lower Snake River projects is 14 feet.

1.5.2 Flood Control. The John Day project provides a part of the comprehensive reservoir system for control of Columbia River floods. Constructed on the Columbia River below Snake River, it affords the last opportunity to obtain downstream flood control storage space for final control of flood peaks. Current plans provide for 500,000 acre-feet of space in the reservoir, which can be secured by an 8-foot drawdown of the normal elevation 265-foot level, supplemented by 3 feet of surcharge storage above this elevation. Storage is based on forecasts of stream flows. Refilling can be accomplished in connection with final regulation of the floods.

1.5.3 Power. Average operating head at the structure is about 104 feet providing for power potential at this site in the range of 2 to 3 million kw and an average energy generation approaching 11.5 billion kilowatt hours (kwh) annually. The powerhouse has space for 20 generating units capable of 135,000 kw each; 16 units have been installed for a present capacity of 2,160,000 kw. Full plant capacity is about 15 percent greater than rated capacity.

1.5.4 Recreation. Public recreation use is a major beneficial resource at the John Day project area. The John Day Lock and Dam project has a high demand for recreational opportunities. In 1989, estimated visitation was 1.6 million people.

1.5.5 Irrigation. There is no specific project authorization for irrigation from the John Day pool. Presently, irrigators are using the pool to provide irrigation water for more than 154,000 acres. All lands that can be irrigated from the pool are bench lands adjacent to the reservoir.

2. CURRENT PROJECT OPERATION

2.1 General

John Day Lock and Dam is operated as a run-of-the-river project within the integrated Columbia River basin system. Under normal operations its pool surface elevation fluctuates on a daily and weekly basis within a relatively narrow range between the minimum and maximum operating pool levels. By controlling the spillway gates and flows through the powerhouse, the reservoir level can be maintained near any elevation between spillway crest and maximum pool, a range of 30 to 50 feet. Prior to 1991, normal operating pool elevations were as follows:

Usable storage: 257.0 to 268.0 feet
Maximum pool: 276.5 feet

Normal operating range:	Upper	Lower
July 1 - October 1	268.0	265.0
Nov 1 - June 1	265.0	260.0

Generally in the winter operation, the midrange of pool level can be considered to be about El 263.5; in the summer about 266.5. A transition period to new pool levels occur in June and in October. See discussion in subsection 2.7, below, regarding the change in spring and summer operation since 1991.

2.2 Navigation

The lock chamber at the John Day project has lock walls at elevation 273 feet, which is 5 feet above the height of the maximum controlled pool attained during flood control operation. At normal pool level, water surface 8 feet below the top of lock walls is considered to be the optimum freeboard for normal operation. With this lock wall height, vessels can proceed through the lock channel with 5 feet of freeboard up to river discharge of 1,757,000 cubic feet per second (cfs), which is maximum spillway capacity at pool elevation of 268 feet. With respect to the upstream guardwall, likewise, a top elevation of 273 feet has been adopted giving protection to navigation similar to that provided in the lock chamber. In connection with the downstream approach channel, however, which is shielded from spillway discharges by an intervening ridge of rock, there is a guide wall at elevation 182 feet against the north shore of the approach channel. This elevation corresponds to net tailwater level for the standard project flood of 1,060,000 cfs. For a discharge of 460,000 cfs however, which has a recurrence interval of about 5 years with existing storage regulation and would be of short duration, 8 feet of freeboard would be afforded. This freeboard would compare with a freeboard of 8 feet at the downstream guardwall for the McNary project available with discharge of 640,000 cfs and which would be reduced for higher discharges. The navigation lock has an upstream sill block located at elevation 242 feet. At minimum operation pool, elevation 257 feet, there is a draft of 15 feet for navigation.

The dimensions of the approach channel to the John Day lock from downstream are proportioned to control velocities to range similar to those occurring at other projects in the lower Columbia navigation system. Likewise, lock filling time is in accordance with design at other projects in the river.

2.3 Flood Control

2.3.1 Runoff. There are two important runoff patterns in the Columbia basin: the snowmelt runoff in the interior east of the Cascade Mountain Range, and the rainfall runoff of the coastal drainages west of the Cascades. In both areas, most of the precipitation occurs during the winter months.

East of the Cascades. East of the Cascades, most of the precipitation falls as snow in the mountains. Snow accumulates and water is held in natural storage until temperatures rise, causing the spring runoff. Streamflows begin to rise in mid-April, reaching a peak flow during May or early June. Fluctuations in streamflow are caused by variations in sunlight and air temperature. Occasionally, rainfall adds to the runoff. Rain and snowmelt over the low-lying portions of the basin in the winter can raise streamflows and cause flooding along the lower Columbia and in some of the tributaries.

West of the Cascades. West of the Cascades, the winter storms tend to bring rain rather than snow. River levels can rise within hours during major storms. Peak flows near the mouth of the Willamette Basin, which drains more than 11,000 square miles, can occur within a few days of large rainstorms, with upstream points flooding within hours of a major storm. Most of the runoff occurs in the winter, from November through March, but moderate streamflows continue through the spring and early summer fed by late snowmelt from high areas and ground water outflows.

2.3.2 Flood Control Space. Flood control space in the John Day reservoir are evacuated and refilled as needed for control of peak discharges in the lower Columbia River. However, in consideration of possible adverse effects of pool fluctuations on power production, drawdown for flood control is limited as far as practical to the minimum period consistent with necessary operation for flood control. There is about 150,000 acre-feet of space for flood control at the dam in the top 3 feet between elevations 265 and 268 feet which would be available nearly all of the time. About 500,000 acre-feet of flood control storage is available between 257 and 268 feet elevation.

Additional space for flood control is provided during moderate spring flows and is incidental to operation for power production. After flows exceed the hydraulic requirements of the power units, usually in April, and until specific operation for flood control is required, usually in late May or June, the pool at the dam is maintained in the range of elevations between 265 and 260 feet for optimum power production at John Day and McNary projects.

As flow increase approaches flood proportions, the final evacuation of space for flood control is made. Based on flows at upstream locations, streamflow forecasts, and on space available at upstream reservoirs, the regulated discharge for the season is determined and just prior to the time of natural flows exceeding the magnitude of the scheduled regulated flow, John Day reservoir is drawn down to minimum pool elevation

257 feet. In years of runoff low enough to ensure lack of need for flood control, the pool is maintained at optimum elevations for power production.

During flood regulation period the reservoir is evacuated as needed to provide storage space for final regulation of flood flows. If the space is not needed for flood control, the pool elevation is operated in the regulation period at levels to optimize power production. Table 2-1 below shows maximum pool elevations based on the forecasted stage at Vancouver, Washington.

TABLE 2-1 *Flood control evacuation requirements*

Forecasted stage at Vancouver, WA (ft)	Maximum pool elevation
12	265.0
14	262.8
16	260.5
18	258.2
19	257.0

2.4 Power

Maximum and minimum controlled pool elevations for John Day reservoir are elevations 268 and 257 feet, respectively. Operational regulation of the project and reservoir between these limits in the interest of optimum power production falls into two general categories, one for the fall and winter low average streamflow season from September through March generally, and the other for the annual high spring and summer runoff season of April through August.

2.4.1 Low Average Streamflow Conditions. During the fall and winter season when power demands are normally the greatest, optimum energy and capability from the combined McNary and John Day plants results from operating the John Day reservoir at or near elevation 265 feet at the dam structure. Allowing for miscellaneous project water usages and losses estimated to average about 1,200 cfs, the river or project discharges at John Day reservoir required to develop full plan capability is 330,000 cfs. Average streamflows during the fall and winter will normally range between 100,000 and 140,000 cfs. Accordingly, load factoring or peak power operations at John Day during this period require daily and possibly weekly pondage operations to utilize maximum plant capability. For this purpose, a minimum pool for power is set at elevation 262 feet at the dam which provides 150,000 acre-feet or more for power use. In addition to peak power pondage operations, drawdown and refill of John Day pool on a forecast basis in the interest of increased energy production at site and downstream at The Dalles and Bonneville plants are also made during the low average streamflow season whenever uncontrolled local freshet runoff conditions indicate that spill will occur unless regulated. The extent of reservoir drawdown and refill in these cases are, of course, dependent upon the forecast conditions of streamflow, power needs, and other resources available at the time.

2.4.2 High Average Streamflow Conditions. Normally beginning in April of each year when river discharges are rising to their annual peak, drawdown and refill of the John Day reservoir in the interest of maximum energy production from the combined John Day and McNary plants are necessary and relate to initial and ultimate power at the John Day project as follows:

Power Operation During Floods. With 16 units installed at the John Day project, optimum power at the John Day and McNary projects is obtained by lowering the John Day pool gradually from elevation 265 feet, the average winter condition operating pool level, to about elevation 259 feet pool level. This drawdown is done when river discharges are rising and range from near the hydraulic limits of the John Day power plant to those of the McNary plant, or when average flows are increasing from about 180,000 to 200,000 cubic feet per second (cfs). An elevation 259 feet pool level could be held at John Day project until discharges reach about 400,000 cfs unless forecast flood conditions dictate the need for evacuation of additional reservoir space. After reaching about 400,000 cfs river discharge, the increasing loss in capability at John Day, due to reduced head conditions with rising tailwater levels and the elevation 259 feet pool level, would indicate an advantage of power-wise if increased head at John Day could be realized. Unless flood control operations dictate otherwise, operating pool levels are raised as required to maintain maximum capability at both John Day and McNary, reaching the average normal operating pool (elevation 265 feet) by about the time flows reach 600,000 cfs, and the maximum pool (elevation 268 feet) for 700,000 cfs or more. During the recession period of the high streamflow season, usually in July and August, the same general reservoir operational procedure is followed in reverse order with similar pool levels and river discharge magnitude for optimum power generation.

2.4.3 Reservoir Water Surface Profiles. The slope of the water surface of John Day reservoir varies with the quantity of flow through the pool. The pool is relatively flat under low flow conditions as might be expected in late summer. The slope increases in the upper 10 to 20 miles below McNary Dam. Figures 2-2 and 2-2 depict reservoir profiles at flows of 100,000 and 300,000 cfs, respectively.

2.5 Irrigation and Water Supply

John Day project has no specific storage for water supply, though the presence of ponded water serves to support water users along the reservoir. The withdrawal of irrigation water from the John Day pool is common at many locations, with users entitled to natural water rights as governed by State law. An

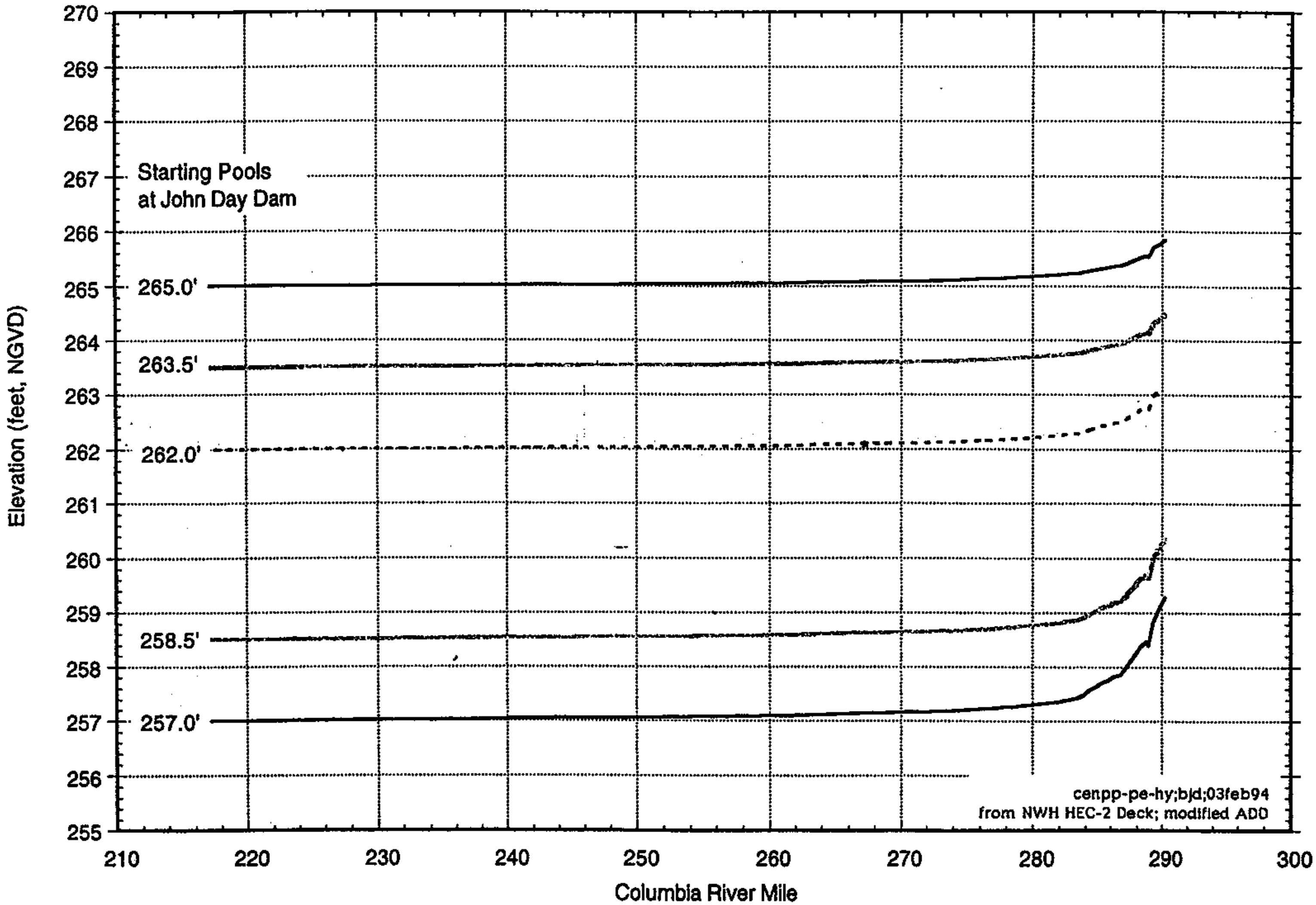


FIGURE 2-1 ***John Day pool profile at 100,000 cfs***

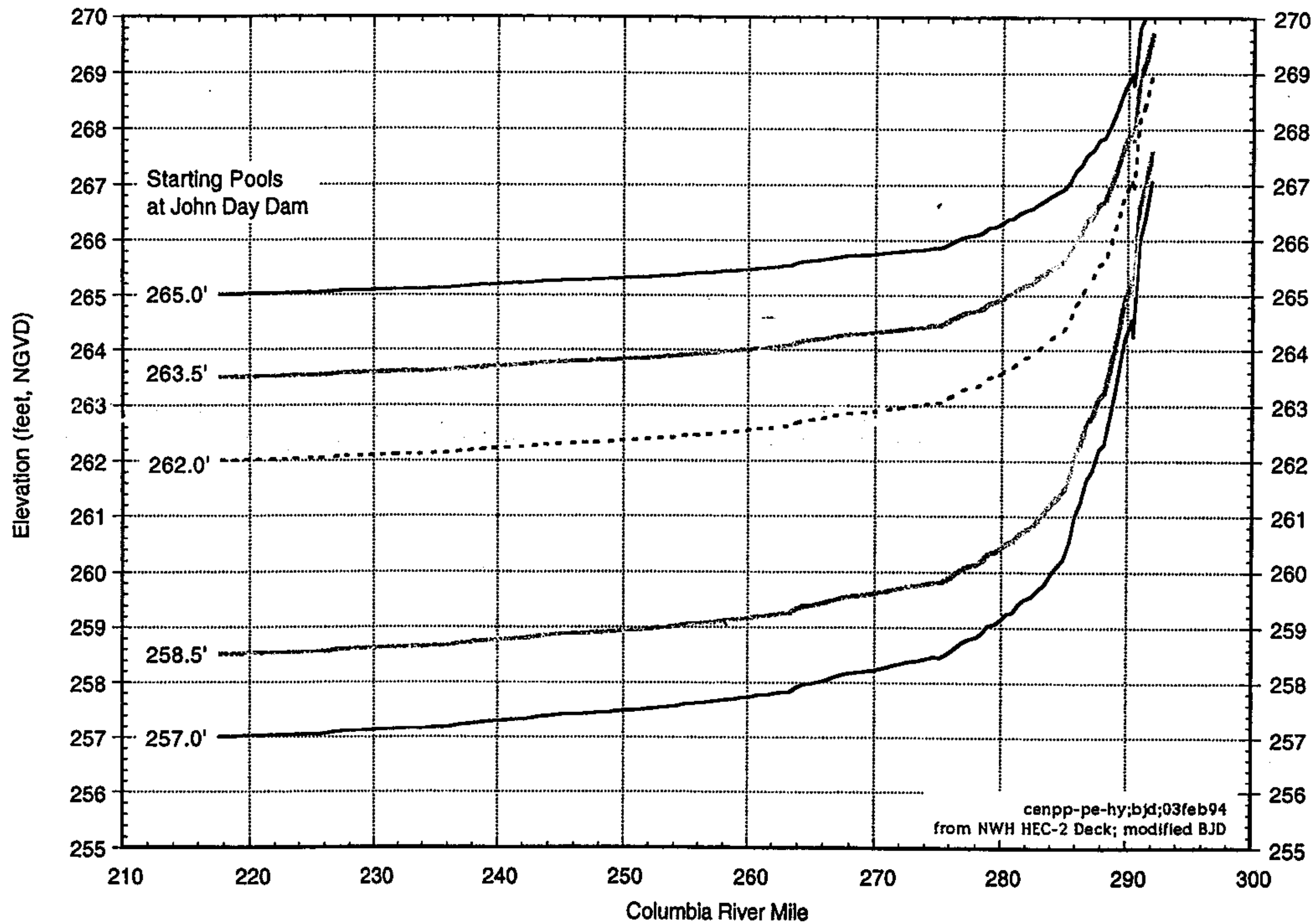


FIGURE 2-2 *John Day pool profile at 300,000 cfs*

estimated 143,000 acres of irrigated farmland are served by water from the pool. The land under irrigation can vary from year to year. On the Washington shore (Klickitat County), most irrigation water is obtained from deep wells. On the Oregon side, the majority of water permits from Columbia River are for agricultural irrigators, with a few municipal and industrial users such as the Portland General Electric steam plant. Discussions with county watermasters indicate that most irrigators can accommodate minor fluctuations in pool levels of Lake Umatilla within their operating limits.

Farmers irrigate crops from about the beginning of April through September, but can continue irrigating into October or November. The chief crops irrigated include potatoes, corn, vegetables, row crops, and alfalfa hay. Of the major crops, the land devoted to potatoes and other vegetables is most valuable. Pumping platforms are often jointly owned, maintained and operated by two or more farms or organizations. Irrigators in the Washington and Oregon counties around Lake Umatilla also draw water from wells.

Water for other purposes is withdrawn from the John Day pool. The Umatilla and Irrigon fish hatcheries and the city of Boardman municipal and industrial supply use withdraw water from the pool. These each involve use of a Ranney well system. The Ranney well shaft collects reservoir water which percolates through bottom sands and gravels into a series of horizontal perforated collector pipes.

2.6 Recreation

Most recreational activity on Lake Umatilla occurs from late spring through early fall. Normal operation of the project for flood control, power generation and other purposes may conflict with optimal recreational uses. Where compatible with other project purposes, the project is operated to provide for recreation benefits. During 1986, about 1,663,000 recreation visits were made to John Day project recreation areas.

2.7 Minimum Irrigation Pool (MIP) Operation

Beginning in 1991 and in the years thereafter, as agreed upon at the Salmon Summit, the Corps initiated operation of the pool at elevation 262.5. In 1992, the lower pool operation was initiated on 1 May and was to continue until 1 September. Operations to generally achieve this level, referred to as "minimum irrigation pool" was to be accomplished by operating over a 1.5 foot range between El 262 to 263.5 and maintained until requirements for operation of irrigation pump stations demanded a higher pool. A key factor in the ability to maintain a minimum level at the dam without impacting irrigation pumping operations is the flow through the pool and the resultant slope of the reservoir. In 1991, the pool was maintained at or near the elevation 262.5 level until mid-July before irrigation stations began to have difficulties. In 1992, by May 18, it became necessary to raise the pool as irrigation pumps began to be affected. The pool level needed to be raised two more times before the end of June as flows decreased. In July and August the level was held between El 264 and 265.5 to avoid impacts.

3. PROPOSED PROJECT OPERATION

3.1 Proposed Operation

The proposed change to the current project operation is to operate the John Day reservoir at minimum operating pool, elevation 257 feet, from May 1 through August 31, annually. This would coincide with the peak downstream migration season for juvenile salmonids (See Figure 3-1). For practical operational reasons, a range of operation of at least 1.5 feet to El 258.5 is assumed. If a normal (pre-Salmon Summit) operating range of 3 feet is used, the range would be between elevations 257 and 260. This operational change would lower the pool about 5-feet from El 263.5, mid-range of the normal winter/early spring operation and about 8 feet below El 266.5, the mid-point of the range during summer operation. Relative to the current MIP operations, discussed in the previous section, the reduction in average pool level would be about 4 to 6 feet, based on the experiences in 1991 and 1992.

3.2 Option for Year-round Operation at MOP

During the course of the studies of the proposed MOP operation, it became apparent that it may be possible to reduce the level of impacts to fish and wildlife habitat through an operation at MOP year-round. Such an operation might be able to provide the oppportunity for at least partial on-site mitigation for habitat loses expected with the drawdown. A preliminary evaluation of the potential effect on habitat mitigation and other uses, was added to the analysis as an option to the 4-month operation.

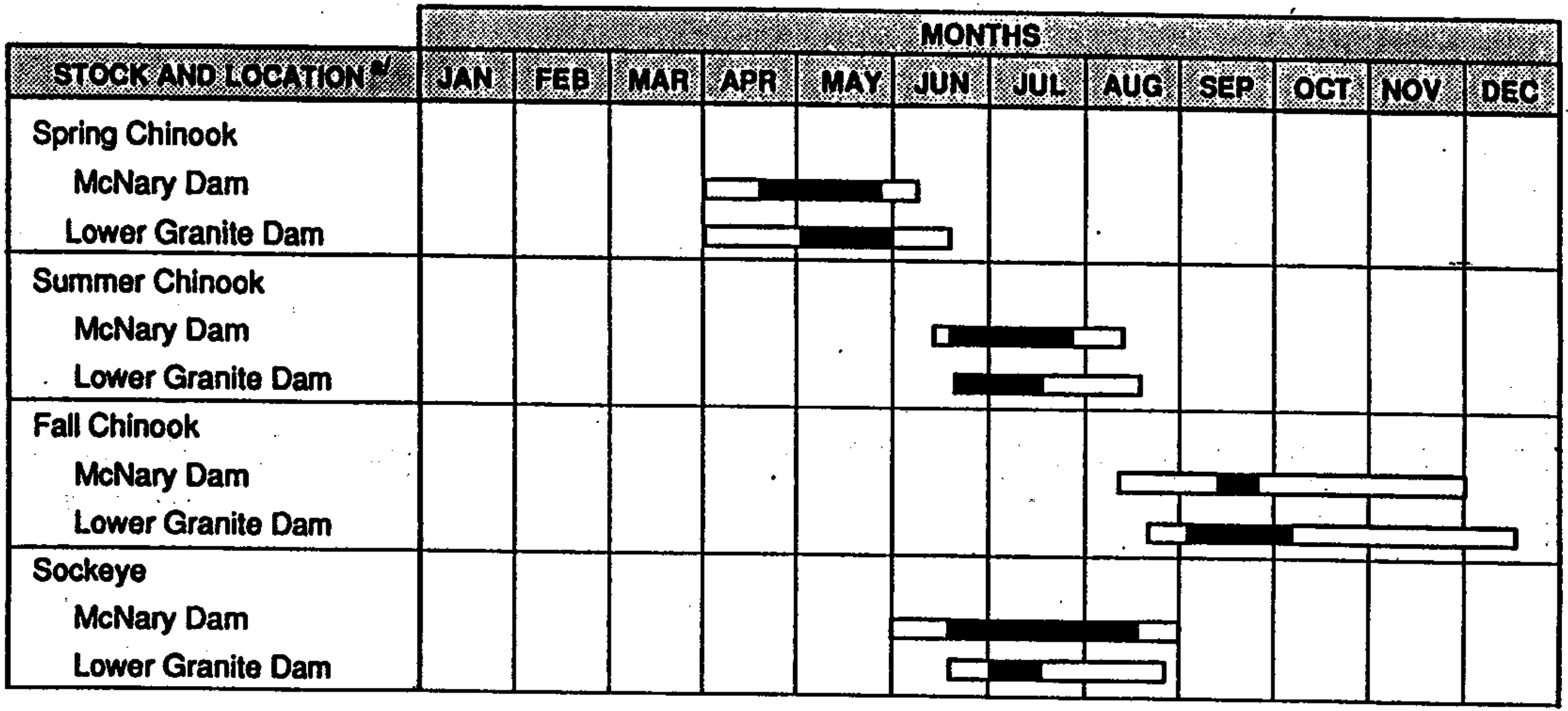
3.3 Flood Control Operation

April through July is the freshet flood season within the Columbia basin. It is assumed that the John Day pool will operate at elevation 257 feet, with higher pool elevations allowed to accommodate flood control operation. After the flood event and with lower flows in the system, the reservoir would be drafted back to elevation 257.

3.4 Authority Issues

Review of the existing authority for the John Day project and effects on the authorized project purposes indicates that operation of the project at minimum operating pool for juvenile fish migration, as described in this report, would be within the discretion of the Corps of Engineers. This should not be interpreted to preclude the need to meet other legal requirements, including environmental laws such as the National Environmental Policy Act.

Obligations and authorities to compensate impacted users is not as clear. Discretionary authorities exist which may be used as appropriate to address impacts to publicly owned facilities and utilities. These authorities do not apply to private individuals or businesses. A case-by-case review will be necessary to



a/ Migration period range and peak annual counts shown as darker central region.

Figure 3-1 *Peak periods of downstream migration of salmon smolts* address obligations and authority to compensate individuals as the law permits. While preliminary, it appears that there will be situations where authority to compensate an impacted party will not exist.

3.5 Water Particle Travel Time

Average regulated flows at John Day project based on the 50-year record range from about 281,000 cfs in May to about 116,000 in the latter half of August. These flows were obtained from HYDROSIM data for the System Operation Review study and represent base conditions. Low flow conditions range from about 216,000 in May to about 109,000 in late August. (lowest 8-year monthly flows at the Dalles, from NPPC staff). Average water particle travel time through the reservoir varies with pool elevation and flow. Table 3-1 presents calculated travel times for varying elevations and flows at John Day reservoir. The increased water velocity reduces the average water particle travel time through the reservoir. The velocity distribution of any cross section through the reservoir varies depending on the configuration of the channel. Generally, the flows are slower along the shallow banks than in the deeper channel.

TABLE 3-1 *Average water particle travel time, in days, from McNary Dam to John Day Dam*

Pool Elevation at Forebay	Flow, cfs 100,000	200,000	300,000
268	11.9 days	6.0 days	4.0 days
267	11.7	5.9	3.9
266	11.4	5.7	3.9
265	11.2	5.6	3.8
264	11.0	5.5	3.7
263	10.8	5.4	3.6
262	10.5	5.3	3.6
261	10.3	5.2	3.5
260	10.1	5.1	3.4
259	9.8	5.0	3.3
258	9.6	4.9	3.3
257 (MOP)	9.4	4.8	3.2

Under average flow conditions, the target pool elevations for normal, MIP, and the proposed MOP operations are shown in table 3.2. Note that these levels represent an approximate midrange of operation to compare changes in water particle travel time. Under normal (pre-Salmon Summit) conditions, the operational range for power pondage was about 3 feet; for minimum irrigation pool (MIP) and minimum operating pool (MOP) the assumed range is about 1.5 feet based on current MIP operations. Assumed pool levels under MIP operation shown in this table and in following tables are flow dependent and were estimated based on experiences during the 1991 and 1992 seasons, as discussed in section 2. It is noted that operating at MIP is considered the base condition for the study.

TABLE 3-2 *Monthly flows and pool levels under specified operational conditions*

Month	Flow,kcfs	Average Pool Levels (ft.msl) Normal	MIP	MOP
May	281	263.5	263.0	257.5
June	264	265.0[1]	263.0	257.5
July	171	266.5	264.0	257.5
August	123	266.5	265.0	257.5

[1] Transition from winter to summer level

From the previous tables, the improvement (decrease) in average water particle travel time (WPTT) for each of the drawdown months can be approximated. Table 3-3 presents the information for John Day pool under average flow conditions. The small change in travel time between normal and MIP reflects the fact that MIP pool levels vary with flow to avoid impacts to irrigators, as shown in the previous table.

TABLE 3-3 *Water particle travel time decrease for indicated pool operations (average flows).*

Month	Decrease in Water Particle Travel Time Normal to MIP	MIP to MOP
May	0.0 days	0.5 days
June	0.2	0.4
July	0.4	0.9
August	0.4	1.5

Under low flows, travel times are greater as also would be the magnitude of the change in travel time with each increment of pool lowering. Table 3-4 displays the WPTT decrease with lowered pool operations under low flow conditions. The flows presented are averages for the lowest eight years at the Dalles from the HYDROSIM data discussed above. These average eight-year low flows were provided by NPPC staff. MIP elevations were again estimated based on flow and the 1991and 1992 experiences.

Table 3-4 *Water particle travel time decrease for indicated pool operations (low flows).*

			Decrease in Water Particle Travel Time	
Month	Flow, kcfs	MIP El, ft.	Normal to MIP	MIP to MOP
May	216	263.5	0.0	0.6
June	164	264.0	0.1	1.0
July	113	265.0	0.3	1.6
August	114	265.0	0.4	1.6

The relative effect of the MOP operation at John Day on the travel time of a particle of water through the system has been calculated and is displayed below. The figures presented must be considered approximate. For the Snake and lower Columbia projects data presented in the 1992 Options Analysis/EIS was used to derive the water travel times. Travel times for the mid-Columbia projects were derived by storage replacement methodology from information provided by NPPC staff. Average flow conditions were used in determining the overall WPTT and relative improvement ranges in table 3-5.

Table 3-5 *WPTT and relative improvement with John Day operation at MOP (May-Aug average flows)*

Reach	WPTT Range, John Day at MIP (days)	Relative improvement range w/ MOP, percent
John Day pool	4 to 10	12-15
John Day pool to Bonn.tailrace	6 to 14	8-10
L.Granite pool to Bonn.tailrace	15 to 56	2-3
Wells pool to Bonn. tailrace	14 to 30	3-5

During low flows the range of average water travel times increase as does the magnitude of the improvement. The relative improvement in the system varies with the location of the low flows, but in general will show percentages similar to those in table 3-4.

4. IMPACTS TO THE PROJECT

4.1 Navigation

4.1.1 Authorized Channel. The authorized Federal navigation channel is 14 feet deep by 250 feet wide and is maintained to these dimensions. A review of past dredging records indicate that there is no dredging required to maintain these channel dimensions through the John Day reservoir. Present studies show that there is adequate depth to operate the navigation channel at pool elevation of 257 feet. There is no impact or cost associated with the authorized channel.

4.1.2 Navigational Aids. There is no adjustment to the authorized Federal channel alignment anticipated to operate the navigation channel at the elevation 257-foot pool. The existing navigational aids are adequate for the change of operation. At about RM 290 there will be a new shallow area exposed on the north side of the authorized channel. This may require side channel markers to be added adjacent to new shallow area to insure safe navigation under the new operation. This would cost about $10,000 and is the responsibility of the U.S. Coast Guard.

4.1.3 Local Access Channels. Local access to ports and docks were investigated and problem areas were identified. Access channels to ports were dredged in 1992 in anticipation of drawdown operation. Special authorization and funds were provided by Congress to perform this work since it was not within Corps authority to dredge outside the Federal channel. Rock Creek Boat Ramp (RM 229), Washington; Roosevelt Grain Facility (RM 243.5), Washington; Port of Morrow Dock Facility and Access Channel (RM 266 to 270), Oregon; and McNary Downstream Lock Entrance (RM 291.5), Washington, were dredged.

The marinas at Plymouth State Park, Washington, and Irrigon, Oregon, will be impacted during operation at elevation 257-foot pool. Impacts described in this section reflect dredging work between the Federal channel and the facilities for access. Other costs, directly related to recreational facilities at the park are discussed in Section 7, Impacts to Recreation. The marina at Irrigon appears to have adequate depth to operate at elevation 257-foot pool. However, the access channel will require dredging to provide service during the drawdown period. The estimated cost of dredging is $150,000 and it is anticipated that rock will be encountered during dredging.

Conditions at Plymouth State Park were not investigated, but it is anticipated that there will be dredging work required in the access channel and in the marina to maintain the current level of service during the drawdown period. A preliminary cost estimate for the dredging is $150,000.

4.1.4 Commercial Docks. Existing commercial docks, except those discussed above, have adequate depth to operate at elevation 257 feet during the drawdown period. These areas were dredged in 1992, in anticipation of drawdown, to avoid impacts to these facilities.

4.1.5 Summary of Navigation Impact Mitigation Costs. Table 4-1 summarizes the costs identified in the subparagraphs for dredging and navigation aids required due to the proposed operation. It is noted that the costs for the year-round alternative would be identical.

TABLE 4-1 *Summary of Navigation Mitigation Costs*

Item	Units	Unit Cost ($)	No. Units	Total Cost ($)
Navigation Aids	job	10,000	1	10,000
Access dredging, Irrigon	job	150,000	1	150,000
Access dredging, Plymouth S.P.	job	150,000	1	150,000
TOTAL				$310,000

4.1.6 Navigation Locks, John Day. Operational impacts due to drawdown would occur during lockages on the upstream side. The upstream sill block is 82 feet long with the upstream side at elevation 241 feet stepping up to elevation 242 feet on the gate side. This leaves a minimum depth of 15 feet with most of the sill block covered with 16 feet of water during pool operation of 257 feet.

There will be some impact to the time required for tows to enter or exit the lock from the forebay side. As the water depth between the lock sill and the underside of the tow is decreased, transit time over the sill is increased. As tow speed increases, squat may cause the flotilla to become temporarily grounded on the sill when exiting.

The project was originally evaluated for barge tows with 9 feet of draft. Currently, the industry is using tows with 14 feet of draft for grain and oil cargos. Delays are anticipated when tows 84 feet wide with 14 feet of draft enter and exit the upstream side of the lock. This delay occurs because the water in the lock chamber becomes trapped and flows out more slowly through the relatively small spaces between the barges and the lock walls. Engineering regulations require a minimum of 1 foot of clearance above the sill before tows can enter the lock. The Corps of Engineers Waterways Experiment Station (WES) indicated that clearances of 7 to 8 feet are preferred for minimum risk of damage to the sill block and tows. Table 4-1 lists the lock entrance and exit times for different draft tows. This impact may be offset by leaving the upstream tainter gates open when barges enter and exit the upstream end of the lock. Presently, no tows of this size have transited at pool elevation of 257 feet.

To avoid potential delays the upstream sill block would have to be lowered and the upstream gate would have to be lengthened. The cost of this work was not investigated, but would be extremely high relative to the delay impact. The alternatives to this scenario would be to limit the draft of tows during the drawdown or suffer the delay. Lockage delay estimates are presented in table 4-1. Refer to Section 11, Economics, for discussion of the impact costs.

TABLE 4-2 *Lock entrance and exit time*

Barge draft (ft)	Present entry/exit time (minutes)	With-project entry/exit time	Net delay
14	10	35	25
13	10	15	5
12	9	9	—
11	6	6	—

The lock approach channel was excavated to elevation 145 feet during the construction of John Day Dam. Adequate depth is available at a pool elevation of 257 feet, but river current velocities may impact tows entering the approach channel. There is no model data available with pool level 257 feet and flows in the range of 100,000 to 350,000 cfs. Model studies performed for the original project indicate 1 cfs velocities directed towards the spillway with a flow of 400,000 cfs and pool elevation 265 feet. Using this information no problems in the approach channel are anticipated.

4.1.7 Navigation Locks, McNary. Downstream lockages at McNary would not be impacted during MOP operation. The downstream sill at McNary lock is at elevation 236. With a John Day pool elevation at 257 feet and a river flow of 100,000 cfs, the tailwater at McNary would be elevation 259 feet. This condition would provide a 9-foot clear distance above the sill with 14-foot draft vessels.

4.2 Flood Control

It is assumed that it would not be necessary for the proposed operation to impact the flood control purpose for the project. There are two flood season on the Columbia River. One is from November through March and the other usually begins in mid-April reaching a peak in May or June. It is assumed, given the frequency and the already high flows associated with potential flooding, that the occasional requirement to raise the pool to reduce peak flows downstream and the temporary operation at levels above MOP would have a negligible effect on the proposed operation for fish. The flood control benefits of the project are discussed in Section 11, Economics.

4.3 Power Generation

No impacts to operation of power generation facilities at either project due to the proposed operation are apparent. Turbine efficiencies would be expected to be somewhat altered by the sustained operation at MOP and adjustments to operating settings may be required.

Operation of the reservoir at elevation 257 feet would result in loss of head at John Day, thereby reducing the power plant's generating capability. The head loss would be partially offset by an increase in head at McNary Dam, due to the lower tailwater with drawdown. The offset would vary with flow through the system. The cost of the lost generation capacity is discussed in Section 11, Economics.

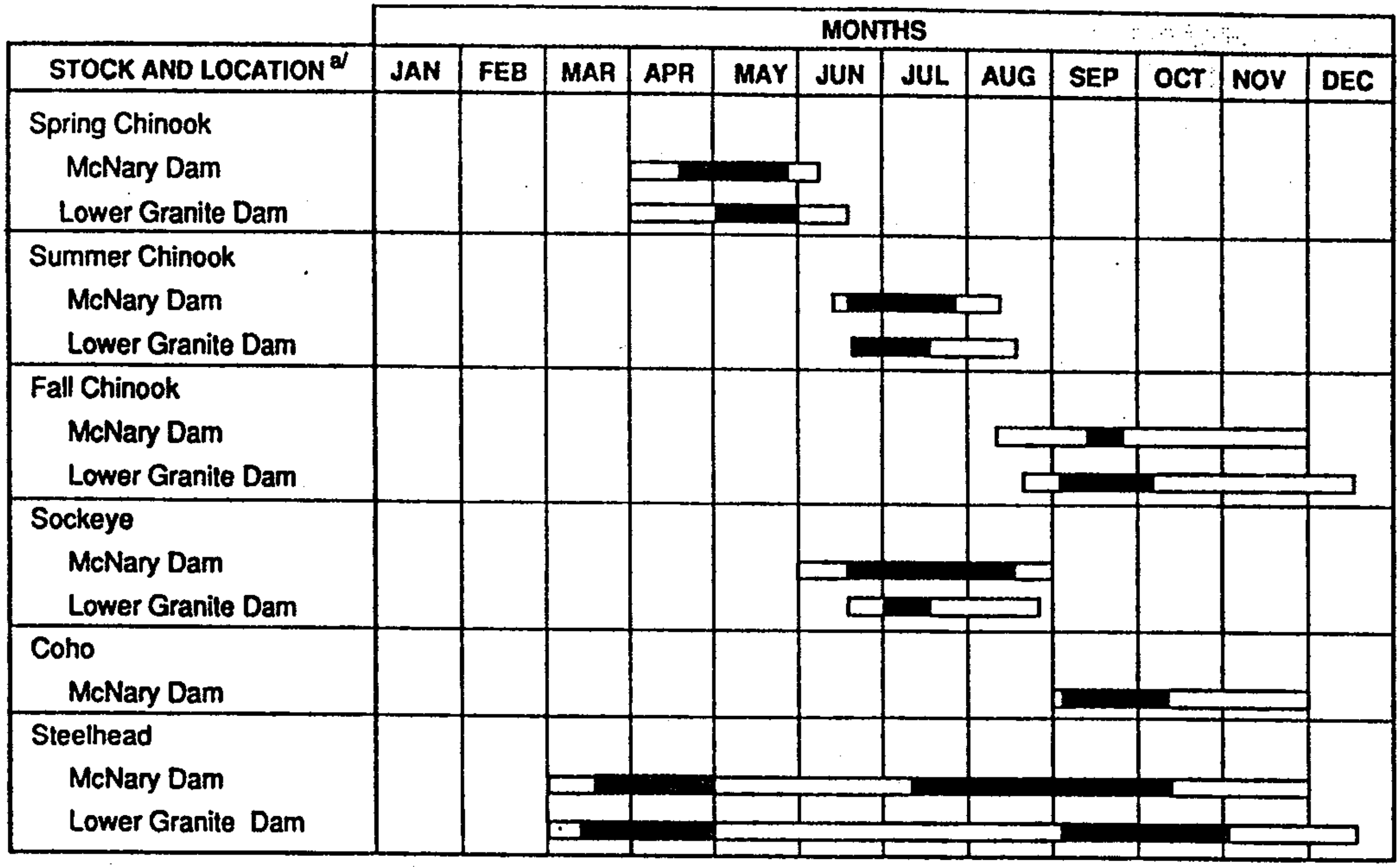
4.4 Adult Fishways at McNary and John Day Dams

Fish ladders, which are designed to allow upstream migration of anadromous fish, are used at all dams on the Columbia River. The ladders are typically operated from March 1 to December 31. Upstream salmonid migration timing varies by fish species, but occurs over the entire period of ladder operation (figure 4-1). The drawdown (May 1 through August 31) will occur during the adult migration and therefore has the potential to impact adult fishways at McNary and John Day dams.

Adult fishways at McNary Dam and John Day Dam are very similar in design. They are composed of (downstream to upstream) entrances, a diffuser system, a ladder section, a regulating section and exit sections. Both dams have two ladders, one on the north shore and one on the south shore. North and south shore ladders have separate water supply and fishway exits (one exit per ladder).

4.4.1 McNary Adult Facilities. McNary Dam is located on the Columbia River at RM 292, near Umatilla, Oregon. A complete description of McNary fish ladders is available in *Basis of Design: Definite Project Report on McNary Dam* (USACE, 1946). It has been determined that impacts to the fishway would be limited to the entrances. All other aspects of the fishway should function within criteria at the John Day pool elevation 257 feet. The adult fishway consists of two fish ladders, one on the Washington shore and one on the Oregon shore. The Oregon shore ladder has four entrances on the north end of the powerhouse and two on the south shore. The north shore ladder has one set of four entrances on the north shore immediately south of the navigation lock. The current criteria for entrance weir depth is 9 feet.

It should be noted that backwater elevation studies (USACE) have shown that under low flow conditions at McNary Dam (100,000 cfs) and John Day forebay at elevation of 257 feet, it can be expected that tailrace elevation at McNary Dam will be 258.5 feet. Therefore 258.5 feet is used as the minimum tailrace elevation to address impacts to McNary adult fishways.



a/ Migration period range and peak annual counts shown as darker central region, shaded area indicates small secondary peak.

FIGURE 4-1 *Adult salmonid main upstream migration periods*

McNary South Shore Fishway. Oregon shore entrances (SSE-1, SSE-2) are 15 feet wide with sills at elevation 243 feet with maximum possible telescoping weir elevations of 260, 268 and 276 feet depending on weir gates installed. The weir gates are segmental, removable gates of varying sizes used to maintain proper entrance depth. The ladder floor is at elevation 242 feet. These entrances will operate within criteria (9-foot weir depth) down to tailwater elevation 257 feet.

North powerhouse entrances (NPE-1, NPE-2, NPE-3, NPE-4) are 15 feet wide and use telescoping, overflow type weirs. Presently only NPE-2 and NPE-3 are operated. NPE-1 has a sill elevation of 249 feet, but since the telescoping weir (minimum height 8.7 feet) sits on this sill, the entrance becomes no longer operational at tailwater elevation 257.7 feet. However, this entrance is not currently used. Sill elevations of the three remaining entrances are at 252 feet and the telescoping weirs sit on a concrete ledge at elevation at 243 feet. These entrances are operational at all ranges of current operations, but do not meet the 9 foot depth criteria at tailwater elevations below 261 feet.

There are 12 entrances into the collection channel along the face of the powerhouse. These are floating, orifice type entrances with entrances 2 feet by 6 feet. They use buoyancy tanks to remain approximately 4 feet below tailwater. Each entrance allows for submerged operation from 257.5 to 278 feet. This will allow for operation at John Day MOP. Depth criteria for the south shore and north powerhouse entrances do not apply to floating orifices.

McNary North Shore Fishway. Four fishway entrances are located in the north shore fish ladder (NSE-1, NSE-2, NSE-3, NSE-4). NSE-1 is nonoperational and has a permanent concrete sill at elevation 249 feet. NSE-2 and NSE-3 are located immediately upstream of NSE-1 and have concrete sills at 252 feet. NSE-4 is a "side" entrance with a sill at 257.4 feet (no depth criteria) . This ladder floor (at the entrance) is 242 feet. At MOP, NSE-1 and 2 will be operational but will not meet depth criteria below tailwater elevation 261 feet. NSE-4 will have less than 1 foot of head at MOP, and therefore will be basically nonfunctional. Impacts to fish passage due to non-operation of this entrance are not known at this time.

Costs. Mc Nary adult fishway entrances will need to be modified to meet established depth criteria during MOP operation. South shore entrances will not need modification, but both the north powerhouse and north shore entrances will need to be changed. Modifications will include lowering concrete sills at these four entrances approximately 3.5 feet. Estimated costs for the removal of these concrete sills is $46,000.

4.4.2 John Day North and South Shore Adult Facilities. John Day Dam has two adult fishways, one on the north shore and one on the south shore. Similar to fishways at McNary Dam, there is a collection channel along the powerhouse with two entrances at the north end. For a complete description of the fishways, see John Day Lock and Dam GDM No. 3 .

Under criteria established prior to construction, adult facilities at John Day Dam were designed to be operated over a full range of Columbia River flows and elevations (257 feet to 268 feet). It appears that entrances and exits will meet criteria for fish passage with John Day pool at elevation 257 feet. However, there appears to be a few minor problems with current conditions at the ladder which may become more severe at pool elevation of 257 feet. Also, criteria for ladder operation has changed since original construction which may effect operation.

Currently, velocities at the ladder exits are fairly low at 2 to 3 feet per second (ft/s). It is expected that these velocities will be slightly reduced at pool elevation of 257 feet. It is not known at this time what effect low exit velocities will have on fish. Because river velocity immediately adjacent to the exits is very low, a delay in passage is not anticipated in the exit section of the ladders. Also, water depth at exits will be reduced at elevation 257 feet. The floors of the exits of the north and south fishway are elevation 250.5 feet. This will result in water depths of 6.5 feet in both fishway exits. Response of adult salmonids to this reduced water level is unknown, but it is not expected to be a major impact. Fishways should be monitored to coincide with the drawdown to ensure that fish passage is not impacted by the above mentioned factors.

Both John Day ladders were originally designed for a total discharge of 82 cfs. This allowed for approximately 1 foot of depth over weirs in the ladder section. Due to a change in weir depth criteria, it is currently necessary to discharge approximately 115 cfs to meet criteria, which is 1.3 to 1.5 foot of weir depth. That is, there must be 1.3 to 1.5 feet of water passing over the weirs in the ladder section. Currently the ladders are supplied with water from diffusers and regulating sections. At pool elevation of 257 feet it has been estimated by use of a model study Technical Report No. 103-2 (1984), that north shore diffusers will produce about 66 cfs and south shore diffusers about 80 cfs. Using the same model study, production of the regulating systems (both ladders) at elevation 257 feet will be about 20 cfs. Based on this information, total discharge will be 86 and 100 cfs at the north and south shore ladders respectively. This will still allow both ladders to operate, but neither ladder will meet the 1.3-foot depth criteria. Both ladders will be able to be maintained with a head at or slightly above 1 foot. Tables 4-2 and 4-3 show that required forebay elevation to maintain 1.3 feet of head is 258.5 feet for the north ladder and 260 feet for the south ladder (USACE, 1984). Response of anadromous fish to this reduced weir depth is uncertain. Salmonids should not be directly affected by reduced weir depth, but it is possible that adult American shad passage may be reduced. This may cause shad to "hold up" or slow down their passage through the ladder. There is a potential that this would impede or slow salmonid passage.

Along with a decrease in water flow through the regulating section, it is also expected that velocity will decrease. Currently, there is not a minimum velocity criteria for regulating sections at John Day Dam.

TABLE 4-3 *North shore ladder flows at varied elevations (diffuser gates completely open)*

pool elevation (ft)	head flow (cfs)	diffuser flow (cfs)	regulating flows (cfs)	total flow (cfs)
257.0	8.0	80	20	100
258.0	9.0	85	26	111
258.5	9.5	87	29	116

NOTE: 115 cfs of total discharge is required to maintain 1.3 feet head in ladder section of the fishway.

TABLE 4-4 *South shore ladder flows at varied elevations (diffusers completely open)*

pool elevation(ft)	head flow (cfs)	diffuser flow (cfs)	regulating flows (cfs)	total flow (cfs)
257.0	8.0	66	20	86
258.0	9.0	70	26	96
259.0	10.0	74	32	106
260.0	11.0	77	38	115

NOTE: 115 cfs of total discharge is required to maintain 1.3 ft head in the ladder section of the fishway.

Current operation velocities range from 4.0 to 6.2 ft/s. Using a model study (USACE, 1984) it has been estimated that velocities in the regulating section will range from 2.1 to 5.6 ft/s. This reduction in velocity is not expected to delay fish passage in the regulating section, but should be monitored during the drawdown period.

It appears that all other flow and velocity criteria will be met at elevation 257 feet, but since tests have not been performed at this lower elevation, ladder conditions should be monitored during drawdown.

Possible Mitigation at John Day. In order to maintain 1.3 to 1.5 feet weir depth in the ladder section, it will be necessary to increase water supply to the diffusers. Water is supplied to the south ladder diffusers from the forebay by two 24-inch pipes. In order to supply additional water needed for operation of the ladder with 1.3-foot head it will be necessary to either increase pipe size to 30 inches or install an additional 24-inch pipe. Water supply pipes for the south shore ladder are hanging pipes located directly beneath the ladder. Water supply for the north fishway is provided through one 36-inch pipe which is mined through the navigation lock monolith. Additional water could be provided by increasing the size of the existing pipe or by adding one 18-inch pipe. It is not known whether adding a pipe through the monolith is possible, but estimated construction costs are still provided. Estimated costs for the addition of these water supply pipes for the south and north ladders are $154,000 and $495,000 respectively. Cost breakdowns are shown in tables 4-4 and 4-5.

Since the adult system has not been tested at elevation 257 feet it will be important to monitor the system during drawdown to ensure proper operation. If unforeseen problems develop, corrective actions should be taken immediately to ensure passage of both salmonids and shad.

TABLE 4-5 *Estimated cost breakdown for increased water supply to John Day fishways (South Shore)*

Item	Units	Unit Cost ($)	No. Units	Total Cost ($)
New pipe connection	ea.	2,000.0	1	2,000
Concrete coring (intake)	job	12,000.0	1	12,000
Crane for intake work	days	1,250.0	7	8,750
Concrete coring (supports)	job	3,500.0	9	31,500
Pipe sleeves, saddles & supports	job	5,900.0	1	5,900
Concrete coring (diffuser)	job	3,500.0	3	10,500
Manlift for concrete coring	days	200.0	21	4,200
Pipe anchor	lbs.	2.5	300	750
Transition to new outlet	lbs.	2.5	1800	4,500
Expansion joint	lbs.	2.5	600	1,500
24" steel pipe (304')	job	71,896.0	1	71,896
TOTAL				$153,496

TABLE 4-6 *Estimated cost breakdown for increased water supply to John Day fishways (North Shore)*

Item	Unit	Unit Cost ($)	No. Units	Total Cost ($)
Concrete coring (intake)	cy	2,000.0	5	10,000
Concrete coring through nav lock (170')	ft	2,000.0	170	340,000
Crane for intake work	days	1,250.0	14	17,500
Concrete disposal	job	2,000.0	1	2,000
Pipe supports and saddles	job	22,500.0	1	22,500
Concrete coring (diffuser)	job	15,000.0	1	15,000
Manlift for concrete coring	days	200.0	21	4,200
Pipe anchor	lbs	2.5	200	500
Expansion joint	lbs	2.5	600	1,500
18" steel pipe (370')	job	55,500.0	1	55,500
Pipe installation	job	7,500.0	1	7,500
Relocating existing pipe (36")	job	1,350.0	15	20,250
Miscellaneous steel	job	2,500.0	1	2,500
TOTAL				$498,950

4.5 Juvenile Bypass Facilities

The juvenile bypass system at the dam was reviewed for operations at lower pool elevations down to MOP. The system was designed to operate at elevation 257. It appears that all criteria for operation of the facilities can be met with operation at the lower level. See discussion in section 12 regarding effects on fish guidance and orifice passage.

5. IMPACTS TO FISH HABITAT

5.1 Resident Fish

Construction of a series of hydroelectric dams on the Columbia River has altered it from a free flowing river to a series of lake-like impoundments. This habitat change has created a shift in resident fish populations to one more typical of a lake environment more conducive to certain resident fish species. Dominant resident species in John Day pool (table 5-1) include largemouth and smallmouth bass, walleye, northern squawfish and suckers. The majority of these are introduced species and are out-competing native resident fish species. Native species include northern squawfish, redside shiner, largescale and bridgelipped sucker, and sandroller.

5.2 Backwaters

Resident fish occupy a variety of habitats in lower Columbia River reservoirs. Use is often dependent on the life history stage of a particular species. Depending on species, fish may spawn, rear, feed, or live the entire life cycle in shallow backwaters. In general, warmwater fish such as bluegill, yellow perch and bullheads tend to spend the majority of their time in backwater areas, and coolwater species such as smallmouth bass and northern squawfish may use backwater areas only periodically depending on life stage. Fish that use backwater areas are generally introduced species while native resident fish species occupy open water areas that more closely resemble pre-dam conditions such as tailrace areas of dams.

5.2.1 Importance of Backwater Areas. Backwater areas are used for spawning by black and white crappie, bluegill, yellow perch, pumpkinseed, carp, channel catfish and possibly bass. Prickly sculpin apparently spawn throughout the reservoir since prolarvae are found in all habitat types (Hjort et al., 1981). Most larvae occur in backwater areas with only yellow perch and prickly sculpin found predominantly in open water areas.

Spawning success for a given species depends upon water levels, water temperature and other environmental factors (Everhart and Young, 1981). Low river discharge, which can result in low water levels or increased temperature, can reduce habitat available for spawning or expose incubating eggs. Temperature can effect survival of eggs and juveniles. An increase in water temperature during low flow periods may cause mortality or reduced growth, especially during critical life stages such as egg incubation.

The greatest abundance of juvenile resident fish of all species is in backwater areas (Hjort et al., 1981). It appears that many species use backwater areas as a rearing/feeding area even if they spawn in other areas. Species which use these areas for rearing are mainly species which spawn in backwaters. However, walleye and smallmouth bass tend to spawn in more open areas but juveniles rear in backwaters. Juveniles of some species are reared in several habitats. Survival of juveniles is also affected by environmental factors similar to those for spawning such as low flows (velocities) and increased temperature. Degraded environmental conditions can reduce food supply, lower dissolved oxygen content of the water, or force the fish into a less favorable environment.

TABLE 5-1 *Resident fish of John Day Pool*

Common name	Scientific name
<u>Game fish</u>	
Largemouth bass	*Micropterus salmoides*
Smallmouth bass	*Micropterus dolomieui*
White crappie	*Pomoxus nigromaculatus*
Black crappie	*Pomoxus annularis*
Walleye	*Stizostedion vitreum*
Yellow Perch	*Perca flavescens*
White sturgeon	*Acipenser transmontanus*
Bluegill	*Lepomis macrochirus*
Pumpkinseed	*Lepomis gibbosus*
Channel catfish	*Ictaluris punctatus*
Mountain whitefish	*Prosopium williamsoni*
Rainbow trout	*Oncorhynchus mykiss*
Brown bullhead	*Ictaluris nebulosa*
Black bullhead	*Ictaluris melas*
<u>Non-gamefish</u>	
Northern squawfish	*Ptychocheilus oregonis*
Carp	*Cyprinus carpio*
Peamouth	*Mylochelius caurinus*
Dace	*Rhinichthys spp.*
Stickleback	*Gastersoteus spp.*
Sculpin	*Cottus spp.*
Sandroller	*Percopsis transmontanus*
Tadpole madtom	*Noturus gyrinus*
Sucker	*Catastomus spp.*
Redside shiner	*Richardsonius balteatus*
Chiselmouth	*Acrocheilus alutaceus*
Tench	*Tinca tinca*

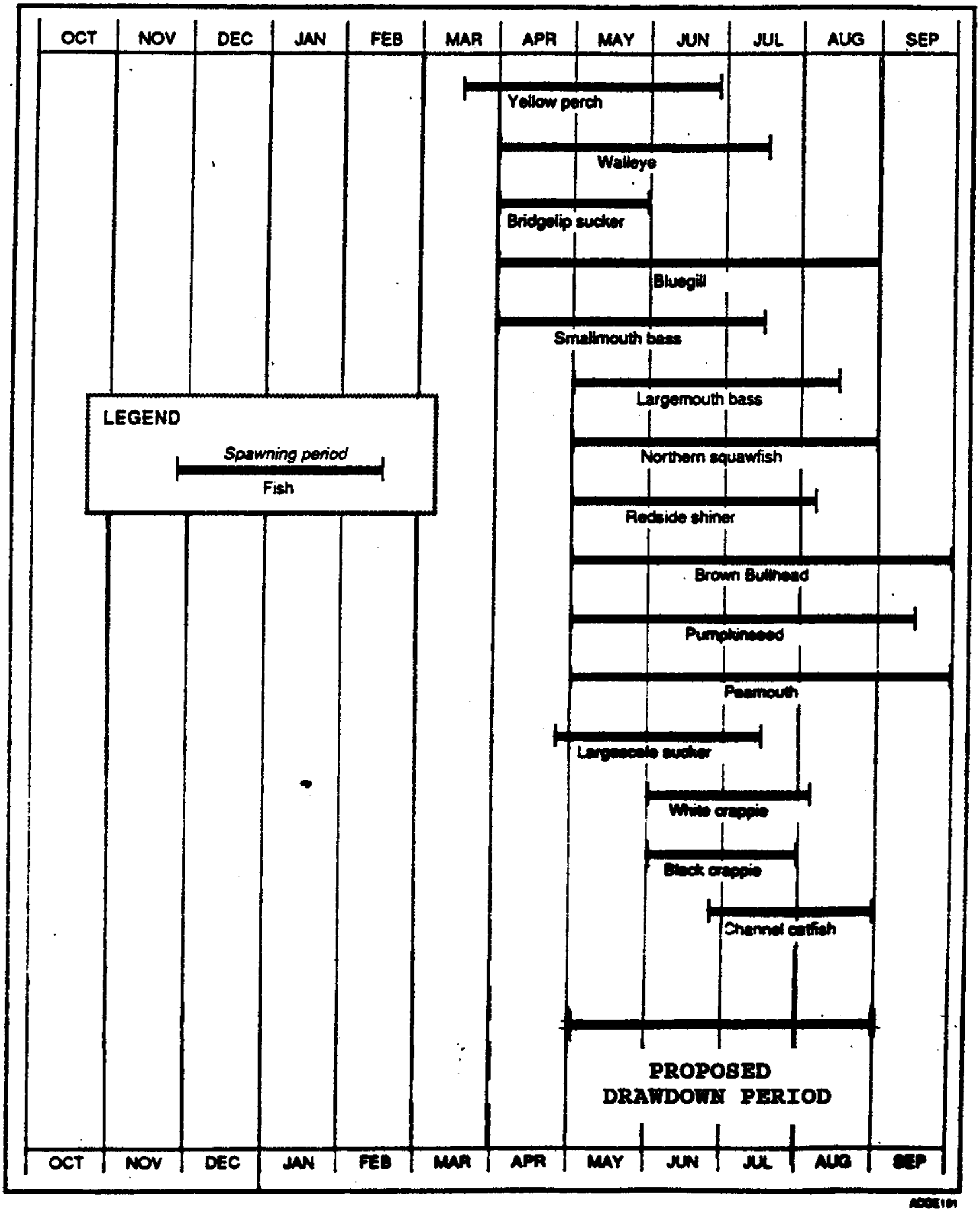


FIGURE 5-1 *Resident fish spawning and incubation chronology in the lower Columbia River*

Resident Fish Spawning and Incubation Chronology in the Lower Columbia River.

Source: 1992 Columbia River Salmon Flow Measures, Options Analysis/EIS (USACE)

5.2.2 Adult Use of the Backwaters. Adult distribution is generally similar to spawning distribution, but can vary due to feeding patterns or strategy. It also may be that some species, (such as smallmouth bass) migrate into shallow waters to spawn, but return to more open waters of the reservoir shortly after spawning. Some smallmouth bass may enter backwater areas in April for spawning, with juveniles remaining to rear during the summer months. Radio-tagging studies (Montgomery et al., 1980) on the Hanford reach (McNary pool) of the Columbia River showed that some adult smallmouth bass entered backwaters in April to spawn and may remain there until the end of June. In general, spawning periods of warm water fish in the lower Columbia River (figure 5-1) begin in April and continue through June depending on species and water temperature (Al Smith, Oregon Department of Fish and Wildlife (ODFW), personal communication, 1992). The drawdown period would be during a time that many resident fish spawn and incubate (see figure 5-1). Some species (generally warmwater species) will spend their entire life cycle in shallow backwaters. In general, similar to juveniles, adult introduced species tend to distribute themselves in shallow backwater areas, while native species prefer the more open and faster flowing waters of the reservoir.

Use of backwaters by many species may be at least partially related to availability of prey organisms. Zooplankton and benthic invertebrates are generally found in higher concentrations and greater species diversity in backwaters than the main river. Backwater studies by Zimmerman and Rasmussen (1981) found that 12 species of zooplankton and benthics were found within Paterson Slough and only three were present in the main river adjacent to the slough (table 5-2). High concentrations of plankton and invertebrates may attract fish species that feed on these small organisms. In turn, high concentrations of small prey fish will attract larger predator species. Therefore, higher concentrations of zooplankton and benthic organisms may affect the habitat selection of predatorial resident fish species (Eggers, 1977). Predatorial fish include species which feed on plankton and benthos as well as other fish.

5.2.3 Culverted Backwaters. This group of backwaters includes areas which are linked to the main river by culverts or small channels. These areas are usually created by road, bridge, or railroad grade construction that creates a diked situation in which culverts or channels are placed to allow flow in and out of the site. The size of these sites on the John Day pool range from a few acres to approximately 60 acres (USFWS, 1980). It is suspected that the main water exchange in these backwaters comes from culverts and channels, and only limited exchange is from ground water or springs.

Fish that reside in these areas are mainly species that remain in culverted of restricted flow backwaters their entire life cycle. Species include yellow perch, crappie, bluegill, pumpkinseed, bullhead, as well as many other warmwater species. Species which migrate into and out of backwaters for spawning, rearing, or feeding are found in relatively low numbers due to the restricted entrance areas.

Twelve culverted (restricted flow) backwaters have been studied on the Washington and Oregon shores. Backwaters are located on the Washington shore at RMs 216.0, 217.0, 236.5 (Sundale), 243.0, and 249.5. Restricted flow backwaters are located on the Oregon shore at RMs 228.5, 237.0 (Lang Canyon), 239.5 (Jones Canyon), 258.0 (6 Mile Canyon), 267.5, and 271.0. Acreage and depths of these area vary

TABLE 5-2 *Comparison of plankton and benthic composition inside and outside of Paterson Slough (Zimmerman and Rasmussen, 1981)*

Species	Paterson Slough	Columbia River at Paterson Slough
Nematoda		
Unidentified nematode	X	NP
Annelida		
Oligochaete		
Unidentified oligochaete	X	X
Branchiura sowerbyi	X	NP
Polychaete		
Neanthes limicola	X	X
Crustacea		
Cladocera		
Bosmina longirostra	X	NP
Daphnia sp.	X	NP
Copepoda		
Cyclops sp.	X	NP
Insecta		
Odonata		
Unidentified odonata	X	NP
Diptera		
Chironomidae	X	X
Miscellaneous		
Mollusc		
Corbicula manilensis	X	NP
Gastropoda		
Lymnea sp.	X	NP
Amnicolidae	X	NP

X = Found at the site during sampling NP = Not present at the site substantially ranging from approximately 3 to 60 acres in surface area and depths from a few feet to almost 100 feet depending on pool elevations. Accurate bathymetric information is not available for the majority of these areas. However, limited information for several of these backwaters (USFWS, 1980, 1981) show that some would be greatly affected by reduced water levels. Lowering the John Day pool to elevation 257 feet will result in the loss of a majority of water from several of these restricted flow backwaters. Larger and deeper areas, though not as greatly affected in total acreage or depth lost, would still lose valuable shoreline habitats that are the most productive and highly used areas by resident fish. Lowering of the pool will eliminate availability of this productive habitat and will have a large effect on productivity of the area even though relative water loss may be insignificant.

Lowering pool elevation to 257 feet will also reduce or eliminate flow (water exchange) into these backwaters from the Columbia River. At 257 feet it is expected that many inflow areas will be non-functional due to the placement of culverts above elevation 257 feet and above the lowest point in the backwater. Reduction or loss of inflow may eliminate entire populations in some backwaters. Even in larger areas, if inflow is reduced significantly, water quality may decrease substantially resulting in fish losses or significantly reduced production. Reduced water exchange may result in decreased dissolved oxygen content, increased temperature, loss or reduction of plankton and benthos production, reduced vegetative production.

5.2.4 Backwaters with Open Connection to Main River and Shoreline Habitat. In John Day pool there are several backwater areas with an open connection to the main river. Plymouth Slough, Paterson Slough, McCormack Slough, Rock Creek and Willow Creek are several of the larger areas. There is also a large amount of important shallow water habitat in the mainstem (particularly between RMs 265 to 282) such as coves, islands and riprap which support resident fish. Higher exchange of water in open connection backwaters relative to culverted backwaters, suggest that these areas also have better water quality and are therefore potentially better habitat for resident fish. Sampling by the Washington Department of Wildlife (WDW) (Doug Fletcher, WDW, personal communication, 1992) and the USFWS has shown that Paterson and Plymouth sloughs are important rearing areas for juveniles of all species. Surveys of Paterson Slough (Zimmerman and Rasmussen, 1981) have shown that a wide variety of species use this backwater areas for all stages of life. It is expected that this is true of other open flow backwaters and shallow shoreline areas.

Reduction of pool to MOP (elevation 257 feet) will eliminate much of these backwaters. Over much of this shoreline habitat resident fish may be flushed out into the main river where flows are higher and available food may be decreased. These exposed areas will also lose much of the benthic and zooplankton populations which are essential to the food chain in this area. Studies in Paterson Slough have shown that the zooplankton and benthic production inside the slough is significantly greater than the river adjacent to the slough (Zimmerman and Rasmussen, 1981). It is likely that even after the pool is raised again, productivity of these backwaters will be greatly reduced due to the initial displacement of original populations. Recovery of these populations will be largely dependant on recruitment from nearby areas. Since nearby areas will most likely be lacking species composition and population numbers that are currently in existing backwaters, it is unlikely that populations of benthics and zooplankton will be re-established to current levels after drawdown.

Another possible problem associated with a drawdown to MOP is the ability of fish to exit backwaters during drawdown. For example, Paterson Slough has an old railroad grade at the mouth. The majority of this railroad grade will be exposed during drawdown (exposure at approximately elevations 260 to 261 feet) and restrict fish passage out of the site. This grade is approximately 12 feet above the lowest point in the backwater. This will result in trapping fish within the lowering backwater, which is expected to be almost completely drained at MOP. This same situation is expected to occur in several backwaters and coves throughout the pool with entrance sills above elevation 257 feet.

5.2.5 Year-round Drawdown. It may be possible to reduce impacts to resident fish by drawing down the reservoir to elevation 257 feet year-round. This measure would have large initial impacts similar to annual drawdown, but leaving the pool at 257 feet throughout the year would allow habitat to develop at this lower elevation. It is estimated that it would take 3 to 5 years for aquatic vegetation and food base to develop in new shallow water areas. This would allow for some resident fish to re-establish over several years.

It is unknown at this time to what extent habitat would develop or if acreage of shallow water habitat would be comparable to present conditions. From limited available data on pool topography it appears that the amount of shallow water areas (potential habitat development) at a pool elevation of 257 feet will be about 25% of current conditions. Additional bathymetric information is necessary before this option is considered to determine the type, quality, and size of habitats that may be established.

Further studies are required to more clearly assess the impacts of an annual drawdown of John Day pool. A habitat analysis of backwaters including vegetation mapping, substrate mapping, population estimates, spawning use and bathymetric mapping would be required.

5.2.6 Summary of Impacts of the Drawdown. The annual drawdown of the John Day pool to MOP from May 1 through August 31 will have a negative effect on resident fish populations. It is unknown at this time the full extent of the effects, but the loss of shallow water habitat, resident fish, and primary and secondary productivity will likely be substantial.

The drawdown of the John Day pool to MOP will reduce the amount of shallow water habitat by approximately 8,400 acres (see Section 6). Some "new" shallow waters may be created, but based on available information the amount of habitat will be reduced. It is possible that the first year of drawdown may allow dormant seeds (which are at lower elevations) to germinate and give some productivity to the "new" habitat. This effect is not expected to last more than one or two years of drawdown. It is expected that pool fluctuations of about 8 feet annually will not allow substantial vegetation to be established in the drawdown zone. Many resident fish use shallow water habitat for spawning, rearing, resting and feeding. Spawning success of these fish species will be decreased and populations will decline. No estimates of population change can be made at this time since there are no current population estimates.

The drawdown has the potential to dry out eggs and larvae of early spawning fish such as yellow perch. Perch in John Day pool begin spawning in early April and may spawn in the drawdown zone. Drawdown may eliminate populations of these early spawning fish, or at minimum drastically reduce populations. Later spawning fish such as large and smallmouth bass and white and black crappies may spawn after initial drawdown and therefore may avoid drying out eggs and larvae. Spawning areas at lower elevations have not been analyzed for substrate composition, cover and flow for spawning. If these factors are not similar to existing spawning areas then spawning success may decrease (or increase if new spawning areas are more favorable). Although at this time it is impossible to determine availability and quality of new spawning sites, it is suspected that the amount of cover will be decreased which will lead to lower spawning success.

Stranding of fish in backwater areas is going to occur. This problem is greatest in culverted backwaters since many of the culverts are relatively high. Based on limited available bathymetric data, it appears that many of these culverts and channels are not the lowest point in the backwater which will restrict fish exits as water level lowers. This stranding situation will also occur in backwaters and sloughs in which entrance sills are above the lowest area in the backwater. This may result in fish being stranded in drying pools with degrading water quality, which will mean a loss of resident fish and production.

Vegetative, plankton and benthic populations of areas within the drawdown zone will likely be lost or at least greatly reduced. After drawdown is completed and water level is again raised in these backwaters there may be a slight recovery of production but a complete recovery is not anticipated due to the large loss expected from the initial drawdown, drawdown occurring during the summer growing season, and the annual pool fluctuation of 8 feet. New shallow water areas that will be exposed are not expected to develop high productivity due to the short duration of drawdown and low productivity and species composition relative to existing shallow water areas.

6. IMPACTS TO WILDLIFE HABITAT

6.1 Introduction

The sustained operation of Lake Umatilla at elevation 257 feet from a normal operation level of about elevation 265 poses concerns for wildlife populations and wildlife habitat. Lowering the pool level by 8 feet, based on historic operating levels, will result in lowered ground water levels in areas adjacent to the river, withdrawal of water from established marsh and riparian habitats, and exposure of presently shallow water habitat. An estimated 8,400 acres of backwater sloughs, marshes, and shallow water areas would be exposed. The estimate of 8,400 acres is based on the acreage between the full pool contour (elevation 268 feet) and the elevation 257-feet contour. Given the date of the topographic information (1955) and erosion-sedimentation occurrences during the interim period, this estimate is considered rough. An estimated 2,100 acres of wetland/riparian habitat, based on interpretation of 1989 aerial photography, would be impacted by drawdown throughout the John Day pool. These impacts will be most noticeable in the upper portion of the pool (RM 254 upstream).

6.2 Post-impoundment Developments

Terrain in the upper portion of the pool adjacent to the river is relatively flat with numerous shallow depressions which hold water during normal pool operation (i.e., elevation 265 to 268 feet). Post-impoundment (1968), these low areas along the pool developed into riparian, emergent marsh, and shallow water habitats where surface elevations were near (riparian) or below full pool elevation. The 2,100 acres is comprised of emergent marsh/riparian units which are highly intermixed and range in size from 0.2 to 172 acres each.

6.3 Soil Permeability

High soil permeability rates further intensify drawdown impacts on backwater, emergent marsh, and riparian habitats. Soil permeability tests conducted for Portland District on Umatilla National Wildlife Refuge indicated soil permeability rates ranging from 4 to 29 inches of water per hour. The average permeability rate was 15.9 inches per hour. Due to these high soil permeability rates, emergent marsh, open water and riparian habitats would experience a very rapid loss of standing and near-surface water upon drawdown. The subsurface water table would fall to a level commensurate with the pool elevation. Some delay between pool drawdown and decrease in water elevation for diked/ponded open water and marsh habitats adjacent to the John Day pool would occur. This time frame may be from several days to several weeks but would be significantly shorter than the projected drawdown period of May 1 through August 31.

6.4 Water Loss

Loss of water from emergent plant communities (i.e., cattail and bulrush) was noted at several locations on the John Day pool during the spring 1992 lower pool operations. Plants seemed to be surviving as subirrigation maintained moist soils in these stands. However, some apparent loss of turgor pressure and sunburn of stem tips of marsh plants was observed in wetlands situated near the full pool elevation limit. A reduction in normal wildlife use and species composition for perched wetland plant communities was also apparent. The spring 1992 pool lowering was short-term (about 18 days at elevation 263 feet) and was not substantially below the lower elevation for normal pool operation (elevation 265 feet). Thus it provided only limited insight as to future impacts from a long-term drawdown during the spring and summer months.

6.5 Weather Effects

Drawdown from May 1 through August 31 each year corresponds to the hottest, driest period of the year. Thus, loss of water to riparian and marsh habitats would occur at the most disadvantageous time for plant survival, growth and recruitment. Riparian and marsh vegetation communities are expected to lose acreage due to mortality from desiccation and lowered or lack of seedling recruitment. Additionally, decreases in biomass and seed production, and reduced plant density, height, and cover attributes are expected. Marsh habitats are expected to have no standing water with substantial mudflats separating them from open water. Currently, emergent marsh communities extend outward from the shoreline to approximately a water depth of 0.5 to 1.0 feet (J. Annear, USFWS, personal communication, 1992). Establishment of emergent marsh plants occurred on mudflats exposed when John Day pool was operated to elevation 263 feet in 1992. These plants are expected to survive under present operating conditions. Although this demonstrates emergent marsh advancement onto mudflats, an expected event in a wetland ecosystem, this vegetative advancement is not expected to be successful during the drawdown. The magnitude of the drawdown (8 feet; 4 month duration) coupled with high soil permeability will preclude moist soil conditions and near surface water levels that occurred during the 1992 partial drawdown to elevation 263 feet. The 1992 drawdown was of much shorter duration and lesser magnitude than projected for the drawdown.

6.6 Aquatic Plants

Open water habitats will either be eliminated or greatly reduced in shallow, backwater areas, thus significantly reducing or eliminating submergent aquatic plant communities. The depth of drawdown (8 feet) exceeds the depth (6 to 8 feet) of much of these shallow backwaters. Aquatic plants, such as *Potamogeton spp.*, occur in the 2 to 3 foot depth range in open water habitat. Thus these aquatic plants, which are an important forage resource for many wildlife species, would be lost.

6.7 Riparian Plants

Riparian plants will fare poorly from the drawdown, also. Poplar seedlings are intolerant of drought (Rood and Mahoney 1990); saplings over two years old are more drought tolerant as they have larger root systems (Pezeshki and Hinckley 1988, in Rood and Mahoney 1990). Mahoney and Rood (1991) concluded that activities that increase the rate of riparian water table decline during the seedling establishment period and would increase poplar seedling mortality. They noted several factors which could modify the effect of water table decline on plants, such as fine-textured substrate and timely precipitation. Neither of these factors would be expected to occur along the John Day pool.

Drought stress also influences mortality rates for mature poplars. Albertson and Weaver, (1945; in Rood and Mahoney 1990), noted extensive mortality in western poplars during the 1930s drought. Abrupt reduction in stream flows preclude drought hardening in poplars that would occur in streams subject to natural variations in streamflow (Rood and Mahoney 1990). Albertson and Weaver (1945; in Rood and Mahoney 1990) observed mortality in riparian trees within a few months where rapid declines in the water table occurred. McNatt et al. (1980) reported 60 to 84 percent mortality in cottonwood trees in an area influenced by ground water withdrawal by the city of Phoenix. Reduction of ground water levels up to 10 feet or more were attributed to this pumping operation and were considered a likely factor in the observed high mortality rate.

These drought related impacts to poplar trees and seedlings would be magnified over time by annual drawdowns. Normal (not necessarily natural) conditions for marsh and riparian plant communities would prevail during the initial period of the growing season; drawdown would impose an instantaneous and severe drought condition on these communities. Drought hardening of riparian species could not occur in such a short time frame. Return of normal water conditions post-drawdown would occur too late for recovery and/or survival of many wetland/riparian species. Large trees with well established root systems would be expected to survive significantly better than younger trees or seedlings with poorly established root systems. Albertson and Weaver (1945; in Rood and Mahoney 1990) noted increasing susceptibility to drought in poplars greater than 30 years old. Poplars on Umatilla National Wildlife Refuge are approximately 24 years old. However, various mortality factors (disease, wind throw, insects) coupled with severe annual drought stress would reduce the number of these mature trees over time with recruitment of new trees precluded by annual drawdowns. The ability of plant communities to "follow" the change in water elevation is precluded by the return to normal pool operation levels post-drawdown. Thus, the eventual (1 to 20 years) creation of a "bathtub ring" around the project would be expected. The fluctuation zone would be vegetated annually by annual forbs (i.e. smartweed) and grasses with extent of cover determined by seed source and/or availability, soil moisture levels and elevation.

6.8 Wildlife

Seasonal or permanent operation of John Day Pool at elevation 257' will result in an initial loss of 8,400 acres of habitat between elevations 257 and 268 feet. Approximately 2,095 acres of emergent marsh and riparian habitat is included in this 8,400 acre loss estimate. These habitat losses will significantly impact resident and migratory wildlife resources that utilize these habitats.

A seasonal drawdown will result in the permanent loss of emergent marsh and eventually riparian habitat. Waterfowl and waterbird production will be virtually eliminated by dewatering of nesting, foraging and cover habitat. Production of Canada geese may be less damaged as hatching would have been nearly completed prior to drawdown. Survival of goslings will be lessened as foraging areas will be more distant from water.

Forage and cover values of habitat for breeding and wintering waterfowl along backwaters and ponds would be severely compromised. Dessication of marsh and shallow open water habitat will result in the loss of aquatic plant and benthic and other invertebrate populations which provide food resources for waterfowl and many species of waterbirds and shorebirds.

The USFWS has indicated that seasonal fluctuations in John Day Pool will result in a moderate decrease (35-45%) in the Umatilla NWR's capacity to support wintering waterfowl. The average number of waterfowl use days supported by Umatilla NWR for the period 1984-1988 was 34,416,934 (ducks) and 2,672,838 (geese). A moderate decrease would result in 18,900,000 - 22,400,00 (duck) and 1,470,000 - 1,737,000 (geese) waterfowl use days with seasonal drawdown.

Small mammals and furbearers associated with the emergent marsh and riparian communities will suffer significant population losses. These losses will arise from exposure and loss of denning habitat and loss of forage and cover habitat. Painted turtles, which are abundant in the Irrigon Wildlife Management Area, will incur substantial population losses. The ponds within the management area will dry up during the drawdown period forcing adults, juveniles and neonates to the Columbia River where habitat conditions are marginal. Recruitment of juveniles into the painted turtle population would be minimal with a significant future reduction in the adult population anticipated. Colonial nesting birds that use offshore islands would be jeopardized by land-bridging that occurs after initiation of nests or nesting activities. Nesting colonies may be lost because the timing of the drawdown will compromise nesting activities annually.

Passerine birds, including neotropical migrants, will lose foraging,nesting and cover habitat. This will result in a net reduction in the local population.

6.9 Drawdown Benefits

Some species will benefit from the drawdown. During spring 1992, the pool was operated at approximately elevation 263 feet for 18 days during May. Exposure of flats in formerly shallow water areas was noted at several locations. These flats were attractive to black-necked stilts, American avocets, and killdeers which nested on the exposed areas and foraged in the shallow water areas or their margins adjacent to the exposed flats.

6.10 Site Specific Impacts

The most significant wildlife habitat areas which would be impacted by drawdown occur on the U.S. Fish and Wildlife Service's Umatilla National Wildlife Refuge (UNWR) and the Willow Creek and Irrigon wildlife areas managed by ODFW. These significant management areas are discussed below. There will be loss of habitat outside the management areas treated in detail but the management areas are the units where habitat degradation/loss is expected to be most noticeable and of most consequence to wildlife and wildlife habitat. Elsewhere on the pool, emergent marsh and riparian habitat generally occurs as small pockets or narrow fringes along the full pool boundary. Rocky, steep shorelines typify much of the project below RM 254.

6.10.1 Paterson Slough. Paterson Slough UNWR is a 1,043 acre backwater area with associated ponds and small lakes on the Washington shore between RM 278 and 280; 353 acres of this total consists of emergent marsh and riparian vegetation (figure 6-1). Submergent aquatic plants occur in open water areas of Paterson Slough. This slough is quite shallow and cartographic analysis indicates that drawdown to elevation 257 feet would dewater this unit to a point riverward of the old railroad grade on the western periphery. This railroad grade was used to form the riverward boundary of the Paterson Slough unit for this analysis. Some pockets of open water would remain within several arms of this slough. Soil permeability rates were 5 inches per hour at the southwest end and 21 inches per hour at the northeast end of Paterson Slough. These high rates indicate that the ponds and small lakes associated with Paterson Slough would be dewatered or else incur a decrease in surface elevation commensurate with the drawdown level. Thus, all emergent marshes and riparian habitat plus most submergent aquatic plant communities in Paterson Slough would be dewatered.

6.10.2 McCormack Slough. The McCormack Slough unit (RM 275) of the (Umatilla National Wildlife Refuge) is a 494 acre area comprised of 272 acres of emergent wetland and riparian forest and 222 acres of open water (figure 6-2). Like Paterson Slough, this slough will be dewatered upon drawdown. Soil permeability rates measured for this unit were 4, 21, 16, 15, and 29 inches per hour. There are two existing dikes in McCormack Slough; one abuts the Columbia River while the other is approximately mid-way up the slough. These structures appear to lessen the loss rate of water from the slough during periods when the pool is operated below elevations 265 through 268 feet. However, water level in McCormack Slough does fluctuate commensurate with the level of the John Day pool and thus the slough will be dewatered upon drawdown to elevation 257 feet. Runoff from upslope irrigation can influence McCormack Slough water levels although more efficient irrigation systems appear to have lessened the influence of runoff on slough levels. Water withdrawal from wells on the refuge for hatchery water supply also appears to influence water levels in McCormack Slough. Water supply from these hatchery wells is adversely impacted by drawdown necessitating the development of additional wells. Thus, additional adverse impacts on McCormack Slough water levels are expected to occur.

Operating the pool at approximately elevation 263 feet during spring 1992 resulted in lowered water levels in McCormack Slough with emergent marsh vegetation experiencing dewatering and exposure of mudflats occurring in formerly open water areas. This exposure occurred at a higher pool operation level and during a shorter time period than the probable drawdown period from May 1 to August 31. Thus, it is likely that the potential drawdown level and time period would result in the complete dewatering of the McCormack Slough unit and the consequent loss of wildlife resource value for many species nesting and foraging there. The recent removal of carp from McCormack Slough by the USFWS has resulted in a dramatic increase in submergent aquatic plant beds and a commensurate increase in waterfowl use and production. Annual drawdown would negate this management success and decrease waterfowl production.

Existing riparian and emergent marsh habitat plus submergent aquatic plant communities in open water habitat are expected to be lost upon drawdown to elevation 257 feet, further compromising wildlife habitat values of the unit. Due to the length of the drawdown and its magnitude, emergent marsh plants advancing into the drawdown zone are not expected to replace the emergent marsh community. The return to normal pool elevations post-drawdown would flood pioneering emergent marsh plants to too great a depth to recover; riparian trees sprouting in the drawdown zone would also be lost.

6.10.3 Willow Creek Wildlife Management Area. Willow Creek Wildlife Management Area is an embayment located at RM 252 to 253 on the Oregon shore. ODFW manages 646 acres of this embayment/upland complex; 404 acres of land and 242 acres within the full pool line (figure 6-3). Riparian and emergent wetlands are interspersed throughout the delta at the upper end of the Willow Creek embayment. This delta, comprised of sediments deposited by Willow Creek, continues to build and fill the embayment. Extensive flats are exposed at lower pool elevations. Acreage estimates of flats derived from 1979 photography indicated 39 acres of flats. There is now substantially more flats acreage based upon comparison of 1992 observations and aerial photography with mapped locations of flats in 1979. This accreted material, upon reaching an elevation of approximately 265 feet, supports emergent wetland communities. At or above the full pool level, riparian shrubs and trees become prevalent. The transition to arid uplands supporting sagebrush, bunchgrass, and annual grasses occurs with only a few feet change in elevation.

There are about 119 acres of emergent wetlands and riparian habitat in the Willow Creek embayment. The spring 1992 drawdown to elevation 263 feet dewatered the emergent marsh habitat and exposed mudflats beyond the causeway supporting the irrigation pumping station. Mudflats were exposed sufficiently long enough for a relatively dense stand of moist soil plants (i.e. smartweed, other forbs, and grasses) to establish. Subsurface water was at or very near the soil surface, which contributed significantly to the greenup observed during the spring 1992 partial drawdown. Substantial foraging by Canada geese and their broods, shorebirds (American avocet, black-necked stilt, long-billed curlew, killdeer), ducks, and gulls were noted on the exposed, vegetated flats.

A pool drawdown to elevation 257 feet would result in further exposure of flats and greater distance to subsurface water than under present conditions. Greenup of exposed flats that occurred could be more ephemeral than that observed in 1992. Greenup is expected to be restricted to exposed areas near the pool where subsurface water occurs at shallow depths. Further, John Day pool held at elevation 257 feet would result in a substantial withdrawal of water from the Willow Creek embayment leaving only a small embayment. This reduction in open water acreage is also a function of the significant sedimentation levels that have occurred since John Day Dam impoundment. Sedimentation is expected to continue to fill the embayment.

Substantial loss of riparian and emergent marsh habitat would be expected to occur under a drawdown to elevation 257 feet. Flows in Willow Creek and subsurface water depths are expected to be insufficient to maintain the present acreage of these plant communities and the wildlife species that use them.

6.10.4 Irrigon Wildlife Management Area. The Irrigon Wildlife Management Area is a 983 acre tract of wildlands adjacent to the Columbia River lying between Umatilla and Irrigon, Oregon (figure 6-4). The area is typified by numerous, relatively linear depressions roughly parallel to the Columbia River. Where surface elevation of these depressions falls below elevation 268 feet (full pool), ponding occurs. These ponds are typically ringed by emergent marsh vegetation transitioning into riparian tree and shrub vegetation. Aquatic plants are prevalent in open water areas of these wetlands. Open water habitat represents only 29.4 acres in the Irrigon Wildlife Management Area. Emergent marsh and riparian habitat comprise 228 acres of habitat within the management area. An estimated 133 acres of shallow water habitat would be exposed along the Columbia River shoreline.

Water elevation in wetlands at Irrigon is directly related to pool elevation. Irrigation runoff from upslope agricultural lands also contributes to water availability in these pocket wetlands. Drawdown impacts are dependent on depth of drawdown and depth of depressions. The high porosity of the soil within Irrigon Wildlife Management Area contributes significantly to loss of water from these wetlands during drawdown; soils present have a percolation rate of 6 to 20 inches of water per hour. Shallow depressions only retain water at higher pool elevations and are the first to dewater as the pool is lowered. These shallow depressions typically are vegetated throughout and have no significant open water habitat. The deeper depressions generally have an open body of water fringed by an inner layer of emergent marsh vegetation and an outer layer of riparian tree and shrub habitat. Open water areas typically support aquatic plant communities. This interspersion of habitats supports many species of breeding birds, furbearers, and a large population of painted turtles. It is expected that drawdown to elevation 257 feet will dewater all wetlands within Irrigon Wildlife Management Area with a concomitant decrease in wildlife use and occurrence.

6.10.5 Three Mile Island. Three Mile Island is situated at Quesnel Park, RM 256, on the Oregon shore (figure 6-5). The island supports a large colony of nesting ring-billed and California gulls (7,000 to 10,000 birds), some Forster's terns, occasionally Caspian terns, and approximately 35 black-crowned night heron nests. An average of 51 Canada goose nests occurred at this island from 1985 to 1991.

The island is located 500 to 1,000 feet off the Oregon shoreline. A shallow embayment separates the island from the Oregon mainland. Drawdown to elevation 257 feet would either landlock Three Mile Island or else result in a very narrow separation of the island from the mainland. Either scenario will result in mammalian predator access (i.e. coyote) to the island and result in desertion or significant depredation annually on colonially nesting birds and their nests. The time frame for the drawdown would exacerbate impact to the colony as nesting birds would be drawn to a perceived secure island and then subjected to a drawdown-related impact (predation) on an annual basis. Gulls, which constitute the bulk of nesting species, would have initiated egg-laying and incubation prior to initiation of the drawdown based upon observations of Thompson and Tabor (1981). They observed that more than half the gull nests hatched between May 15 and May 31. Great blue heron egg-laying and incubation occurred from late February to early March with fledgling beginning in late May (Thompson and Tabor 1981). Black-crowned herons initiated egg-laying and incubation in early April with fledgling beginning in June (Thompson and Tabor 1981). Thus, drawdown to elevation 257 feet would allow predator access to Three Mile Island during critical periods.

The expected cumulative impact of drawdown on colonial nesting birds would begin with a gradual reduction in the nesting population with a total loss of nesting at this location 5 to 10 years later due to poor recruitment and adult turnover. Terns, which initiate egg laying and incubation in early May, could simply abandon the colony location. The drawdown could also result in an immediate abandonment of the gull colony.

If the drawdown is initiated on May 1 each year, impacts on Canada goose nest success (i.e. land-bridging, predator access) should be relatively minimal as hatching is nearly complete by that date. However, should drawdown be initiated earlier in the season, impacts to nesting Canada geese would be much greater.

6.10.6 Glade Creek - Crow Butte - Whitcomb Island - McCredie Islands. These areas are relatively small acreages of wetland, open water or island habitat on the John Day pool. Glade Creek contains approximately 19 acres of emergent wetland habitat and 12 acres of open water habitat if shallow water areas riverward of the railroad causeway are included (figure 6-6). Glade Creek, in combination with backwaters of the John Day pool, provides water to this wetland. Some dewatering of the wetlands at this location would be expected with drawdown. The extent of dewatering is difficult to determine given the influence of Glade Creek flows and the railroad and highway causeways through the area.

A similar wetland exists at Crow Butte on either side of the access road from SR-14 to Crow Butte Island (figure 6-7). Emergent marsh (37 acres) has formed on the delta at the mouth of the drainage at this location. Pool drawdown will result in perching of this wetland; it is unknown if flows from the drainage into the delta will continue to support the entire wetland plant community or just that portion of the stand along the drainage channel.

Riparian and emergent marsh habitat at Whitcomb Island occurs along the backwater between Whitcomb Island and the Washington mainland and along the Columbia River shore (figure 6-8). A dike occurs at the upstream end of the backwater. The backwater is further broken up by two causeways in the center. The downstream end of the backwater has direct water exchange with the Columbia River only at higher pool levels. Habitat present consists of shallow water, emergent marsh and riparian shrub. This backwater would be completely dewatered with drawdown to elevation 257 feet. Riparian and marsh habitat along the Columbia River shore would be perched above the water table upon drawdown to elevation 257 feet and are expected to be lost.

McCredie Islands occur at RM 254 along the Washington shore (figure 6-5). These are a series of small, rocky islands just offshore from the Washington mainland. Drawdown will cause a land bridge to develop to the Washington mainland. Potential impacts would arise from depredation of Canada goose nesting efforts that occurred after or continued past the May 1 initiation date for drawdown.

Table 6-1 displays a summary of the marsh/riparian and shallow water acreages discussed in the previous subparagraphs.

TABLE 6-1 *Shallow water and emergent marsh-riparian habitat at various sites*

Site (acreage)	Emergent Marsh/ Riparian Acreage	Shallow Water Acreage
Paterson Slough (1043 acres)	353	690
McCormack Slough (494 acres)	272	222
Willow Creek WMA (WMA=646 ac; 362 acres w/in pool	119	243
Irrigon WMA (WMA=983 ac)	228	29.4 (ponds)
Glade Creek	19	12
Crow Butte	37	-
Whitcomb Island	215	-
Total	1243	1196

6.11 Mitigation Measures

Potential mitigative measures were solicited from and discussed with USFWS, ODFW, Washington Department of Wildlife, and Corps of Engineers technical staff. A number of factors were immediately identified which constrain mitigation opportunities. Constraints identified included:

1) large acreages impacted at four major sites and a number of smaller sites;
2) a requirement for large volumes of water at each major habitat impact site due to high water permeability rates for area soils;
3) water permeability rates for area soils (i.e. 4 to 29 inches of water per hour);
4) lack of water rights coupled with a water withdrawal moratorium imposed by both Oregon and Washington on Columbia River waters;
5) the lack of existing water control features and the absence of a water supply/control system(s), to include provision of power; and
6) the impacts on wildlife habitat and populations associated with potential mitigation developments (timing of actions, their duration and nature of action).

A number of potential, permanent mitigation measures were investigated to offset drawdown impacts. The primary emphasis of these measures, with one significant exception, was to assure continued supply of water to backwater and marsh habitat. Such measures were directed at ensuring survival of marsh, aquatic and riparian plant communities and the wildlife values associated with these communities. Measures evaluated included: permanent drawdown to elevation 257 feet; then diking backwaters and pumping water to maintain water levels; drip irrigation; and conventional sprinkler irrigation.

Major sites considered for these mitigation actions included McCormack and Paterson Sloughs on Umatilla National Wildlife Refuge and the Irrigon and Willow Creek Wildlife Management Areas. Each of these areas contains substantial acreage of riparian, marsh, and backwater habitat.

Minor sites considered for mitigative actions included Three Mile Island, Whitcomb Slough, McCredie Island, Crow Butte, and Glade Creek. Compared to the four aforementioned sites, these areas are considerably smaller, although their resource values can be very high. An example of high resource value is Three Mile Island which supports 7,000-10,000 nesting gulls plus other colonial nesting species. These sites typically have riparian-emergent marsh communities associated with them that would be lost with pool drawdown or else are islands which would be land-bridged.

In addition to developing mitigative actions at locations directly impacted by the drawdown, mitigation actions were considered at non-impacted locations in the project area. These sites were given consideration as it was recognized that drawdown impacts would occur in many areas where implementing mitigative actions was initially determined to be not feasible. An example would be fringing emergent marsh and/or riparian habitat along the Columbia River; mitigation actions to retain fringing habitat is not feasible. Thus other lands in the project area were considered for mitigation development.

There are several initial factors representing significant constraints on mitigative actions. The first factor of significant concern was the extremely high water permeability rate (4 to 29 inches per hour, average 16 inches per hour) for area soils (i.e. Burbank and Quincy soils). Rates this high would require substantial pumping capacity to maintain water levels in diked backwaters. Mitigation measures were developed for and cost estimates based upon a 6 inches per hour permeability rate, and thus should be considered minimal estimates.

The second factor of concern dealt with water availability. Currently, there is a moratorium in Oregon and Washington on water withdrawal from the Columbia River in this region. Thus, it will be difficult to obtain a water right for wildlife mitigation purposes. No water right currently exists for wildlife/wetland management purposes.

A third factor concerns physical impacts to existing habitats to implement the mitigation measures currently being considered. Substantial disturbance to existing habitat would arise from constructing mitigation features. Placing supply pipelines and irrigation systems, and constructing power lines and pump stations, road access, dikes and other features would have a substantial physical impact on the existing habitat and in some instances would substantially destroy what they are ultimately designed to save.

Costs associated with implementing, operating and maintaining mitigation features represents a fourth factor. Present habitat conditions resulted from the pool normally being held at elevation 265 to 268 feet and does not rely upon pumped water or a significant diking system. Therefore, there are minimal inputs (i.e. personnel, equipment, structural features) to maintain and operate wildlife habitat. Implementation of the drawdown would result in a switch to an intensive management system prone to mechanical problems, and personnel and funding limitations, particularly with the passage of time and current and expected budget constraints.

Mitigation measures involving surface and subsurface drip irrigation were not investigated further in this study phase because constructing these measures was considered:

1) too destructive to marsh/riparian habitat;
2) ineffective in maintaining standing water conditions, and therefore the invertebrate and vertebrate communities dependent upon the presence of standing water;
3) too expensive to maintain and operate, with respect to both funds and personnel; and
4) ineffective in mitigating wildlife and wildlife habitat impacts arising from drawdown.

Similarly, conventional irrigation was dropped from consideration as a mitigation measure. Relying on technical features for mitigation was not considered practicable nor particularly functional with respect to mitigation objectives.

Those measures which were perceived to maintain and/or replace habitat values lost due to drawdown were pursued further. Cost estimates were derived for those features required to implement measures considered practicable. Decisions on the feasibility of those measures analyzed further will be based upon cost, development associated impacts, operation and maintenance requirements and effectiveness.

6.11.1 Year-round (Permanent) Drawdown. This mitigation measure would result in the permanent operation of the John Day pool at elevation 257 feet; drawdown would not be seasonal as for the proposed 4-month operation. It is recognized that initial impacts would be severe for existing wildlife habitat, not unlike the initial impacts of raising a reservoir. However, this option allows for a land-base upon which habitat development can develop post-drawdown. Current habitat on Umatilla National Wildlife Refuge developed post-impoundment in 1968. It is unknown whether the land-base exposed by a permanent drawdown would develop comparably to the existing habitat acreage on the refuge or wildlife management areas. Such development would be dependent upon topography and soils within the drawdown zone relative to pool elevation. A preliminary estimate is that only 25 percent of the existing acreage to be impacted by drawdown could be recovered in this manner.

The recovery of 25 percent of riparian and emergent marsh habitat impacted by permanent drawdown would be expected to occur along the fringes of John Day Pool, within existing backwater areas and in newly formed backwater areas. Pocket areas within Patterson Slough where elevations are near elevation 257 (i.e. +/- 2 feet) are expected to develop riparian/emergent marsh communities. These areas will not have the interspersion of open water which now occurs in conjunction with the emergent marsh/riparian habitat at Patterson Slough. A present area which may depict future habitat conditions in Patterson Slough is the Irrigon Wildlife Management Area. There depressions below elevation 268 feet contain emergent marsh/riparian habitat with the deeper pond locations supporting submerged aquatic plants.

The development post-drawdown of pocket emergent marsh/riparian communities at McCormack Slough is expected to be minimal. This slough is much smaller in acreage than Patterson Slough and also very shallow. Thus, much, if not most of the slough is expected to be dry post-drawdown.

Virtually the entire backwater area behind Whitcomb Island would be dewatered post-drawdown with little emergent marsh/riparian habitat development expected. The emergent marsh community in the Crow Butte backwater would be expected to reestablish near the elevation 257 feet contour. Loss of emergent marsh in most of the present stand would be expected; water from the drainage emptying into the Columbia River at this location may ensure the survival of portions of this existing emergent marsh.

Emergent marsh and riparian habitat development will occur in Willow Creek embayment. It is unlikey that habitat development will be comparable in acreage at this location to existing habitat acreage. Most emergent marsh/riparian habitat within the Irrigon Wildlife Management Area is expected to be lost; some habitat may remain around a few deeper pools. The fringing emergent marsh habitat which occurs along portions of the Columbia River, primarily within the Umatilla NWR boundaries, is expected to reestablish along portions of the shoreline.

Some emergent marsh/riparian habitat may establish in shallow water/nearshore areas associated with mid-river islands (RM 273-276).

A relatively large, shallow embayment is expected to form between the Oregon shore and Long Walk Island (RM 273-276). This area, which is just riverward of McCormack Slough, may form a habitat complex comparable to McCormack Slough. However, the Long Walk Slough area would have to be diked to allow for comparable submerged aquatic plant communities to develop. Diking the entrance to this area would allow for carp control efforts to be enacted. The presence of carp precludes establishment of submerged plant communities. As demonstrated in McCormack Slough, carp eradication efforts can lead to development of extensive stands of submerged aquatic plants and greatly enhance waterfowl and other species productivity and abundance. Consequently, dike construction at this location may be necessary.

The preliminary estimate of 25 percent habitat recovery over a period of time post-drawdown to a permanent pool elevation to 257 feet would equate to 525 acres of the 2,100 acres of emergent marsh/riparian habitat expected to be impacted by drawdown. In a later discussion (subsection 6.13, Wildlife Mitigation Costs for Offsite Lands), it is estimated that 5,000 acres would be required to offset impacts to 2,095 acres of emergent marsh/riparian habitat (2.4:1 mitigation ratio). Thus, as a preliminary estimate, if 525 acres were recovered by natural habitat reestablishment, 3,750 acres of offsite lands would be required.

Habitat development costs, both implementation and operations and maintenance costs, associated with this measure are anticipated to be substantially lower than those associated with a pumping and diking operation. Substantial recovery of emergent marsh and aquatic plant communities could occur within 3 to 5 years; riparian habitat would take at least 24 years to attain present conditions.

This measure is considered the most cost effective per unit of mitigation. Further, development-related impacts and operations and maintenance costs are anticipated to be minor when compared to other measures considered. Mitigation effectiveness would be expected to be high over time upon habitat development. However, additional and offsite mitigation would still be required to fully replace the wildlife habitat lost.

6.11.2 Diking and Pumping. Diking of backwater areas and pumping water from the Columbia River to maintain water levels was considered as a mitigation measure at several sites. Areas considered for this mitigative measure include Paterson Slough, McCormack Slough, Whitcomb Island Slough, Willow Creek Wildlife Management Area, Crow Butte, Glade Creek and Irrigon Wildlife Management Area.

Cost projections have only been developed for diking and pumping at Paterson Slough due to time constraints. Cost estimates for other sites where pumping and storage are being considered have not been developed but could be developed based upon the cost estimate for Paterson Slough.

Soil permeability rate is the principal factor regulating costs of this mitigation action. The permeability rate for soil(s) in Paterson Slough, and other mitigation areas, was determined to range from 6 to 20 inches per hour based upon literature on area soils. For analysis of mitigation features and their cost at Paterson Slough and elsewhere, the 6 inches per hour rate was used to determine the amount of water required to maintain present water levels and, therefore, the associated wildlife and riparian, emergent marsh and aquatic plant communities. Recent information from field tests, received subsequent to derivation of cost estimates for mitigation features, indicated that soil permeability rates at Paterson and McCormack Sloughs ranged from 4 to 29 inches of water per hour with an average rate of 15.9 inches per hour. The reader should remember that the following information was derived from an estimated permeability rating of 6 inches of water per hour and therefore that the required pumping and supply elements plus the cost estimate are therefore low.

A system of three dikes was evaluated at Paterson Slough. Impoundments behind these dikes would account for 390 acres of a total backwater area of 1,043 acres; 281 acres of riparian/marsh habitat would be maintained under this option from an estimated total of 353 acres.

Numerous features would have to be constructed in the Paterson Slough unit to mitigate wildlife and wildlife habitat impacts arising from the drawdown. Three pump stations containing a total of 45 300-horsepower vertical turbine pumps would have to be constructed. Two pump stations would have to be located offshore at approximately the elevation 250-foot contour. The third pump station would be located in a diked sub-impoundment and would transfer water to the third sub-impoundment. These pump stations would have to provide 1.3 million gallons per minute (gpm) to compensate for water loss due to soil permeability (i.e. at 6 inches per hour), thus the large number and capacity of pumps required. The intake pipes for each pump station would have to be screened to prevent entrainment of fish. Overhead power lines would have to be brought in across the refuge to provide power to the pump stations. An estimated 27,000 lineal feet of 5-foot diameter steel pipe would be required for water transfer. Three diffuser aprons would be required to prevent erosion at the pipeline outfalls. An estimated 4,000 lineal feet of dike would have to be constructed and armored to prevent erosion. Each dike would be equipped with a control works for ingress/egress of water during the non-drawdown period. Access roads would have to be constructed, enlarged or improved in order to implement the mitigation measures. Other substantial infrastructure elements would also be required in order to implement this measure.

This method to mitigate impacts at Patterson Slough alone would have a very high initial development cost (preliminary estimate $69 million). Operation and maintenance costs are also anticipated to be high plus they would require additional personnel above and beyond that existing on Umatilla National Wildlife Refuge. High development costs are attributable to the need for pumping and diking to maintain water levels, which in turn is associated with the high permeability rate for area soils. Developing the infrastructure to maintain 400 acres of the Paterson Slough unit would also have considerable impact on wildlife resources at Paterson Slough (i.e. dikes, roadways, pipelines, and power lines). These factors, whether singularly or in combination, represent serious concerns about the feasibility or practicability of such development.

The water rights issue would also need to be addressed and would be a significant factor considering the substantial quantity of water required.

Mitigation involving pumping and diking would not appear feasible as a mitigation measure given the high initial and operation and maintenance costs, limited acreage wherein mitigation can be attained, lack of a water right, and impacts associated with construction and operation of the massive infrastructure required for this action. These factors would also be applicable to potential mitigation of this nature at McCormack Slough, Umatilla National Wildlife Refuge and at the ODFW Wildlife Management Areas at Willow Creek and Irrigon. The Irrigon Wildlife Management Area, although it does not require diking and water control features, is further complicated by the dispersed nature of wetland and riparian habitat throughout the 8-mile length of the area. The logistical and infrastructure problems associated with mitigation for the Irrigon area make implementation impracticable.

6.11.3 Blackberry Slough. Blackberry Slough is an upland area east of Paterson Ferry Road that represents a continuation of the swale which contains McCormack Slough (west of Paterson Ferry Road). This area is comprised of dry uplands except for a small area adjacent to Paterson Ferry Road which contains some riparian, emergent marsh and open water area during full pool. The opportunity to develop additional emergent marsh, open water and riparian habitat has been discussed with the USFWS. Water, upon which development of these habitats would be contingent, would have to be either pumped from the Columbia River or else derived from Umatilla and Irrigon hatchery outfall water. Given the soil permeability rate (4 to 29 inches per hour) and cost factors associated with pump station and water supply development at Paterson Slough, this measure was not pursued further.

6.11.4 Offsite Mitigation. Pursuit of mitigation measures discussed above, except island reconstruction, are not merited due to:

1) the high cost involved for development, operations and maintenance, and
2) the significant increase in refuge/wildlife management area infrastructure and personnel requirements.

Mitigation for wildlife habitat and population losses associated with the drawdown should be directed at off-site mitigation. This would require acquisition of lands where comparable wildlife habitat/population levels could be attained through changes in existing resource management actions and/or through less intensive development actions. Mitigation actions along this line would be significantly more cost effective than measures reviewed above.

Mitigation actions should be directed toward, but not restricted to, acquisition of lands in the project area. Given sociopolitical considerations, in addition to availability of comparable lands, consideration should be given to off-site lands that may occur in another drainage basin. Enlargement of existing refuges elsewhere represents one avenue of approach. Measures which improve habitat quality at other locations, particularly existing refuges, may also represent options to pursue. An example would be carp eradication and reattainment of water quality and consequently aquatic plant communities. This has been demonstrated at both Malheur and Umatilla National Wildlife Refuge to boost waterfowl and other aquatic-associated species occurrence and production.

6.11.5 Fish and Wildlife Service Recommendations. A Planning Aid Letter from the Fish and Wildlife Service, dated Setember 15, 1992, provided mitigation recommendations from State and Federal resourse agencies. The specific recommendations and responses are attached at the end of the appendix. In general, it is noted here that as the study proceeds into the next phase (see section 13), input to the study from the USFWS and State agencies to document and quantify specific impacts to fish and wildlife resources will be sought. Appropriate and specific mitigation measures will be developed and detailed in cooordination with the resource agencies. A Coordination Act report will be required for the next phase of study.

6.12 Miscellaneous Impacts to Wildlife/Wildlife Habitat

Mitigative actions, whether interim or permanent measures, to offset impacts to irrigation pump stations could pose concerns for wildlife and/or wildlife habitat. The location and nature of these mitigative actions for pump stations are not known. Dredging actions pose a timing consideration but the principal impact will arise from where dredged material is placed and what habitats are impacted from that placement. More concerns are expected to arise relative to wildlife as additional impacts and associated mitigative measures are identified.

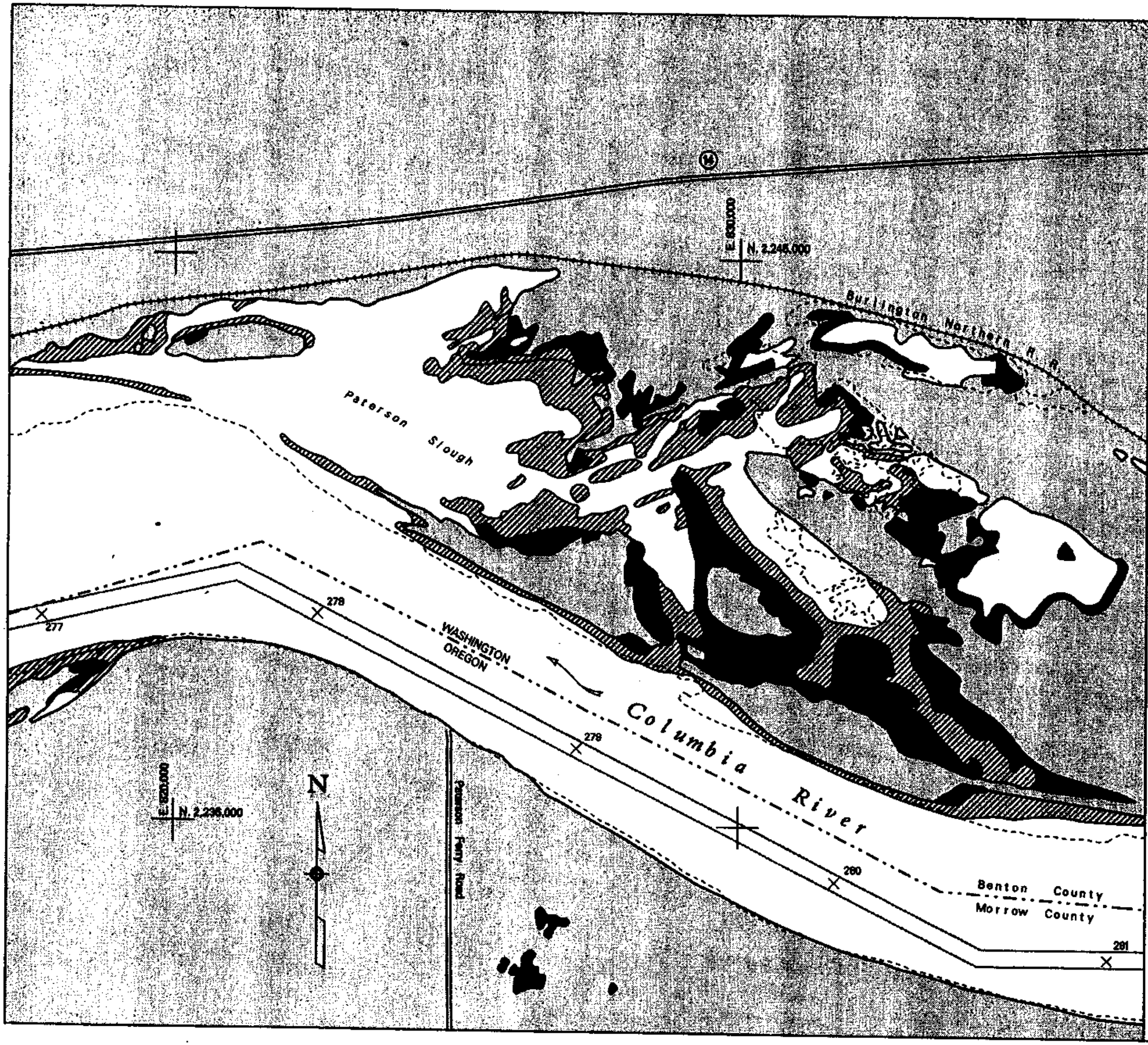
6.13 Wildlife Mitigation Costs for Offsite Lands

A preliminary estimate is that a minimum of 3,750 to 5,000 acres of wildlife habitat would have to be acquired to offset impacts to wildlife associated with John Day drawdown to elevation 257 feet. Current estimates are that 2,100 acres of riparian and emergent marsh habitat would be impacted by the drawdown. The 3,750 acre estimate is predicated upon a 25 percent recovery (i.e. 525 acres) for emergent marsh/riparian habitat post-drawdown to a permanent elevation of 257 feet.
Emergent marsh/riparian habitats are bounded by open water and shrub-steppe upland. Open, shallow water habitat comprised 6,300 additional acres that would be dewatered by the drawdown. Ideally, a mitigation site would contain a comparable mixture of emergent marsh, riparian, open water and adjacent upland habitats.

The estimated 3,750 to 5,000 acres for mitigation purposes does not encompass all the shallow, open water habitat. Much of that habitat has limited value for wildlife; open water associated with backwaters and ponds is much more important and represents less acreage than open water in the John Day pool.

The location and nature of lands for mitigation are unknown at this juncture; these variables will have an impact on the amount of acreage required for mitigation purposes. Thus, in the interim, an estimated 3,750 - 5,000 acres are being used to develop a preliminary cost estimate for wildlife mitigation.

Purchase plus initial development costs are preliminarily estimated at $2,000 per acre. This would result in a $7.5 to $10 million acquisition and initial development cost for wildlife mitigation. Based on these preliminary costs, off-site mitigation has been assumed in the final estimate to determine project costs. Operation and maintenance costs are not calculated as management requirements and capabilities for mitigation lands are not known.



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands Riparian at Pool El. 267' (353 ac.)
- Sand Flats Exposed at Pool El. 261' (423 ac.)
- 1043 ac. Open Water and Wetlands within Paterson Unit at Normal Pool
- 257' Contour (From 8 December, 1955)

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

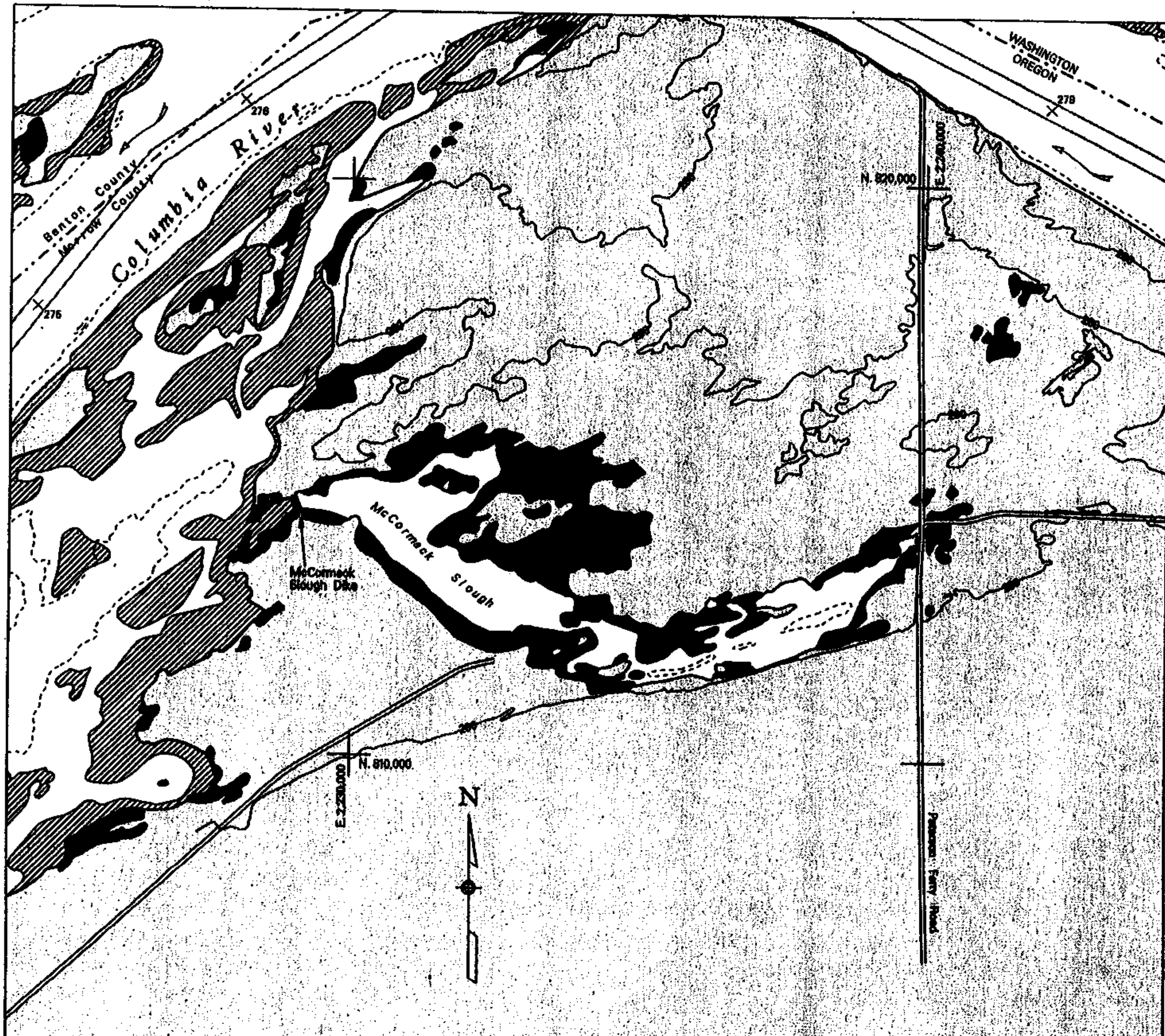
1800 0 1:21,600 1800 3600
SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Paterson Unit
River Miles 277 - 281

Figure 6-1



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation of 267'
- Wetlands /Riparian at Pool El. 267' (272 ac.)
- Sand Flats Exposed at Pool Elevation 261'
- 494 ac. Open Water and Wetlands within McCormack Unit at Normal Pool
- 257' Contour (From 8 December, 1966)
- 280' Contour (From USGS 7.5' Quadrangle)

Acreages shown are calculated for the area from McCormack Slough Dike to just east of Paterson Ferry Road, for habitats adjacent to McCormack Slough.

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

1800 0 1:21,600 1800 3600

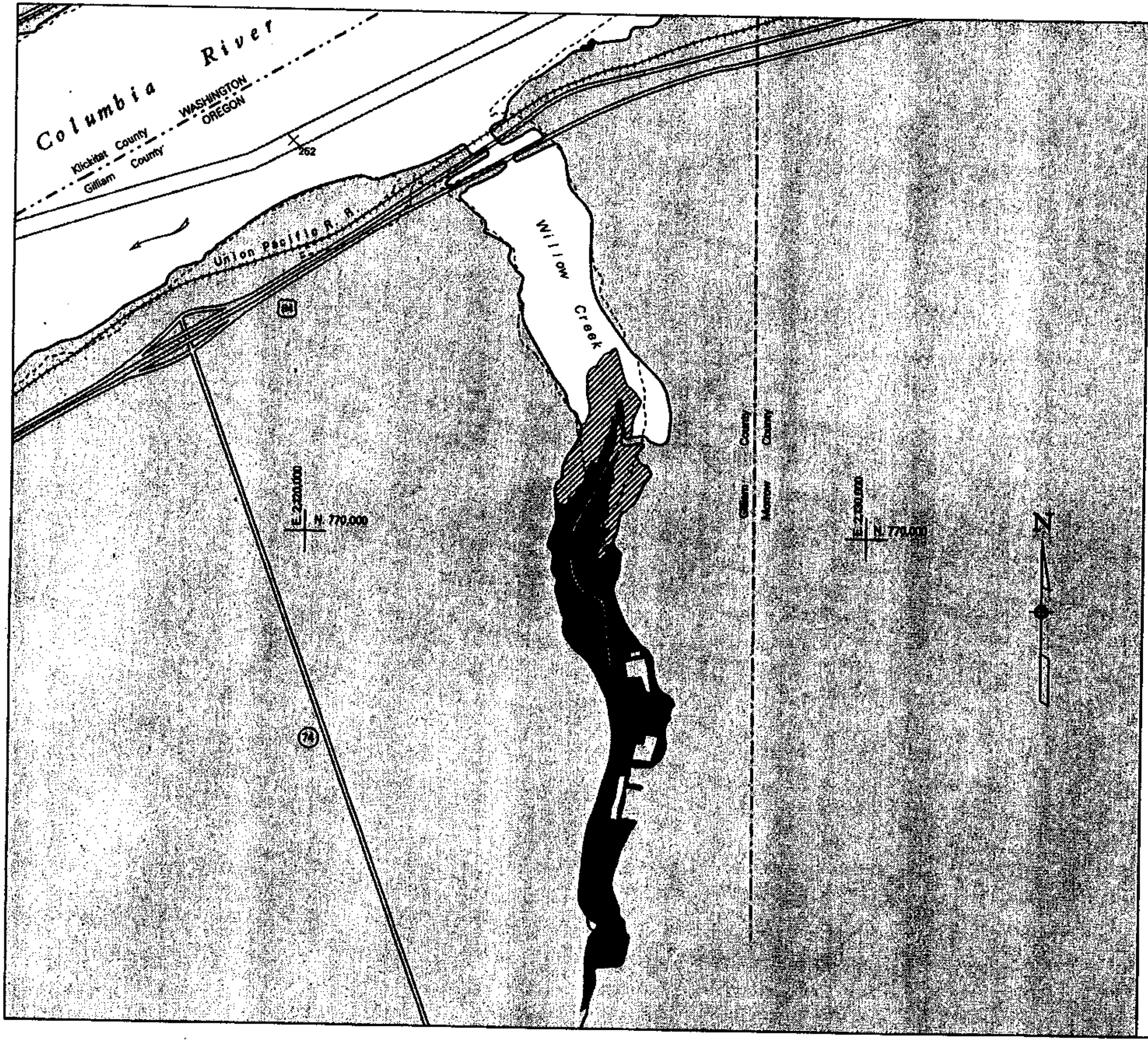
SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
McCormack Unit
River Miles 275 - 279

Figure 6-2



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 264.5'
- Wetlands / Riparian at Pool El. 264.5' (182.2 ac.)
- Sand Flats Visible at Pool El. 264.5 (62.6 ac.)
- ----- 257' Contour (From 8 December, 1955)

Note: Wetlands and sand flats interpreted from 1:24,000 scale photography dated 22 June, 1992, pool elevation 264.5'.

Willow Creek Unit is an Oregon Dept. of Fish and Wildlife Wildlife Management Area

1:21,600

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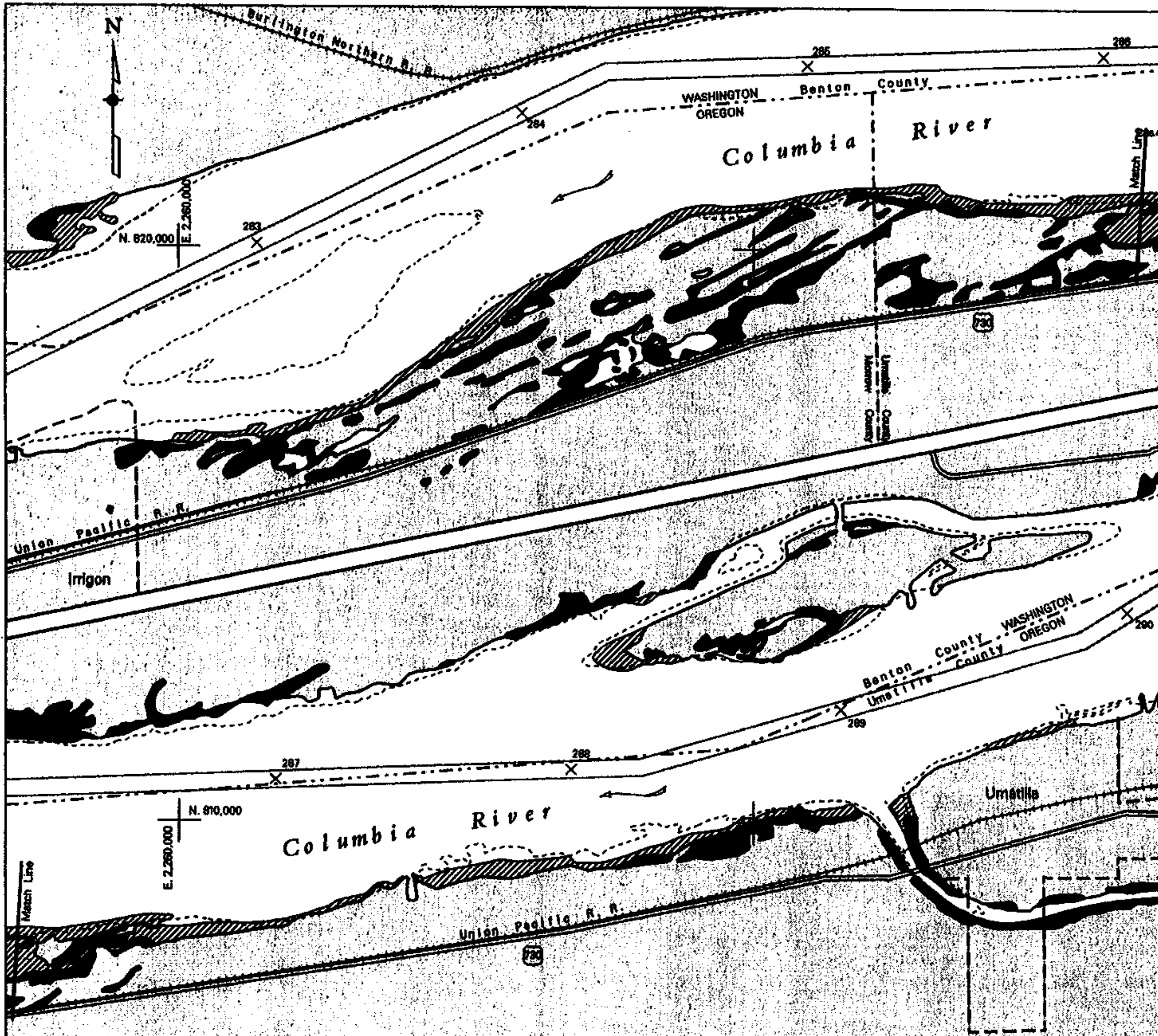
SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Willow Creek Unit
River Mile 252.5

Figure 6-3



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands /Riparian at Pool El. 267' (227.8 ac.)
- Sand Flats Exposed at Pool El. 261' (133.2 ac.)
- 257' Contour (From 8 December, 1955)

Note: Wetlands Interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

Irrigon Unit is an Oregon Dept. of Fish and Wildlife 'Wildlife Management Area'

1:21,600

1800 0 1800 3600

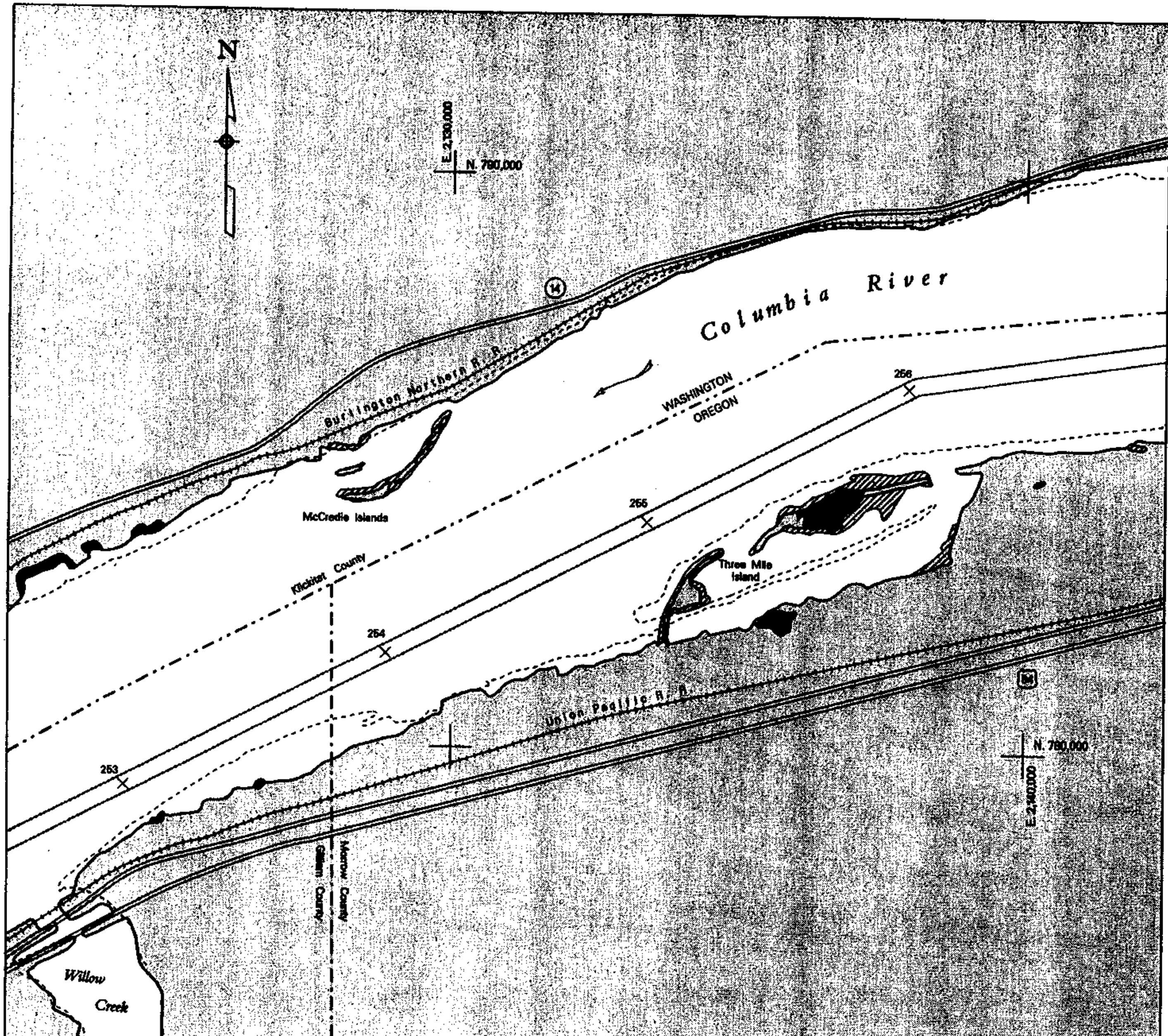
SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Irrigon Unit
River Miles 283 - 290

Figure 6-4



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands / Riparian at Pool Elevation 267'
- Sand Flats Exposed at Pool Elevation 261'
- 267' Contour (From 8 December, 1955)

Wetland Acreages

Three Mile Island:
10.7 acres of wetlands at 267' pool elevation
28.2 acres of sand flats exposed at 261' pool elevation

McCredie Islands:
0.0 acres of wetlands at 267' pool elevation
7.4 acres of sand flats exposed at 261' pool elevation

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

1800 0 1:21,600 1800 3600

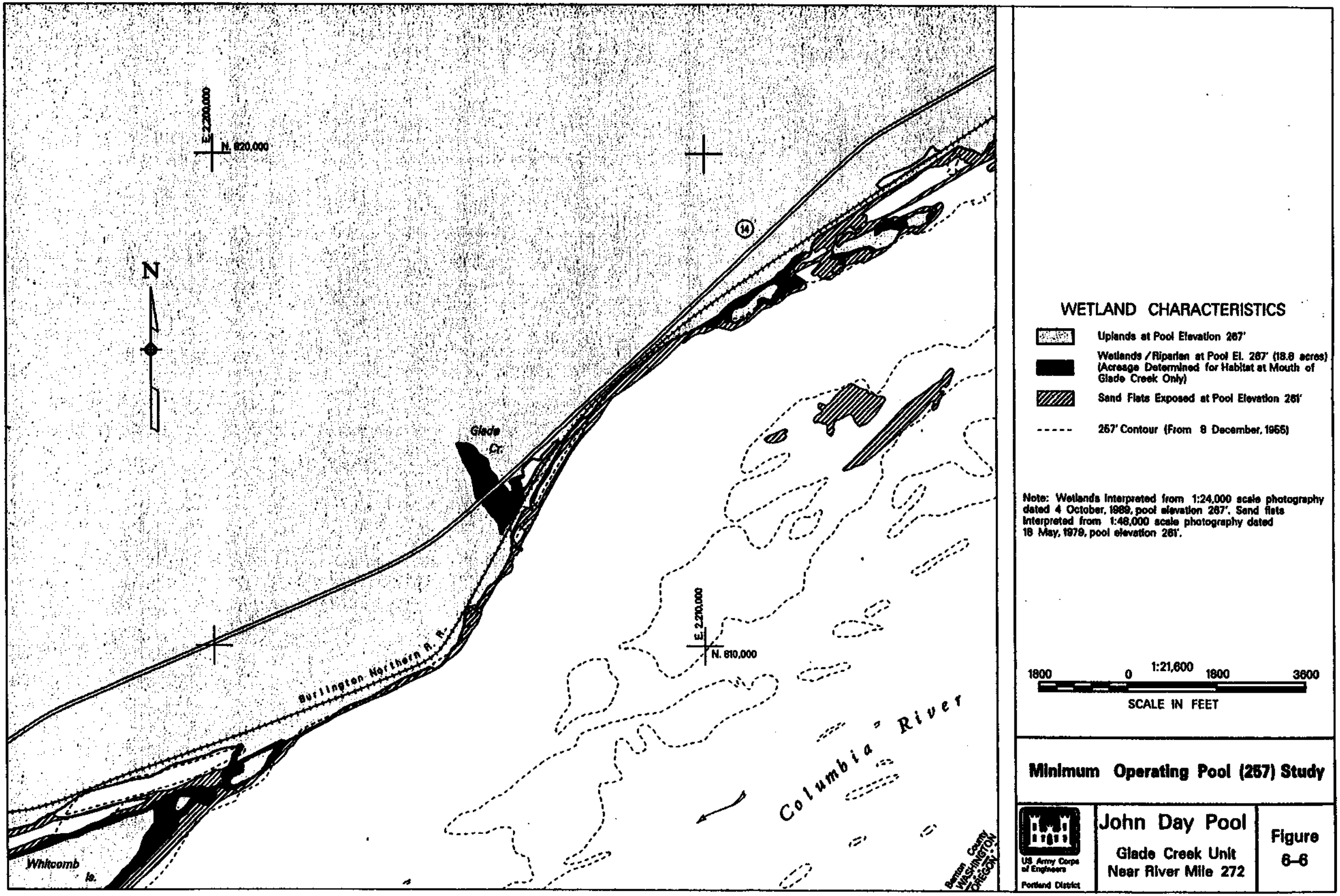
SCALE IN FEET

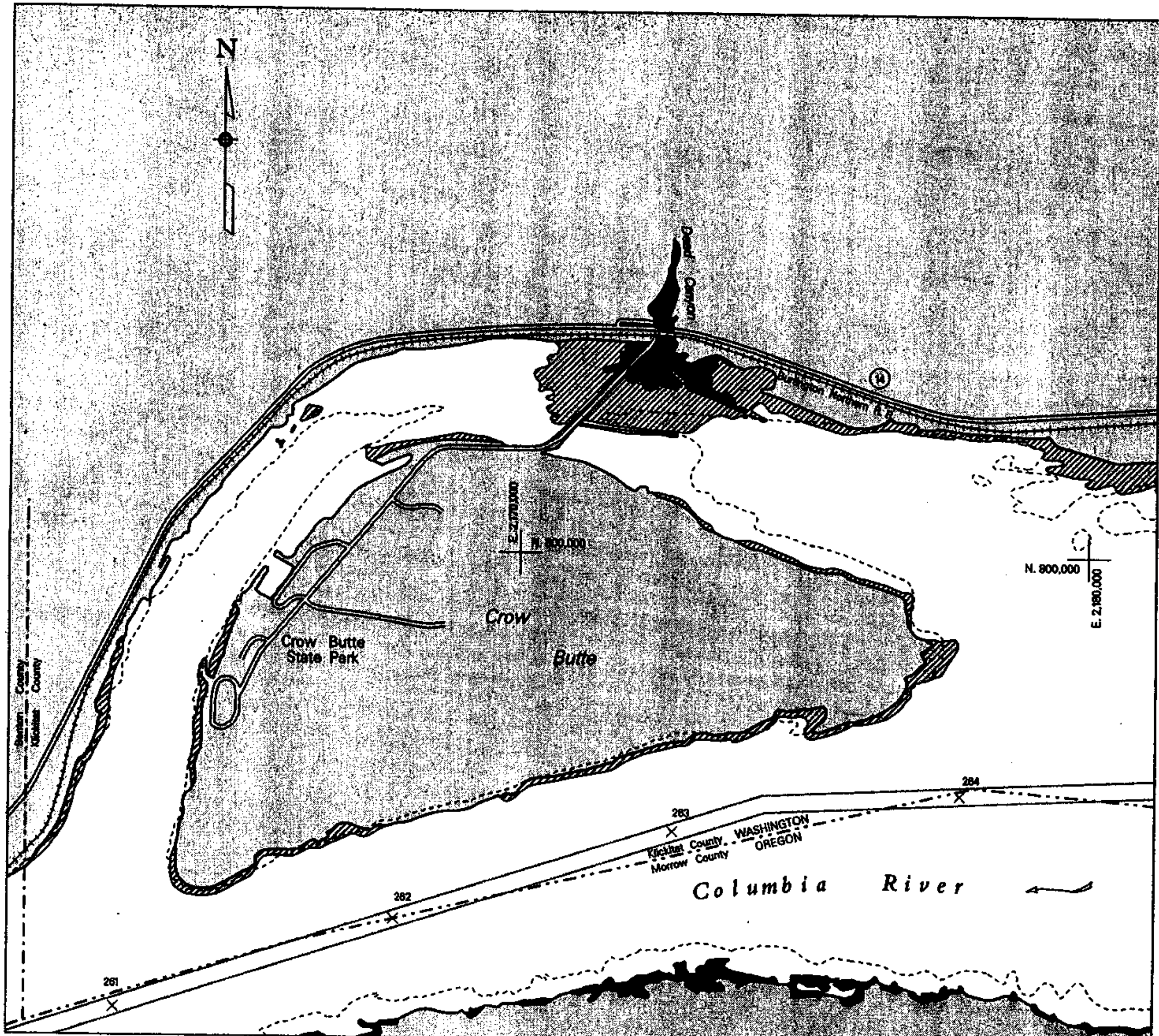
Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Three Mile Island
McCredie Islands
River Miles 275 – 279

Figure 6-5


WETLAND CHARACTERISTICS
Uplands at Pool Elevation 267'
Wetlands / Riparian at Pool El. 267' (18.8 acres) (Acreage Determined for Habitat at Mouth of Glade Creek Only)
Sand Flats Exposed at Pool Elevation 261'
257' Contour (From 8 December, 1955)
Note: Wetlands Interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.
1800 0 1:21,600 1800 3600
SCALE IN FEET
Minimum Operating Pool (257) Study
US Army Corps of Engineers
Portland District
John Day Pool
Glade Creek Unit
Near River Mile 272
Figure 6-6
N
E. 2,200,000
N. 820,000
E. 2,210,000
N. 810,000
14
Glade Cr.
Burlington Northern R. R.
Columbia River
Whitcomb Is.
Benton County
WASHINGTON
OREGON



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands / Riparian at 267' Pool El. 34.6 ac. (Acreage for Dead Canyon Wetlands Only)
- Sand Flats Exposed at Pool Elevation 261'
- 257' Contour (From 8 December, 1955)

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

1800 0 1:21,600 1800 3600

SCALE IN FEET

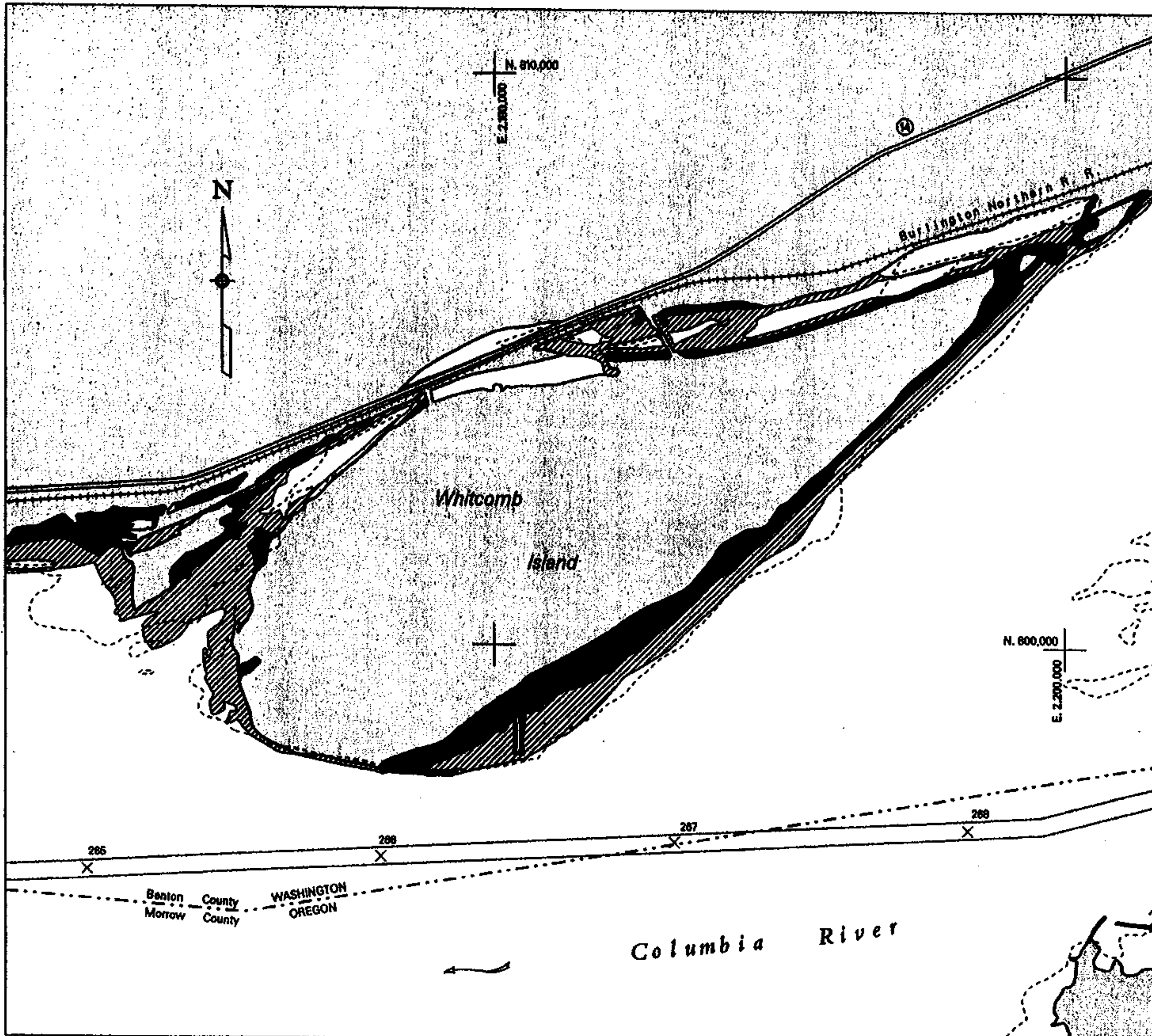
Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool

Crow Butte Unit
River Miles 261 – 264

Figure 6–7



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands / Riparian at Pool El. 267' (215.2 ac.)
- Sand Flats Exposed at Pool Elevation 261'
- 257' Contour (From 8 December, 1955)

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

Whitcomb Island Unit is included in the Umatilla National Wildlife Refuge.

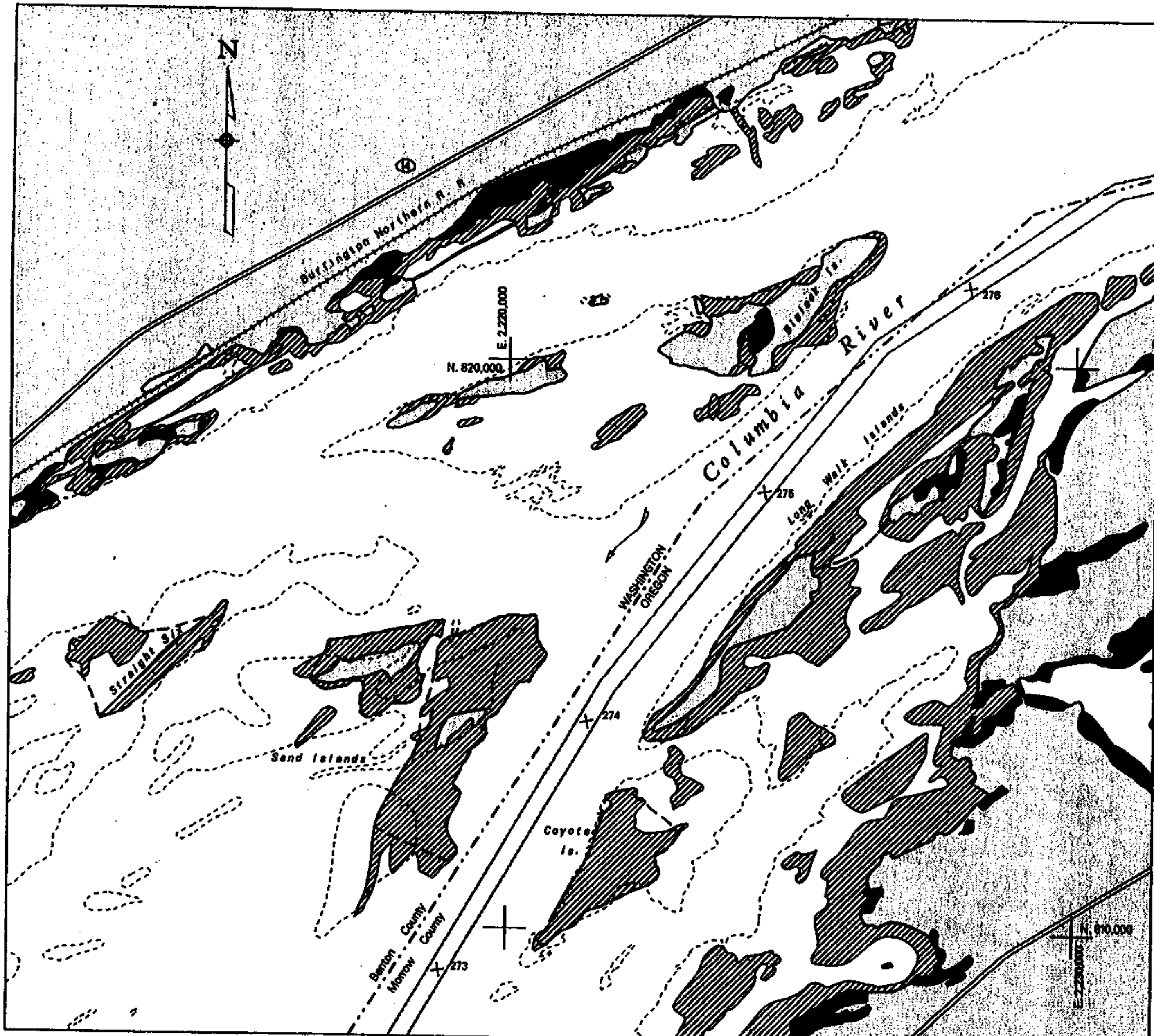
1:21,600
1800 0 1800 3600
SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Whitcomb Island Unit
River Miles 265 - 268

Figure 6-8



WETLAND CHARACTERISTICS

- Uplands at Pool Elevation 267'
- Wetlands / Riparian at Pool Elevation 267'
- Sand Flats Exposed at Pool Elevation 261'
- Island Rehabilitation Area
- 267' Contour (From 8 December, 1956)

Straight Six Isand's rehabilitation area consists of 58.2 acres, with an area perimeter of 7,833'

Sand Islands' rehabilitation area consists of 48.3 acres (north island) and 122.8 acres (south island) with perimeters of 7,051' and 12,076' respectively.

Long Walk Island's rehabilitation area consists of 130.7 acres with an area perimeter of 14,445'.

Bialock Island consists of 3,234' of sandy beach; 27.7% of 11,695' of the island's perimeter.

Coyote Island's rehabilitation area consists of 59.8 acres with a perimeter of 7883'.

Note: Wetlands interpreted from 1:24,000 scale photography dated 4 October, 1989, pool elevation 267'. Sand flats interpreted from 1:48,000 scale photography dated 18 May, 1979, pool elevation 261'.

These islands are a portion of the Umatilla National Wildlife Refuge

1800 0 1:21,600 1800 3600

SCALE IN FEET

Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
Sand, Bialock, Coyote, Long Walk & Straight Six Islands
River Miles 273 - 276

Figure 6-9

7. IMPACTS TO RECREATION AND TREATY ACCESS SITES

7.1 Introduction

The following paragraphs provide a preliminary assessment of the effects that operation of the pool at MOP will have on recreation facilities at the various sites on the John Day pool. Information is based on review of as-built drawings when available and limited field investigations. Hydrosurveys and additional field work will be necessary to verify the impacts and costs of the mitigation measures described herein. Cost information for the marine facilities such as boat ramp extensions, gangways, floats, etc. were derived from the Oregon Marine Board Statewide Cost Averages, February 21, 1992. Impacts to recreation sites are assumed to be the same for the 4-month and year-round drawdown. For this report it has been assumed that mitigation of recreation impacts would be accomplished. Section 11, Economics, discusses information from the System Operation Review (SOR) which provides estimated economic impacts due to reduced recreational visitation of the operation at MOP, without mitigation.

There are 15 recreation sites on John Day pool. The sites, in upstream order, are Railroad Island, Le Page, Philippi, Rock Creek, Blalock Canyon Boat Ramp, Sundale, Roosevelt, Arlington (Port of Arlington), Quesnel, Crow Butte (State of Washington), Boardman (Boardman Park and Recreation District), Irrigon (Irrigon Park and Recreation District), Plymouth, Umatilla (Port of Umatilla), and Nugent (City of Umatilla). The sites not otherwise indicated are operated by the Corps. Three parks (Boardman, Irrigon, and Umatilla) include marina facilities, operated by local public entities under leases from the Corps. A commercial tour boat operates on the river, and makes stops at the Umatilla marina. The locations are shown on the figures attached behind the report. Annual visitation to the recreation sites is estimated to be more than 1.6 million visitor-days based on data from the year 1986.

Existing treaty fishing access is provided at Le Page, Sundale and Quesnel (Three Mile Canyon) using the boat ramps at those sites. It would be necessary to maintain treaty access and boat launching to those sites serving that purpose. The boat ramps serving treaty fishing access at Quesnel and Sundale parks are among those which would be impacted. The boat ramps at those sites would need to be extended to maintain treaty commitments. The other treaty access site boat ramp at Le Page Park is anticipated to be serviceable to elevation 257.

7.2 Railroad Island Park, Washington

7.2.1 Description. This park is located on the Washington shore at RM 216, immediately above and east of the John Day Dam. There are the following facilities at this park: a boat ramp, a dock along the boat ramp, potable water, and a water-borne sewer system. The park can be accessed via SR-14 from the north or by boat through a culvert under the Burlington Northern Railroad. The boat ramp toe elevation is 256.2 feet. The bottom of the access culvert is 254.6 feet. Assuming that 3 to 4 feet of floating clearance is needed for most boats using the park, the usable pool elevation is approximately 260 feet. Neither the water nor sewer systems will be affected.

7.2.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the boat ramp and associated dock will have approximately 1 foot of floating clearance. The access culvert would be accessible to only the shallower draft boats, requiring 3 feet or less.

7.2.3 Potential Mitigation Measures. A potential mitigation measure would be to excavate and extend the boat ramp and associated dock. A secondary mitigation measure would be to remove and replace the culvert under the Burlington Northern Railroad at a lower invert elevation.

7.2.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock (including two extra steel piles) 20 feet, and add an extended-length access gangway (100 feet long and 4 feet wide). It is estimated that the construction work at this site will take approximately 2 months to complete.

TABLE 7-1 *Cost estimate, Railroad Island Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$ 20,000
Unclass. excavation	lyd^3	20	$ 4	$ 80
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	20	$ 1	$ 20
Concrete boat ramp	yd^2	50	$ 100	$ 5,000
Steel pile	each	2	$10,000	$20,000
9-foot concrete float	ft^2	110	$ 20	$ 2,200
Aluminum gangway	ft^2	440	$ 44	$19,360
CONSTRUCTION TOTAL				$67,160

7.3 Le Page Park, Oregon

7.3.1 Description. This park is located on the Oregon shore at RM 217, on the west side of the John Day River. There are the following facilities at this park: a boat ramp, two docks along the boat ramp, four moorage docks, a swimming beach, potable water, and a water-borne sewer system. The park can be accessed via I-84 from the north or by boat under the Union Pacific Railroad and I-84 bridges. The boat ramp toe elevation is 252.3 feet. The elevation of the river bottom at the east end of the docks along the boat ramp is 257.9 feet for the northern dock and 252.8 feet for the southern dock. The river bottom elevations along the moorage docks range from 255.0 feet at the north to 241.6 feet near the middle to 254 feet at the south end. The river bottom elevation of the swimming beach near the warning floats is 241.3 feet, but about 30 feet inland, the bottom elevation is 259.3 feet. Neither the water nor sewer systems will be affected.

TABLE 7-2 *Cost estimate, Le Page Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$ 20,000
Unclass. excavation	lcy	30	$ 4	$ 120
Aluminum gangway	ft^2	1760	$ 44	$ 77,440
Steel Pile	each	8	$10,000	$ 80,000
CONSTRUCTION TOTAL				$177,560

7.3.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, only the boat ramp dock and the swimming beach would be affected. The swimming area would be completely gone and the beach cannot be relocated, since the river bottom drops away quite steeply east of the current float location.

7.3.3 Potential Mitigation Measures. A potential mitigation measure would be to dredge around the boat ramp dock to ensure that the last two dock sections will be floating at water elevation of 257 feet. Also,addition of longer dock access gangways will be needed to make the angle to the docks walkable.

7.3.4 Costs and Schedules. The assumption for construction are; to excavate/dredge around the boat ramp dock for 40 feet by 15 feet, add four new longer access gangways (4 feet by 100 feet) and add eight new steel piles (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 1 month to complete.

7.4 Philippi Park, Oregon

7.4.1 Description. This park is located in Oregon on the east shore of the John Day River at RM 3.5, upstream from Le Page Park. There are the following facilities at this park: two moorage docks, a swimming beach, potable water, and a water-borne sewer system. Access to the park is by boat only. The river bottom elevation at the north end of the northern dock is 253.8 feet and at the southern end is 254.4 feet. The river bottom elevation at the southern dock ranges from 258.9 feet at the east end to 245.6 feet at the west end. The river bottom elevation at the swimming beach warning floats is 245.2 feet. Neither the water or sewer systems will be affected.

7.4.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the northern dock will have approximately 3 feet of floating clearance. The southern dock would be partly grounded at the east end, and have 2 to 4 feet of clearance around the rest of the dock. Grounding the dock might possibly rack the dock unit.

7.4.3 Potential Mitigation Measure. A potential mitigation measure would be to dredge around both docks and add longer dock access gangways to make the angle to the docks walkable.

7.4.4 Costs and Schedules. Assumptions for construction; dredge around both docks (average depth of dredging to be 3 feet), install a new, longer access gangway (100 feet by 4 feet) on each dock and add four new steel piles (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 2 months to complete, due to this site's remote location.

TABLE 7-3 *Cost Estimate, Philippi Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$20,000
Dredging (soil)	lcy	700	$ 10	$ 7,000
Aluminum gangway	ft^2	880	$ 44	$38,720
Steel pile	each	4	$10,000	$40,000
CONSTRUCTION TOTAL				$105,720

7.5 Rock Creek Park, Washington

7.5.1 Description. This park is located on Rock Creek in Washington at RM 229. There is a boat ramp and a swimming beach at this park. Access to the park is via SR-14 from the south or by boat under a Burlington Northern Railroad bridge. The boat ramp toe elevation is 259.6 feet. The river bottom elevation of the swimming beach near the warning floats is 256.8 feet. The embayment along the north and west sides is very shallow, with the river bottom elevation averaging 260.9 feet.

7.5.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, access to the ramp would be possible, since there is a channel with its river bottom elevation deeper than 244 feet, however, the ramp's toe would be above water. The swimming beach would be approximately 1 foot deep near the floats, rendering it unusable.

7.5.3 Potential Mitigation Measures. Potential mitigation measures would be to extend both the swimming beach and boat ramp to the south. However, this might not be possible due to a steep drop-off in embayment bottom elevation. In addition, sand would be needed to surface the river bottom of the extended swimming area.

7.5.4 Costs and Schedules. Assumptions for construction; extend the boat ramp (40 feet) and swimming beach (100 feet). It is estimated that the construction work at this site will take approximately 2 months to complete.

TABLE 7-4 *Cost Estimate, Rock Creek Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$20,000
Unclass. excavation	lcy	1,020	$ 4	$ 4,080
Riprap, class I	lcy	20	$ 50	$ 1,000
Filter fabric	yd^2	80	$ 1	$ 80
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Swimming beach sand	lcy	1,000	$ 8	$ 8,000
CONSTRUCTION TOTAL				$40,160

7.6 Blalock Canyon Boat Ramp, Oregon

7.6.1 Description. This facility is located on the Oregon shore at RM 233.2. The only amenity at this primitive facility is a gravel boat ramp. This site is used as a refuge for boaters, during stormy, windy conditions on the river. Land access to the facility is via I-84 from the west. Boat access is through a culvert under the Union Pacific Railroad. The boat ramp toe elevation is 261.3 feet. The river bottom of the access culvert is 254.3 feet. Assuming that 3 to 4 feet floating clearance is needed for most boats using the park, the usable pool elevation is approximately 265 feet.

7.6.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the boat ramp toe will be above the water level by approximately 3 feet. The access culvert and embayment would be accessible to only the shallower draft boats, requiring 3 feet or less.

7.6.3 Potential Mitigation Measure. The only mitigation measure for this site would be extension of the boat ramp.

7.6.4 Costs and Schedules. Assumption for construction; extend the boat ramp (60 feet). It is estimated that the construction work at this site will take approximately 1 month to complete.

TABLE 7-5 *Cost Estimate, Blalock Canyon Boat Ramp, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$20,000
Unclass. excavation	lcy	870	$ 4	$ 3,480
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Gravel boat ramp	lcy	870	$ 15	$13,050
CONSTRUCTION TOTAL				$37,110

7.7 Sundale Park, Washington

7.7.1 Description. This park is located on the Washington shore at RM 237. There are the following facilities at this park: a boat ramp, a dock along the boat ramp, a swimming beach, and a vault toilet. Access to the park is by road off SR-14 from the north or by boat under both the Burlington Northern Railroad bridges. The boat ramp toe elevation is 260.8 feet. The elevation of the river bottom at the east end of the dock along the boat ramp is 260.8 feet. The river bottom elevation of the swimming beach near the warning floats is 255.9 feet at the north end and 259.7 feet at the south end. The northeast side of the embayment is shallow, with a bottom elevation ranging from 263.2 to 258.4 feet. The vault toilet will not be affected.

7.7.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the swimming beach and the boat ramp and dock would be affected. The area inside the swim beach floats with water would be reduced on the north side to a small area only 2 feet deep and dry on the south side. The boat ramp toe would be above the water level and the dock would be grounded, possibly racking the dock units.

7.7.3 Potential Mitigation Measures. A potential mitigation measure would be to extend the boat ramp and dock out to achieve at 3 feet of floating clearance at the new toe. However, this might not be possible due to a steep drop-off in river bottom elevation. In addition, sand would be needed to surface the river bottom of the extended swimming area.

7.7.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock (including four extra steel piles) for 60 feet. It is estimated that the construction work at this site will take about 2 months.

TABLE 7-6 *Cost Estimate, Sundale Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$20,000
Unclass. excavation	lcy	170	$ 4	$ 680
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	110	$ 1	$ 110
Concrete boat ramp	yd^2	110	$ 100	$11,000
Steel pile	each	4	$10,000	$40,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
CONSTRUCTION TOTAL				$80,290

7.8 Roosevelt Park, Washington

7.8.1 Description. This park is located on the Washington shore, at RM 241, at the community of Roosevelt, Washington. The following facilities are located at this park: one moorage dock, a swimming beach, a boat ramp, and a vault toilet. Access to the park is by road from SR-14 or by boat. The boat ramp toe elevation is 253.8 feet and the river bottom elevation at the end of the boat ramp dock is 251.9 feet. The river bottom elevation at the western end of the moorage dock is 250 feet and 251.8 feet at the east end. The river bottom elevation at the swimming beach warning floats is approximately 257 feet. The vault toilet will not be affected. The bottom elevation at the east end of the embayment is 252.2 feet and the west end is 239.2 feet.

7.8.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the swimming beach will be above the water level and the boat ramp toe will have approximately 3 feet of floating clearance. The boat ramp dock will have approximately 5 feet of clearance. The moorage dock will have between 6 and 7 feet of clearance. The reduction in pool level would require using smaller draft boats to access the boat ramp and would render the swimming beach useless.

7.8.3 Potential Mitigation Measures. Potential mitigation measures would be to extend the boat ramp and dock to the south so the boat ramp toe has more clearance and to create a new swimming beach either by extending the existing one or by establishing a new site, so it would be usable at the lower pool elevation. At MOP elevation, a longer dock access gangway will be needed to make the angle to the dock walkable.

7.8.4 Costs and Schedules. Assumptions for construction; construct a new swimming beach, add an extended-length access gangway (100 feet long and 4 feet wide), and add two new piles (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 2 months to complete.

TABLE 7-7 *Cost Estimate, Roosevelt Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Dredging (soil)	lcy	1,440	$ 4	$ 5,760
Swimming beach sand	lcy	960	$ 8	$ 7,680
Aluminum gangway	sq. ft	440	$ 44	$ 19,360
Steel pile	each	2	$10,000	$ 20,000
CONSTRUCTION TOTAL				$152,800

7.9 Arlington Park, Oregon

7.9.1 Description. This park is located on China Ditch in the city of Arlington, Oregon, at RM 241. There are the following facilities at this park: a boat ramp, a floating bandstand and access ramp, one moorage dock, one tie-up dock, and a swimming beach. The bandstand is located on the north edge of the swimming area at the warning floats. There is an inactive ferry slip adjacent to the boat ramp. The toe of the slip is eroded and currently not usable without some work to re-establish the ramp. Access to the park is by city street and access ramps off I-84 from both the east and west, and by boat under the Union Pacific Railroad and I-84 bridges. The boat ramp toe elevation is 258.5 feet. The river bottom elevation of the west end of the boat ramp dock is 252.4 feet and the east end is 258.5 feet. The river bottom elevation of the tie-up dock is 252.3 feet. The river bottom elevation of the west end of the moorage dock is 248.2 feet and the east end is 244.5 feet. The bottom elevation of the swimming beach near the warning floats is 252.5 feet. The river bottom elevation along the south side of the bandstand is about 256.5 feet.

7.9.2 Impact of Operation. Access to the boat ramp and docks would not be affected if the MOP elevation of 257 feet is adopted, since there is a channel with its river bottom elevation deeper than elevation

244 feet. However, the boat ramp toe would be approximately 1.5 feet above the water level, the swimming beach area would be reduced in size by approximately one half, and the new bandstand would be grounded along its south edge. The grounding of the bandstand will affect the city's summer concert program because the grounding may make the bandstand surface too steep to stand or sit on. In addition, the grounding might rack the bandstand making it unusable in the future. The boat ramp dock's east end would be grounded at elevation 257 feet, making it more difficult to use the boat ramp.

7.9.3 Potential Mitigation Measures. Potential mitigation measures would be to extend the swimming beach along the western side of the embayment, extend the boat ramp to the west, install longer access gangways to the moorage and tie-up docks, extend the boat ramp dock, and dredge the existing swimming beach to allow floating clearance for the bandstand. Sand would be needed to surface the river bottom of the extended swimming area, and new boat ramp paving would be needed.

TABLE 7-8 *Cost Estimate, Arlington Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Dredging (soil)	lcy	1,830	$ 4	$ 7,320
Swimming beach sand	lcy	890	$ 8	$ 7,120
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	8	$ 10,000	$80,000
9-foot concrete float	ft^2	260	$ 20	$ 5,200
Aluminum gangway	ft^2	1,760	$ 44	$77,440
CONSTRUCTION TOTAL				$285,020

7.9.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock 40 feet, add four extended-length access gangways (100 feet long and 4 feet wide), dredge around the bandstand (4 feet by 10 feet by 200 feet), extend the swim beach north of the bandstand (100 feet by 100 feet by 3 feet), and add eight new piles (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 2 months to complete.

7.10 Quesnel (or Threemile Canyon) Park, Oregon

7.10.1 Description. This park is located on the Oregon shore at RM 255. There is only a boat ramp at this park, although the concrete boat ramp dock anchor is in place without the dock. There is also a vault toilet. Access to the park is by road off I-84 from the south or by boat through either entrance channels in the reef to the north. The boat ramp toe elevation is 259 feet. The elevation of the river bottom at the east entrance channel is 258.1 feet. The elevation of the river bottom at the west entrance channel is deeper than 244 feet.

7.10.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the boat ramp toe would be approximately 2 feet above the water level and the east entrance channel would be unusable.

7.10.3 Potential Mitigation Measures. Potential mitigation measures would be to extend the boat ramp to the north, dredge the east entrance channel, or close the park.

TABLE 7-9 *Cost Estimate, Quesnel (or Threemile Canyon) Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Dredging (rock)	lcy	700	$ 50	$ 35,000
CONSTRUCTION TOTAL				$142,940

7.10.4 Costs and Schedules. Assumptions for construction; extend the boat ramp for 40 feet and dredge the east entrance channel (5 feet by 50 feet by 50 feet). It is estimated that the construction work at this site will take approximately 2 months to complete.

7.11 Alderdale Park, Washington

This park is located on the Washington shore at RM 257. The park is not currently maintained, therefore there will be no further discussion of the site.

7.12 Crow Butte State Park, Washington

7.12.1 Description. This park is located on Crow Butte on the Washington shore at RM 262. There are the following facilities at this park: overnight camping areas, day use areas, three boat ramps, a tie-up dock in the east embayment, a boat ramp dock between two of the boat ramps, several swimming beaches, potable water, and water-borne sewage. Access to the park is by road off SR-14 from the north or by boat. The toe elevation for the boat ramp in the embayment is 261.3 feet. The toe elevation for the east boat ramp is 259.6 feet, and for the west boat ramp is 258.8 feet. The river bottom elevation along the tie-up dock is 259.5 feet. The river bottom elevation of the swimming beach ranges from 260.3 to 253.1 feet. The east embayment bottom elevation is approximately 254 feet. In addition to the recreational facilities, there is an irrigation pump mounted to a steel pile dock adjacent to the swimming beach area (outside the embayment for swimming). The river bottom elevation on the southwest side of the pump intake is approximately 260 feet and on the northeast side is 258.4 feet. However, at 15 feet to the north from the intake, the river bottom drops away to be deeper than elevation 249.3 feet.

7.12.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, access to the boat ramp in the eastern embayment would be possible, since the access channel river bottom is deep enough. However, the boat ramp toe would be approximately 4 feet above the water level and the embayment bottom elevation near the tie-up dock would be approximately 2.5 feet above the water level. The swimming beach area would be reduced in area, with depths ranging from 0 feet to 4 feet deep. The irrigation pump intake would be above the water level and thus useless.

7.12.3 Potential Mitigation Measures. Potential mitigation measures would be to extend the swimming beach and all three boat ramps to the east and north, and dredge the embayment around the tie-up dock. In addition, sand would be needed to surface the bottom of the extended swimming area and the irrigation pump intake would need to be extended down into the water again. This might be a simple pipe addition or a whole new pump/motor set. A longer dock access gangway to the tie-up dock will be needed at MOP elevation to make the angle down the dock walkable.

7.12.4 Costs and Schedules. Assumptions for construction; extend three boat ramps and two boat ramp docks 40 feet, add one extended-length access gangway (100 feet long and 4 feet wide), dredge the swimming beach (300 feet by 100 feet by 3 feet), extend one irrigation pump inlet (20 feet), and add four new piles by the embayment dock (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 3 months to complete.

TABLE 7-10.--*Cost Estimate, Crow Butte State Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Unclass. excavation	lcy	560	$ 4	$ 2,240
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	150	$ 1	$ 150
Dredging (soil)	lcy	8,500	$ 4	$ 34,000
Swimming beach sand	lcy	2,890	$ 8	$ 23,120
Concrete boat ramp	yd^2	150	$ 100	$ 15,000
Steel pile	each	4	$10,000	$ 40,000
9-foot concrete float	ft^2	260	$ 20	$ 5,200
Pump inlet extension	LS	Job	$ 5,000	$ 5,000
Aluminum gangway	ft^2	440	$ 44	$ 19,360
CONSTRUCTION TOTAL				$244,570

7.13 Plymouth Park, Washington

7.13.1 Description. This facility is located on the Washington shore, at RM 289, across the river from Umatilla, Oregon. The park contains camping areas, picnicking areas, a swimming beach, a boat ramp with two docks, and a tie-up dock in the boat ramp embayment. Access to the facility is via SR-14 from the north or by boat. The boat ramp toe elevation is 257.8 feet. The river bottom elevation at the end of the eastern boat ramp dock is 255.3 feet and at the end of the western dock, is 253.7 feet. The river bottom elevation at the eastern end of the tie-up dock is 253.1 feet and at the western end of the dock, is 255.4 feet. The river bottom elevation of the access channel leading to the swimming beach from the Columbia River east of the park ranges from approximately 250 to 254 feet. The river bottom elevation of the swimming beach at the warning floats is approximately 250 feet. The boat ramp embayment bottom elevation is approximately 251 feet.

7.13.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the boat ramp toe will be above the water level by approximately 1 foot. The boat ramp and tie-up docks will have between 2 and 4 feet of depth at their southern ends.

7.13.3 Potential Mitigation Measures. Potential mitigation measures for this site would be dredging of the boat ramp and dock area and extension of the boat ramp, boat ramp docks, and adding a longer access gangway to the tie-up dock.

7.13.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock for 40 feet, add two extended-length access gangways (100 feet long and 4 feet wide), dredge around the moorage dock (2 feet by 200 feet by 10 feet), and add four additional piles by the moorage dock (assumes that existing piles can be pulled and reused, if needed. It is estimated that the construction work at this site will take approximately 2 months to complete.

TABLE 7-11 *Cost Estimate, Plymouth Park, Washington*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Dredging (soil)	lcy	190	$ 4	$ 760
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	4	$10,000	$ 40,000
9-foot concrete float	ft^2	260	$ 20	$ 5,200
Aluminum gangway	ft^2	880	$ 44	$ 38,720
CONSTRUCTION TOTAL				$192,620

7.14 Nugent Park, Oregon

7.14.1 Description. Nugent is a city park located in Umatilla, Oregon on the east shore of the Umatilla River at about RM 0.5. There is a boat ramp and a single unit dock along the ramp. Access to the park is by boat up the Umatilla River or by city street off US Highway 730 (US 730) from the north. The boat ramp toe elevation is 260.3 feet. The elevation of the river bottom at the end of the dock along the boat ramp is approximately 265 feet. The Umatilla River channel up to the ramp is very shallow. At the mouth of the river, the river bottom elevation is 256.4 feet and directly off the boat ramp, the river bottom elevation is 259.3 feet.

7.14.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, access to Umatilla River and to the boat ramp will be affected. The boat ramp toe will be approximately 3 feet above the water level and the river channel will be reduced to a very small size, not passable by boats larger than canoes.

7.14.3 Potential Mitigation Measures. Potential mitigation measures would be to dredge the Umatilla River from the mouth up to the boat ramp, to extend the boat ramp, and to extend the boat ramp dock.

TABLE 7-12 *Cost Estimate, Nugent Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$100,000	$100,000
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Dredging (soil)	lcy	17,800	$ 4	$ 71,200
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	4	$ 10,000	$ 40,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
CONSTRUCTION TOTAL				$227,140

7.14.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock (including four steel piles) 40 feet and dredge the Umatilla River (3,696 feet by 5 feet by 20 feet). It is estimated that the construction work at this site will take approximately 2 months to complete.

7.15 Boardman Park, Oregon

7.15.1 Description. This park is located on the Oregon shore, near the community of Boardman, Oregon, at RM 268. There are the following facilities at this park: two moorage docks, a swimming beach, a boat ramp, a boat ramp dock, a tie-up dock, camping facilities, potable water, and water-borne sewage from the city of Boardman. Access to the park is by road from I-84 to the south. The boat ramp toe elevation is 259.2 feet and the river bottom elevation at the end of the boat ramp dock is approximately 249 feet. The river bottom elevation at the northern end of the western moorage dock is 251.1 feet and 257.3 feet at the south end. The river bottom elevation at the northern end of the eastern moorage dock is approximately 252 feet and 257.2 feet at the south end. The river bottom elevation at the warning floats for the swimming beach ranges from 242.3 feet at the northern float to 248.5 feet at the southern float. The water and sewer facilities will not be affected. The river bottom elevation at the east end of the embayment ranges from 256.7 to 249.9 feet. The bottom elevation at the west end of the embayment entrance is approximately 247 feet. Portions of the bottom of the embayment are rock.

7.15.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, the swimming beach will be reduced in area, but, given the water depth at the floats, could be extended. The boat ramp toe will be approximately 2 feet above the water surface. The boat ramp dock will have approximately 8 feet of clearance at the north end, however, the south end will have several more dock units grounded. The tie-up dock will be grounded. The western moorage dock will have approximately 6 feet of clearance at the north end and the south end will be grounded. The eastern dock will have approximately 5 feet of clearance at the north end and the south end will be grounded. The tie-up dock and both moorage docks will require longer access gangways. If the boat ramp is not extended, the number of park users would most likely drop, since they could not launch their boats at the park. They could continue to use the moorage docks, if the access gangways are lengthened. The reduction in pool level would require that smaller draft boats be used to access an extended boat ramp and to use the moorage docks.

7.15.3 Potential Mitigation Measures. Potential mitigation measures would be to extend the boat ramp and tie-up dock to the north so the boat ramp toe has clearance and to lengthen all access gangways to reduce the slope. In addition most of the embayment should be dredged 5 feet deeper. Deepening will be extremely costly due to the rock materials. No other alternative to dredging the embayment, except no action, appears reasonable. For purposes of this reconnaisance study, deepening is included. In followon activities, incremental justification of this measure will be addressed.

7.15.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock 40 feet, add two extended-length access gangways (100 feet long and 4 feet wide), dredge the embayment 5 feet deeper (involving about 48,000 cy of rock), and add 10 new piles along the moorage docks (assumes that existing piles can be pulled and reused, if needed). It is estimated that the construction work at this site will take approximately 4 months to complete.

TABLE 7-13 *Cost Estimate, Boardman Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$320,380	$ 320,380
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Dredging (rock)	lcy	48,000	$ 100	$4,800,000
Dredging (soil)	lcy	147,000	$ 4	$ 588,000
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	10	$ 10,000	$ 100,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
Aluminum gangway	ft^2	1,320	$ 44	$ 58,080
CONSTRUCTION TOTAL				$5,882,400

7.16 Irrigon Park, Oregon

7.16.1 Description. This park is located at Irrigon, Oregon, at RM 282. There are the following facilities at this park: a boat ramp, two long-term moorage docks, one tie-up dock, a swimming beach, and camping facilities. Access to the park is by city street off US 730 from the south. The boat ramp toe elevation is 259.9 feet. The river bottom elevation at the north end of the boat ramp dock is 255.5 feet. The river bottom elevation along the tie-up dock ranges from 253.2 feet at the north end to 255.8 feet at the south end. The river bottom elevation along the western moorage dock ranges from 251.2 feet at the north end to 254.6 feet at the south end. The river bottom elevation at the eastern moorage dock ranges from 251.2 feet at the north end to 253.2 feet at the south end. The river bottom elevation of the channel north of the docks ranges from 251.5 feet at the east end to 254.2 feet off the end of the boat ramp to 255.6 feet at the entrance to the embayment. The river bottom elevation of the swimming beach near the warning floats ranges from about 258.3 feet at the northern float to 259.4 feet at the southern float to 257.9 feet at the swimming platform.

7.16.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, access to the boat ramp would not be possible, since the entrance channel river bottom elevation is 255.6 feet. The boat ramp would be above water level by approximately 3 feet. In addition, the swimming beach would be dry.

7.16.3 Potential Mitigation Measures. Potential mitigation measures would be to extend boat ramp to the north and dredge the entrance channel. All access gangways to all docks would also need to be lengthened to access the now-lower docks.

7.16.4 Costs and Schedules. Assumptions for construction; extend the boat ramp and boat ramp dock 40 feet, add three extended-length access gangways (100 feet long and 4 feet wide) and add eight new piles along the moorage docks (assumes that existing piles can be pulled and reused, if needed). Dredging is required at the entrance only, not by the docks. It is estimated that the construction work at this site will take approximately 2 months to complete.

TABLE 7-13 *Cost Estimate, Irrigon Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$20,000	$20,000
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	8	$10,000	$80,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
Aluminum gangway	ft^2	1,320	$ 44	$58,080
CONSTRUCTION TOTAL				$174,020

7.17 Umatilla Park, Oregon

7.17.1 Description. This park is located at Umatilla, Oregon, at RM 290. The following facilities are provided; a boat ramp, four long-term moorage docks, a fueling dock, a swimming beach, and camping facilities. Access to the park is by city streets off US 730 from the south. The boat ramp toe elevation is 256.2 feet. The river bottom elevation at the north end of the boat ramp docks is 252.5 feet. The river bottom elevation along the fueling dock ranges from 247.8 feet at the north end to 252 feet at the south end. The river bottom elevation along the western moorage dock ranges from 251.7 feet at the north end to 254.3 feet at the south end. The river bottom elevation along the western covered moorage dock ranges from 253.6 feet at the north end to 252.2 feet at the south end. The river bottom elevation along the eastern covered moorage dock ranges from 251.9 feet at the north end to 253.8 feet at the south end. The river bottom elevation along the eastern moorage dock ranges from 252.2 feet at the north end to 252.8 feet at the south end. The river bottom elevation of the channel north of the docks ranges from 250.9 feet at the east end to 250.7 feet off the end of the western moorage dock to 247.8 feet west of the fueling dock. The entrance channel is quite deep since the current marina was built over an older one. The eastern moorage dock has about 10 boats with a draft greater than 3 feet. The river bottom elevation of the swimming beach along both the east and west sides is 255.9 feet and ranges from 253.5 feet at the western float to 255.1 feet at the eastern float. The bottom of the embayment at this marina appears to be solid rock.

7.17.2 Impact of Operation. If the MOP elevation of 257 feet is adopted, access to the ramp would be possible, however, there would be approximately 1 foot of clearance at the toe. The docks appear to be accessible to shallow draft boats but not for the deeper draft sailboats moored at the facility. The swimming area would be reduced in size and depth of water. In addition, the eastern half of the embayment would be dredged 3 feet deeper.

7.17.3 Potential Mitigation Measures. Two potential mitigation alternatives were identified for Umatilla Park. A potential second alternative was identified in order to eliminate costly rock removal within the existing embayment. Further consideration of the alternatives after determining actual rock depths and locations will need to be made during more detailed studies.

Alternative 1: Extend both the swimming beach and boat ramp to the north. Dredge the embayment along the eastern moorage dock . Lengthen access gangways.

Alternative 2: In addition to the boat ramp and swimming beach work, this alternative would provide a new moorage dock, passenger access, and fueling dock outside the existing embayment. It would also provide a new breakwater to protect the new facilities. The existing facilities inside the embayment would remain to provide service to shallow draft boats.

7.17.4 Costs and Schedules. Costs for the alternatives are shown in the following tables. It is estimated that the construction work at this site will take approximately 4 months to complete.

TABLE 7-15 *Alternative 1 Cost Estimate, Umatilla Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$166,800	$ 166,800
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Dredging (rock)	lcy	53,330	$ 100	$5,333,000
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	10	$10,000	$ 100,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
Aluminum gangway	ft^2	2,640	$ 44	$ 116,160
CONSTRUCTION TOTAL				$5,731,900

TABLE 7-16 *Alternative 2 Cost Estimate, Umatilla Park, Oregon*

Item	Unit	Qty.	Unit price	Total price
Mobilization	LS	Job	$166,800	$ 166,800
Unclass. excavation	lcy	90	$ 4	$ 360
Riprap, class I	lcy	10	$ 50	$ 500
Filter fabric	yd^2	80	$ 1	$ 80
Concrete boat ramp	yd^2	70	$ 100	$ 7,000
Steel pile	each	10	$10,000	$ 100,000
9-foot concrete float	ft^2	400	$ 20	$ 8,000
Aluminum gangway	ft^2	2,640	$ 44	$ 116,160
Dredging (rock) (new)	lcy	5,500	$ 100	$ 555,000
Paved access walkway	lf	2,500	$ 7	$ 17,500
Unclass. embankment	lcy	5,230	$ 5	$ 26,500
Riprap, class III	lcy	20,440	$ 33	$ 675,500
Filter fabric (additional)	yd^2	5,990	$ 1	$ 5,990
Extend fueling dock utilities	LS	job	$35,000	$ 35,000
Additional aluminum gangway	ft^2	800	$ 44	$ 35,200
CONSTRUCTION TOTAL				$1,749,590

8. IMPACTS TO WATER SUPPLY

8.1 Introduction

This section presents a preliminary evaluation of the impacts of MOP operation to various subsurface collectors and wells on and in the vicinity of the John Day project. Impacts to surface water irrigation stations are discussed in Section 9. Subsurface collectors (Ranney wells) are used by the City of Boardman and the Umatilla and Irrigon fish hatcheries as the primary source of water for their respective purposes. Groundwater supplies vary significantly in capacity and are used for a number of purposes, including irrigation , municipal and industrial water supplies, private commercial and domestic uses. The certainty and extent of impacts to groundwater wells is difficult to predict at this point and would require establishment of base conditions prior to MOP operation followed by monitoring during the operation, should it be implemented. Even this relatively small reduction in pool level is of concern because of the apparent strong connection between the pool and water table in this area, the rapidly decreasing permeability with minor drawdown in the shallow aquifer from which many of the wells derive the water, and the arid climate in the region.

8.2 City of Boardman Municipal and Industrial Ranney Well

Most of the communities adjacent to Lake Umatilla obtain their domestic use water from ground water wells. Boardman's well is unique, however, in that it is a Ranney well system. This Ranney well consists of a large diameter vertical shaft constructed through sediments to below elevation 225 feet. A series of 10 3/4-inch-diameter screened laterals extend out horizontally from the shaft at elevation 225. These laterals trend both toward and parallel to the Columbia River. This increases the effective well diameter to approximately 50 feet. Water is pumped directly from the shaft through the use of two pumps with a third standby pump available for emergency use. Maximum theoretical water quantity available through the Ranney system is 10,600 gal/min at pool elevation 265. Actual maximum well production is limited to 6,030 gal/min at pool elevation 265. This limitation is to maintain the entrance velocity through the lateral screen to less than 0.05 feet per second to prevent screen clogging and potential damage to the system.

The city of Boardman has extensive studies of the Ranney well system underway and has plans to construct two additional Ranney wells when water demands increase. Currently, the city is only using an average of 600 to 800 gal/min with peak demand in excess of 1,300 gal/min in the summer months. This water demand is less than the estimated 6,030 gal/min capacity at pool elevation 265. Studies of the present Ranney well indicate that as the pool is lowered the river edge moves away from the Ranney well increasing the size of the drawdown curve and adversely affecting the well capacity. Maximum allowable capacity of the existing well drops from 6,030 gal/min at elevation 265 to 3,300 gal/min at elevation 250. This drop represents a loss of about 182 gal/min per foot of drawdown. Assuming a straight line relationship, the loss of water when the pool is lowered to elevation 257 is about 1,460 gal/min or an approximate loss of 25 percent of the currently available water supply for which mitigation is required. Additional sources would be required to restore the system's capacity.

Based on testing by the city, a problem with water quality deterioration occurs when the pool is lowered below approximately elevation 263. Alkalinity, hardness silt and sand increase in the water. The degree of increase in the constituents at pool elevation 257 feet cannot be accurately predicted without testing, but indications are that hardness and alkalinity would exceed drinking water advisory standards at that level. There are no required standards for these constituents. Restoration of existing water quality can be accomplished with addition of treatment and filtration to the water.

Detailed estimates have not been prepared, but the cost to restore the 25 percent of capacity and to provide a treatment plant is estimated to be $1.3 million. Operation and maintenance of the additional facilities is estimated to cost about $100,000 per year.

8.3 Private, Commercial, Municipal and Irrigation Ground Water Wells

Drawdown to elevation 257 will have significant effects upon some of the more than 2,000 private, commercial, municipal, and irrigation ground-water wells in the area adjacent to Lake Umatilla. The number of wells affected and the severity of the impacts will in large part be dependent upon the time frame and length for the drawdown period. Drawdown effects at water wells during the proposed 4-month period which is also a high ground water use period, will have greater impacts upon well operations than if the 4-month period occurred during the winter in a low ground water use period. Of even greater significance will be differences between the temporary effects of a 4-month drawdown vs. the permanent effects of a continuing year round drawdown.

Drawdown impacts for ground-water wells will be similar in many ways to drawdown impacts for irrigation pump stations within Lake Umatilla. Similarities include reduced capacity, reduced efficiency and increased operating costs. Other impacts are primarily related to aquifer conditions and include reduced saturation intervals, lowered permeability, increased water hardness and increased alkalinity. Ground-water well impacts will generally tend to be less severe and more delayed than irrigation pump station impacts. But some wells with very limited saturation intervals and/or with saturation intervals primarily above elevation 257 will go dry with drawdown.

Potentially significant adverse impacts to ground-water wells from a pool drawdown from elevation 265 to elevation 257 are indicated from a pool drawdown test made for the Irrigon and Umatilla hatcheries ground-water supply in 1992. This test indicated a loss of water well efficiency of more than 5 percent per foot of pool drawdown.

The two major ground-water sources in which wells are located are the relatively shallow alluvial aquifers and the deeper underlying Columbia river basalt flows. Drawdown impacts upon ground-water wells will increase with proximity to Lake Umatilla, and will mostly occur in the alluvial aquifers that have saturated intervals at or near Lake Umatilla water elevations. Year round drawdown impacts will also include long term affects upon ground water recharge conditions among the various aquifers and as a result will also impact ground-water wells in the basalt aquifers. Time intervals between lake drawdown and specific impacts at individual wells are primarily dependent upon the water transmitting capability that exists between Lake Umatilla and the individual well. These time intervals will vary considerably from less than a minute to as much as several years for permanent drawdown conditions.

Measurement of drawdown effects upon ground-water wells will be difficult to determine particularly for long-term delayed impacts. About 1,500 well logs from the more than 2,000 water wells in the Lake Umatilla area were copied during preliminary studies for the Interim Status Report. A brief review of about 700 of these logs was made to determine potential 4-month drawdown impacts. A preliminary estimate is that 67 wells will be adversely impacted by a 4-month drawdown sufficiently to require well modification. This number will increase to an estimated 5 to 10 percent of the 2,000+ wells within the area that will be adversely impacted by a year round drawdown sufficiently to require well modifications.

A four phase program is required to determine ground-water well impacts caused by drawdown. Establishment of a complete and accurate ground-water well inventory based upon well logs obtained from state agencies in Oregon and Washington supplemented by field data collection is the first phase of this essential process. This inventory must include critical well installation details, aquifer information, and well production records. The partial inventory prepared for the Interim Status Report was only the initial step in preparing a complete inventory of all ground-water wells in the vicinity of Lake Umatilla that could be impacted by drawdown.

The second phase of the process is to select typical ground-water wells for monitoring of pump operations, well production and water levels. These typical wells need to include representative wells for each well concentration area and for the various aquifer conditions that could be impacted by the drawdown. These typical wells must also be distributed throughout the lands surrounding Lake Umatilla.

Monitoring of operating conditions in the typical wells is the third phase in determining drawdown impacts upon ground-water wells. Monitoring must begin at least one year and if possible more than one year prior to the initial drawdown to establish base conditions. Monitoring during drawdown will continue at least two years if a 4-month drawdown period is implemented, and will continue at least five years if a year round continuing drawdown period is implemented. The five year monitoring time requirement for implementation of permanent drawdown is essential to determine all of the adverse long term impacts to the ground-water wells. Monitoring will also be necessary throughout the full year for all of these monitoring periods.

Monitoring will include both manually and instrumented measurements obtained on a regular basis. Additional inspections will be made for all observed ground-water well problems where suspected drawdown impacts have occurred. Well instrumentation for monitoring purposes will include various types of piezometers, elapsed time meters, flow meters and hydrographs installed in appropriate typical wells.

The fourth phase in determining impacts to wells will be to investigate all measured and/or reported well problems that are attributed to drawdown. Data obtained from the monitoring program will be utilized to determine the validity and amount of remedial mitigation required to compensate for drawdown impacts at specific ground-water wells. Well mitigation actions can include increasing well efficiencies by various means, lowering pump intakes, deepening wells, installing new pumps, installing new or extended well screens, and as a final resort drilling a new replacement or supplemental well.

Mitigation costs for a 4-month drawdown and for a year round drawdown are summarized in the following tables. Phase 1 and 2 costs are similar for either proposed drawdown period but the phase 3 and 4 costs are considerably higher for year round drawdown due to the longer monitoring requirements and the greater anticipated long term impacts.

GROUND-WATER WELLS
MITIGATION COSTS FOR 4-MONTH DRAWDOWN

PHASE	ACTIVITY	COST
1	COMPLETION OF WELL INVENTORY	$180,000
2	SELECTION OF REPRESENTATIVE WELLS	20,000
3a	PURCHASING/INSTALLATION OF MONITORING INTERVALS	250,000
3b	MONITORING COSTS (BASE YEAR)	150,000
3c	MONITORING COSTS (TWO DRWDWN YEARS)	300,000
4	WELL MODIFICATIONS (67 WELLS)	633,000
	TOTAL	$1,563,000

MITIGATION COSTS FOR YEAR-ROUND DRAWDOWN

PHASE	ACTIVITY	COST
1	COMPLETION OF WELL INVENTORY	$180,000
2	SELECTION OF REPRESENTATIVE WELLS	20,000
3a	PURCHASING/INSTALLATION OF MONITORING INSTRUMENTS	250,000
3b	MONITORING COSTS (BASE YEAR)	150,000
3c	MONITORING COSTS (FIVE DRWDWN YEARS)	750,000
4	WELL MODIFICATIONS (200 WELLS)	2,000,000
	TOTAL	$3,600,000

8.4 Irrigon and Umatilla Fish Hatcheries

8.4.1 Irrigon Fish Hatchery. Irrigon Fish Hatchery is located on the Oregon shore of the John Day pool at RM 279 and is operated by ODFW under authority of the Lower Snake River Compensation Plan (LSCP). Fish reared include spring and fall chinook salmon (*Onchoryncus tshwaytscha*) and steelhead (*Onchoryncus mykiss*). Fish are released off station in late April through late May.

Two Ranney wells and three standard vertical wells supply water to Irrigon Fish Hatchery. The original well system was designed to produce 25,000 gal/min of flow to meet system fish loading capacity. Current (1992) maximum water production is approximately 18,000 gal/min (at pool elevation of 264 feet)

8.4.2 Umatilla Fish Hatchery. Umatilla Fish Hatchery is located immediately downstream from Irrigon Hatchery and is also operated by ODFW. This facility is funded by BPA. Fish reared include spring and fall chinook salmon and steelhead. Fish are released off site, primarily in the Umatilla River.

Water supply for Umatilla Hatchery includes one Ranney well and four vertical wells. The well system was originally designed to produce 15,000 gal/min at maximum production, but actual production is approximately 9,000 gal/min.

8.4.3 Possible Impacts. Presently well systems for both hatcheries are well below designed production (table 8-1). When the Irrigon hatchery was designed, estimated water production was 25,000 gal/min. Actual (original) production was 21,000 gal/min and then dropped to 18,000 gal/min in 1992 (Ray Hill, ODFW, personal communication, 1992). This decrease was suspected to be due to a gradual decrease in permeability due to siltation failure of one lateral in the Ranney system. Umatilla hatchery was designed to produce 15,000 gal/min of water at full capacity, but in 1992 (first full production year) the system produced only a maximum 9,000 gal/min. Since the hatcheries are currently not meeting production goals (water or fish production), any further decrease in water production would cause significant impact.

Table 8-1 shows current and designed water demands. The greatest water demand during the 4-month drawdown period is early May just prior to release of many juveniles from the hatchery. A reduction in water production at the hatcheries will result in reduced fish production at both hatcheries or an early release of fish which may translate into lower survival of adult fish. Since fish production is currently below that prescribed by the LSCP, any further reduction could be significant. Considering a year-round drawdown, the maximum combined requirement under the current level of operation would be 27,000 gpm during the months of February, March, and April.

TABLE 8-1 *Actual (1992) and designed water production at Irrigon and Umatilla fish hatcheries*

	Irrigon Fish Hatchery		**Umatilla Fish Hatchery**	
Month	**actual water use (gal/min)**	**designed water need**	**actual water use (gal/min)**	**designed water need**
Jan	18,000	22,000	4,000	4,000
Feb	18,000	25,000	9,000	11,000
March	18,000	25,000	9,000	15,000
April	18,000	22,000	9,000	15,000
May	2,000	2,000	9,000	15,000
June	2,500	2,500	400	400
July	6,000	6,000	1,000	1,000
Aug	6,000	6,000	1,800	1,800
Sept	8,000	8,000	2,200	2,200
Oct	13,000	13,000	3,250	3,250
Nov	14,000	14,000	3,250	3,250
Dec	18,000	21,000	3,650	3,650

If the pool level is lowered, production from wells at Irrigon and Umatilla hatcheries will be reduced. The amount of reduction is difficult to predict without a complete testing program. During preparation of the interim report a reduction of as much as 10 percent per foot of drawdown or approximately 75 percent at elevation 257 feet was estimated. Since that report, Walla-Walla District conducted a preliminary test during normal lowering of the pool for the winter season of 1992-1993. As discussed in paragraph 8.3, results of those preliminary tests seem to indicate a lesser effect than originally estimated, on the order of about 5% per foot of drawdown. Field studies including test wells continue and the figures are likely to require further adjustment. Based on the preliminary test, it is now estimated that production under the drawdown condition for the existing system would be reduced to about 17,000 gpm. Based on that information, under current level of operation it appears that additional water would not be necessary for the 4-month drawdown alternative. In the case of year-round drawdown, however, the system would not appear to be capable of supplying the quantity of water required during the peak periods of hatchery operation with the pool lowered.

8.4.4 Mitigation Alternatives. In determining solutions to reduction of water supply to the hatcheries it was assumed that the most effective method was to develop one water source for both hatcheries. In other words, combine the water supply for the hatcheries and split the water to the individual facilities prior to the aerator towers.

Possible solutions investigated were; 1) use shallow ground-water wells along the Oregon and Washington shores, 2) deep ground water wells, 3) reuse hatchery water, 4) use Columbia River water, 5) recharge the shallow aquifer, 6) early release of fish, 7) relocate the hatcheries, 8) reduce fish production.

Shallow Ground-Water Wells. Use of shallow ground-water wells was determined to be a desirable solution since this is the current water supply source, and therefore would require little change in hatchery operations. This option considered using ground-water from Oregon and Washington shores based on known availability of water from current well production. Based upon available information it is estimated that to meet current well production levels approximately 20 new wells would be needed. The distance of these wells from the hatchery would be up to 20 miles. Although this production of the required 10,000 gpm of supplemental water from shallow wells is a desirable solution, it does not appear to be a practical solution. Critical ground-water shortages exist in some areas and locating 20 new wells without interfering with existing irrigation and domestic well productions would be extremely difficult. Numerous test wells would be required to determine final well locations and available data suggest that the total aquifer capacity may be inadequate to readily provide the needed 10,000 gpm on an annual basis when the pool elevation in held at 257.0 ft. The complexity of a distributor system from the various wells to the hatcheries and the possible need to chill the water due to the long transport distances anticipated further complicates use of shallow ground-water wells as a potential solution for the supplemental water supply.

A preliminary cost for a supplemental shallow well system is in excess of $20,000,000 as shown on Table 8-2. This amount does not include real estate aquisition costs. Estimated engineering and design time is 36 months and includes one year for the drilling of 40 initial test wells.

Estimated construction time is 24 months for a total time frame of 60 months. Due to high cost and unknown production of ground-water wells at a permanent pool elevation of 257.0 ft., this option does not appear to be feasible in comparison with some of the alternate solutions. Certainly additional water well investigations would be required to validate the potential and costs for producing 10,000 gpm of supplemental water from shallow ground-water wells and/or additional Ranney well installations.

TABLE 8-2 *Estimated costs for new well system for Umatilla and Irrigon hatcheries (year-round drawdown)*

COST ITEMS	AMOUNT
Initial Surveys, Permits, Drilling, Development & Testing @$50,000 each for 40 Initial Test Wells	$2,000,000
Final Surveys, Permits, Drilling, Development & Testing @ $100,000 each for 20 Final Selected Wells	$2,000,000
Pumphouse, Pump, Electrical & Mechanical @ $115,000 each for 20 Wells	$2,300,000
Pipeline Unit Prices - Inplace Costs (Assume 20 Miles) a. 80% Overburden @ $65/L.F. 5,491,000 b. 20% Rock @ $200/L.F. 4,224,000 c. River Crossing 5,000 ft. @ $120/L.F. 600,000	$10,315,000
Electrical Distribution Costs "@ $100,000/Mile	$2,000,000
Backup Power Source - Emergency Generators @ $20,000 each for 20 Wells	$400,000
Booster Pumps for Pump Stations @ $60,000 each for 20 Wells	$1,200,000
Piping Tie In for System	$400,000
TOTAL COST*	$20,615,000
* Does not include aquisition costs for land and/or rights of easement. E&D and S&A costs also not included.	

Deep Ground Water Wells. Use of deep water wells was examined, but due to lack of drawdown data, long-term recharge periods, and inconsistency of deep wells in the area, this is not a desirable option. It also appears that there may be a limited quantity of available water and that the water quality may not be conducive to use at the hatchery without treatment.

Reuse Hatchery Water. Treatment and reusing hatchery water was studied and a schematic plan was developed (figure 8-1). Present combined water production at pool elevation of 264 feet is 27,000 gal/min and is estimated to be 17,500 gal/min at elevation 257 feet. Under the current hatchery production levels (below design standards) 9,500 gal/min of reuse water is required to meet peak water needs for current operation under a year-round drawdown scenario.

Water reuse would include treatment of water after one pass through the system before it is reused. This treatment would include filtering out sediments using a large mesh screen, a bio-filter to remove ammonia and allow some sediment to settle, a secondary filter (screen or sand) to remove fine particulate matter, ozone treatment to remove all pathogens, and chilling to maintain constant water temperatures. Chilling is required in a reuse system since the water treatment process may slightly increase the water temperature. Extent of required chilling is unknown at this time. The system will also include a discharge process to insure that water treated with chemicals can be discharged directly and not be used as reuse water. A cost estimate for a water reuse system is presented in Table 8-3. Operation and maintenance is estimated to be $1.5 million, annually.

Irrigon and Umatilla hatcheries are designed to utilize serial reused water. That means water is used in two or three raceways before it is discharged into the Columbia River. The water reuse plan which has been developed to mitigate for the John Day drawdown would be approximately 60 percent reuse at maximum production levels.

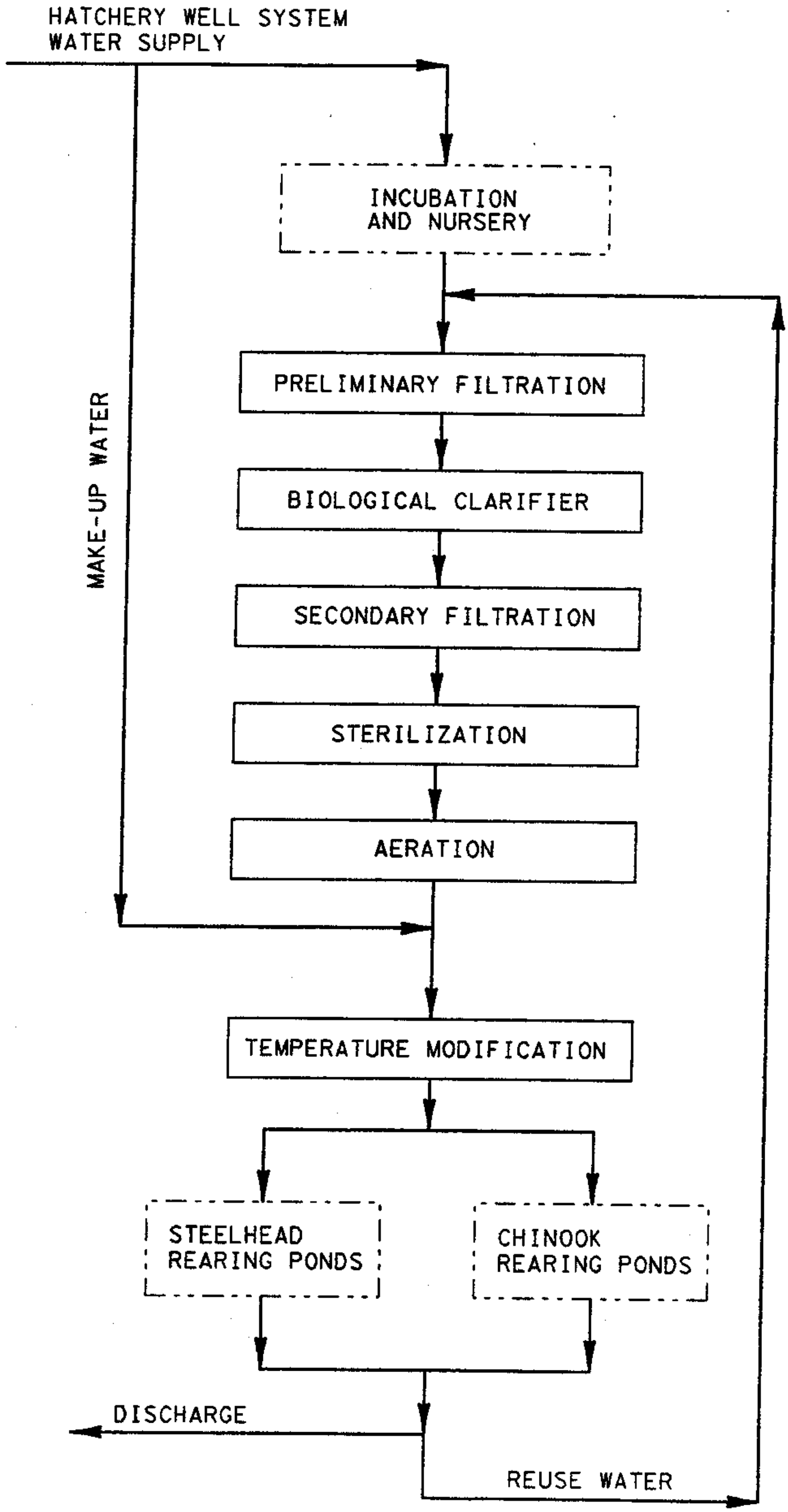


Figure 8-1 Proposed hatchery reuse water system

SCALE: NONE

TABLE 8-3 *Estimated cost for hatchery reuse system, year-round drawdown*

Feature	Estimated Cost
Preliminary filtration	$750,000
Clarification	$2,400,000
Secondary filtration	$6,000,000
Sterilization	$650,000
Aeration	$650,000
Temperature modification	$7,500,000
Electrical	$500,000
TOTAL	$18,450,000

Use Columbia River Water. The idea of using Columbia River water was examined since this would allow for large quantities of water to be used. Water treatment costs would be very high and the water chemistry may be unknown. It is possible that chemical spills, oil spills, fish pathogens, and pesticides may be in the water and not be detected prior to treatment. Positive aspects of using river water are the large availability and the temperature. It appears that the water temperature is near that of the hatchery needs for the drawdown period and therefore it may not be necessary to chill the water to any large extent (more than a few degrees). But construction of a treatment plant for longterm replacement of designed water needs during other than the drawdown months would require extensive water temperature treatment operations.

Recharge Shallow Aquifer. The idea regarding using hatchery outfall and irrigation water to recharge the shallow aquifer would most likely require more water than will be available at MOP and therefore is most likely not desirable or practical.

Other Alternatives. Other alternatives examined included early release of fish, relocating one or both hatcheries, and reducing fish production. Due to the current over-burden of fish hatcheries in the region and the current reduced fish production at Irrigon and Umatilla hatcheries, the above options are not desirable but have not been eliminated as possibilities.

9. IMPACTS TO IRRIGATION

9.1 Introduction

A majority of the information in this section was extracted from reports completed or under preparation by IRZ Consulting together with PACAM Engineering Inc., of Hermiston, Oregon. Their reports were sponsored by Umatilla Electric Cooperative Association, Hermiston, Oregon, which investigates the effects of drawdown on irrigated agriculture in Oregon and Benton County Public Utility District, Kennewick, Washington, which investigated the effects of drawdown on selected pumping stations in Washington. That report covered four of the nine pump stations in Washington. A separate study conducted since publication of the interim report was conducted by a consultant (Bovay Northwest) to the Corps for the remaining Washington stations.

Of the 21 pump stations investigated only one, serving Sandpiper Farms in Washington, appears not to require modifications due to the drawdown operation. The majority of the remaining stations are located in Klickitat and Benton counties in Washington, and Umatilla, Morrow, and Gilliam counties in Oregon. (See figures 12-2 through 12-8 for pump station locations.) The pumping stations range in size from a small 50 gpm station to a large multi-pump platform with a capacity of over 300,000 gpm. The value of crops irrigated by the 21 platforms is estimated to be about $246 million dollars per year. In total, these farms represent 154,280 acres, approximately 30 percent of the total acreage irrigated from the Columbia River in John Day pool. Crops grown on the farms include potatoes, alfalfa, corn, wheat, melons, peas, carrots, asparagus, grapes, and apples. Table 9-1 lists available information on the irrigation station locations and operating data.

The pumping stations are generally constructed in two configurations. One configuration, with vertical turbine pumps, lifts water from a platform in the river. The other configuration employs a pumping facility constructed at the shore of the river with water brought to the station via either a pipeline extending into deep water or an inlet channel.

Although both configurations are vulnerable to lower pool levels, pumping stations located on the shore present the most serious problem because they are generally located further from deeper water in the river.

9.2 Impacts to Irrigation at MOP

When the pool is lowered, several kinds of irrigation system problems can arise. These include pump priming difficulties, reduced capacity, intakes not able to reach the water, reduced cross-section of intake channels, increased pumping cost due to a higher lift, and reduced water levels at sump inverts or weirs. In a number of cases the water surface will be separated from the pumping platform by sandbars up to several thousand feet wide. Floor, weir and fish screening components of the pumping platform sumps vary in elevation and design. As an example, one platform (C&B Livestock) employs a Ranney infiltration collector system to bring the water into the sump. Another (Circle C) is located in a culverted backwater where the

TABLE 9-1 *Irrigation pump station data John Day pool*

RM	Name	Estimated Acreage	Pumping Capacity, gpm
OR 252.2	Boeing/Taggares	25,000	226,000
OR 252.2	J. Trafton	100	800
OR 252.2	Sullivan	700	4,000
OR 268.0	Circle C	550	4,800
OR 271.5	Columbia Impr. Dist./ East Oregon Farms	28,000	259,000
OR 271.6	Port of Morrow	2,000	18,900
OR 271.5	Western Emp. #2	2,400	31,000
OR 280.8	Western Emp. #1/ W. Ext. Irr. Dist #2	3,150	37,200
OR 285.4	Strebin Farms	1,530	13,300
OR 287.3	Perkins Farm	1,700	19,100
OR 287.5	C&B Livestock	2,900	32,500
OR 288.7	Red Leonard/Lamb/ W. Ext. Irr. Dist. #1	10,550	43,100
WA 262.0	Mercer Ranches	3,500	28,000
WA 264.0	100 Circles	10,000	93,000
WA 267.5	Whitcomb Is./USFWS	700	5,000
WA 272.0	Sandpiper Farms	5,100	40,800
WA 271.5	Milliman Farms	50	300
WA 275.5	Stimson Lanes	9,100	90,300
WA 275.5	Sunheaven Farms	9,950	66,000
WA 276.0	South Slope Irrigation Dist.	4,800	36,000
WA 285.0	U&I Inc./Agri-NW	21,000	145,000
	TOTAL ESTIMATED ACREAGE	142,780	

culverts are located under I-84 and the Union Pacific Railroad (at an invert elevation estimated to be El 263). Table 9-1 summarizes the information from the consultants' reports including the measures required to maintain the facility's pumping capability during the drawdown.

9.3 Mitigation Measures and Costs

Preliminary evaluation of measures to restore service to the existing pumping stations generally resulted in several common requirements. Complexity and costs of restorations varied considerably with the configuration and size of the stations. Physical requirements would be the same regardless of 4-month or year-round drawdown. A small increase in operational costs is assumed for the year-round drawdown in that normal irrigation requirements would extend beyond the May-August period. The following is a general description and discussion of the various measures required for restoration of service to the stations under MOP conditions.

Dredging. It appears that for some stations, primarily on the Washington shore, dredging an extended inlet channel or sump would be feasible. At some stations, however, dredging could involve rock excavation. Dredging channels was not generally found to be an acceptable method, particularly along the Oregon shore, due to an anticipated significant amount of sediment movement and infill which would not allow reliable service to the stations during an irrigation season.

Pipeline Extensions. Service to many stations may be restored with an extension of a pipeline from deep water to the existing pump station intake sump. Pipelines would generally be buried and vary in sizes depending on the capacity of the station involved. All pipeline extensions would require appropriate fish screening at the intake end. Twin wedge-wire screens would be attached to the ends of the pipelines. Modification or replacement of vacuum-syphon systems for some intake pipes would also be required.

Low-lift pump stations. The most extensive and costly modifications required at some stations involves installation of a new pumping facility to supply water to the intake sumps or manifold into existing stations. In some cases, as the cost estimates indicate, major construction would be involved. Preliminary indications are that the Boeing/Taggares platform, located about 1-mile up Willow Creek arm, will require a new pump station and a 5,000 foot pipeline to pump water to an improved surge basin at the existing station site. Similar requirements have been identified for the Red Leonard/Lamb/ West Ext. Irrigation District # 1 stations which are located about 0.5 miles up the Umatilla River. Other smaller stations will require similar measures but of a lesser magnitude and cost.

Replace pump screens. For the U&I/ Agri-NW station a potential problem with the screening system was identified subsequent to completion of the consultants reports. The information was provided through discussions with the owner and IRZ. The station employs a series fine mesh screen on each pump intake individually. At the lower head of MOP operation, it is believed that the pumps will not function properly with these screens in place and that they would need to be replaced. The cost for the replacement of these screens was provided by the owner and is included in the estimates. The information and costs will need to be verified during the subsequent phases of study.

Reconnaissance level mitigation costs were prepared by the consultants. Cost estimates were prepared on the existing irrigation platforms based on discussions with the irrigators and limited field observations. Table 9-2 presents a summary of the direct construction costs. Contingencies, planning, engineering and design, and supervision and inspection costs will be summarized for all measures in Section 12. The annual cost associated with the increased electrical power required to pump irrigation water under the lower pool levels and operation and maintenance for new facilities were provided in the consultants' reports and are included in the table.

Modification measures and construction costs for year-round drawdown are assumed to be the same as in Table 9-2 above. Based on information provided by IRZ with regard to the canal alternatives (see below), approximately 20 percent of irrigation occurs during months other than the 4 months in question. It is assumed therefore that increased energy costs for the year-round option would be 20% greater.

TABLE 9-2 *Irrigation pump platform mitigation cost summary*

Name	Modifications	Construction cost	Increased annual operating cost
OREGON			
Boeing/Taggares	Pumping station, pipeline, surge basin	$3,818,000	$169,300
J. Trafton	Pumping station, pipeline	$57,000	$1,600
Sullivan	Pumping station, pipeline	$254,000	$3,100
Circle C	Pumping station, pipeline	$307,000	$2,400
Col Imp. Dist./East Oregon Farms	Dredge sump	$68,000	$33,600
Port of Morrow	Pumping station, pipeline	$245,000	$4,700
Western Empire #2	Pipeline	$199,000	$4,000
West Emp. #1/W. Ext. Irr. Dist. #2	Pipeline	$301,000	$5,000
Strebin Farms	Pumping station, manifold	$100,000	$7,300
Perkins Farms	Pipeline	$423,000	$2,700
C&B Livestock	Pipeline, dredge channel	$426,000	$3,800
Leonard/Lamb/W. Ext. Irr. Dist. #1	Pumping station, pipeline	$1,733,000	$31,300
WASHINGTON			
Mercer Ranches	Dredge channel	$92,000[1]	$3,400
100 Circles	Dredge channel, modify pumps	$516,000[1]	$12,000
Whitcomb Is./USFWS	Dredge channel, modify intake	$46,000	$5,000
Sandpiper Farms	none	0	$8,000
Milliman Farms	Extend intake	$15,000	$1,000
Stimson Lane	Dredge channel, new pumps	$476,000	$22,000
Sunheaven Farms	Extend intake, new vacuum system	$300,000	$41,000
South Slope Irrigation Dist.	Replace vacuum system	$25,000	$6,000
U&I Inc./Agri-NW	Replace pump screens	$1,000,000	$28,000
	Totals	$10,401,000	$395,200

[1] Costs based on excavation in basalt

9.4 Canal Options

Reconnaissance level studies for canal alignments and associated costs in Oregon and for Washington sides were completed by engineering consultants IRZ Consulting and PACAM Engineering, Inc. The study on the Oregon side was sponsored by John Day Pool Irrigators, Oregon Economic Development Department, Bonneville Power Administration, Umatilla Electric Cooperative Association, and Pacific Power. The report titled "Feasibility of Irrigation Canal Along the Columbia River in Oregon" was completed in December 1992. Study objective was to examine the feasibility of an alternative solution to providing irrigation water to the present irrigators on the Oregon side of the John Day Pool. There were six design routes (alignments) studied along with five different Design Capacities for providing varying total amounts of water to the western end of the pool. Alternative combinations of routes and capacities were examined and analyzed for costs and feasibility of construction. Provisions were made to maintain 1/40 cfs (cubic foot per second) flow for each acre to be irrigated by the canal for either those acres presently being irrigated and for an additional 20,000 acres in an expanded irrigation scenario. Power savings for all of the canal alternatives were also calculated for the study. An analysis for modifying the current irrigation pumping systems was made for comparison to the alternative. It was found that of all the alternatives looked at, the pump modification plan still resulted in the least cost alternative, even with the projected power savings included. The modification alternative was less costly by a factor of at least 5 times then that of the canal option plans of choice.

The report on the Washington side was sponsored by the Bonneville Power Administration, Benton County Public Utility District, and John Day Pool Irrigators. The report, "Feasibility Of Irrigation Canal Along The John Day Pool In Washington" was published in March 1993. For the Washington side, canal options included only two routes. Both present and future flows for currently irrigated acreage and for that which may be planted were considered. Cost for the least cost canal on the Washington side was found to be nearly 40 times the cost of modifying the present pump stations.

Based on the results of these studies, the canal options were not considered further as alternatives to pump station modifications.

10. OTHER IMPACTS

10.1 Cultural Resources

For full-scale analysis of the operating strategies, the assessment of cultural resources is based on three assumptions. First, all cultural resources undergo deterioration at a certain rate, regardless of context (i.e. there is no permanent, static situation of preservation). Second, the construction of the dam and reservoir accelerated the deterioration process in most cases. Third, any change in the existing reservoir operation will probably increase the intensity or rate of the deterioration of the cultural resources. This increase in the rate of deterioration is defined as an adverse effect.

The application of an uniform method of assessment to all types of cultural resources located on the John Day reservoir is difficult, since it must be able to evaluate such factors as size, type, affiliation, context, condition, significance or eligibility under National Register Criteria, and Native American values. For this particular effort, all sites are treated equally. Further, the assessment is based on the best available data recognizing the quality and quantity of recorded site inventory information on cultural resources varies considerably among reservoirs.

Figure 10-1 depicts the current known status of the number and elevation of cultural resources located on the John Day pool.

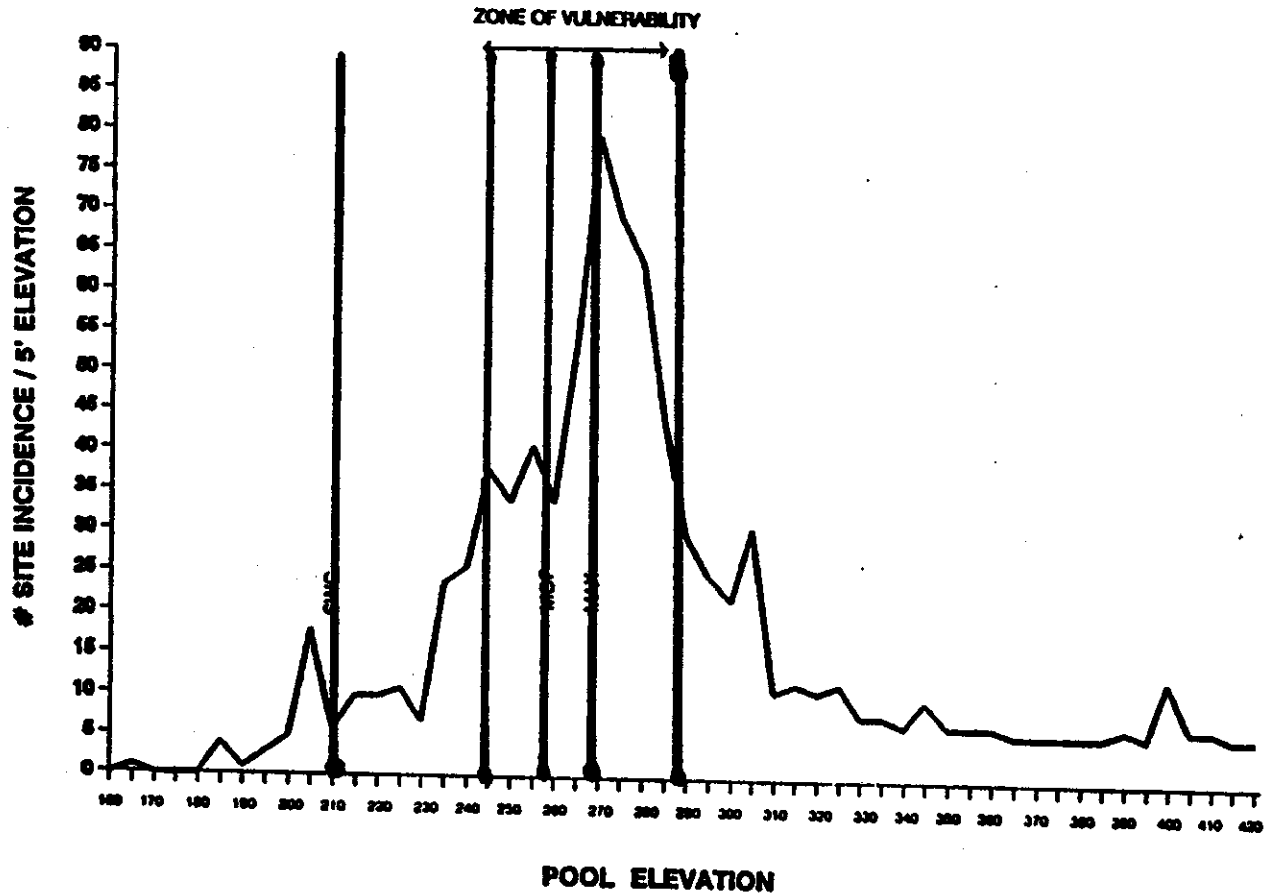
While the drawdown may involve varying assumptions about flow and timing conditions, the initial cultural resources analysis resulted in fairly simple and graphically demonstrable reservoir water surface elevations. Because site elevations can be co-related readily with water surface elevations, the initial cultural resources analysis used site elevation as a main variable to assess the effects of the various proposed alternatives on cultural resources.

The analysis did require some reordering of the site elevation data base because sites commonly occur across an elevation range. Therefore, each site was assigned an arbitrary site incidence values to better match the water surface elevation ranges associated with each proposed alternative.

The elevation intervals were selected based on knowledge of the operating alternatives and local geomorphology. At the John Day reservoir, the water surface elevation changes can be reasonably modeled in 5-foot increments, so site incidence values could also be assigned in 5-foot increments. For example, a site with the recorded elevation of 260 feet was assigned one site incidence value. A site with recorded elevations of 260 through 280 feet would have the site incidence value of four, based on 5-foot increments.

The next step in applying the assessment requires correlating the data on site incidence with the known physical impacts occurring at the sites. Impacts on cultural resources within a reservoir operation area result from a number of agents --wind, water, plant and animal, including humans. The most obvious human-caused effects include vandalism and theft due to exposure and opportunity for access to the resources.

JOHN DAY RESERVOIR



209 Sites Recorded
642 Projected Total Site Incidences within Zone (vulnerability)
8400 Acres within Drawdown Zone

MOP: Minimum Operating Pool (elevation)
MAX: Maximum operating Pool (elevation)
SWC: Spillway Crest
Zone of Vulnerability: Area of highest adverse impact to cultural resources.
Projected Total: Interpolation of highest # sites assuming equal distribution.

Figure 10-1 *Cultural resources on the John Day pool*

In addition, there are effects specific to the geomorphological context and the natural processes which act upon cultural resources in that context. These include, but are not limited to cryoturbation, bioturbation, deposition, wind and wave erosion, chemical and pH change, wet and dry cycle exposure, scouring, terracing, undercutting and slumping.

The majority of the adverse effects are known to occur between 15 feet below the MOP level and 20 feet above the maximum operating pool (MAX) elevation. This the area is termed the "zone of vulnerability", and is shown on the accompanying graph. The chart of known recorded sites indicates that the highest number of cultural properties (by site incidence as well as number) occurs within the zone of vulnerability, where the majority of archaeological surveys have been completed.

Through interpolation or projection, one can reasonably assume that if a complete (100 percent) inventory of the reservoir area were available, there would be an equal number of site incidence both above and below the reservoir edge, as indicated by the highest number of site incidence. This would allow hypothesizing a projected total site incidence for each reservoir project.

The projected total for the John Day reservoir, then, would be 642 site incidence. Thus, 642 cultural properties, or site incidence, would occur within the 8,400 acres of the fluctuation zone.

For future analysis of potential effects on cultural resources, a geomorphological base will be used to discuss the effects. These effects on site incidence are dependent upon geomorphological setting, and the type of geomorphic process occurring (erosion or deposition).

A profile of one side of a reservoir is depicted in figure 10-2. If the fluctuation zone (FZ) or the zone of vulnerability extends from directly above the reservoir edge to the second terrace (T2), we can make statements regarding the geologic context -- granites, basalt and granite schist and gneiss.

The relative stabilities of these three rock-type exposures differ when subjected to the weathering and erosion. These surfaces also demonstrate variable resistance to flow shear, wave attack, bioturbation, pedoturbation, or cryoturbation. Other geomorphic processes which have variable effects on the context include soil dispersion and piping, earth flows, block falls (slumpage), shallow soil slips, and rotational slides.

The John Day reservoir has several rock types and geomorphological contexts which exist within the area of study. Often, sides of the reservoir will vary. In places, there are broad, flat, sedimentary terraces on the north side of the pool, while the southern edge is bordered by steeply-cut basalt terraces.
The effects of wave attack upon a cultural resources located in a steeply-terraced context, granite schist or sandy terrace may result in complete deterioration of a site by scouring all soil material and leaving only the bedrock. Artifacts, too, will be scoured away by this action, or deflated into secondary deposits. However, the context of a site contained in a deep soil located on a broad flats or gentle slopes with a granite or basalt bedrock base would provide more stability for a cultural resource when subject to wave attack.

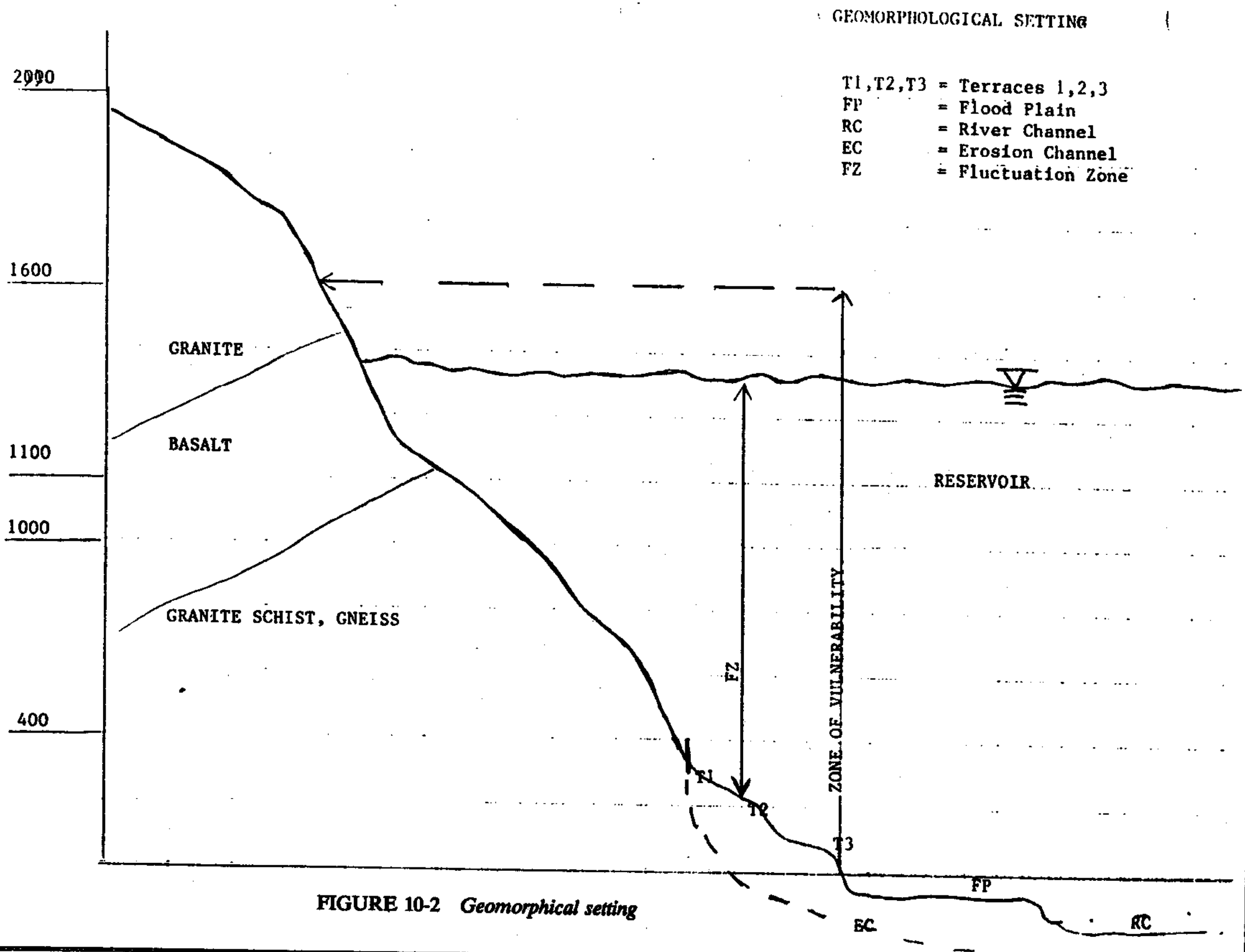


FIGURE 10-2 *Geomorphical setting*

The final step in the impact assessment process for these cultural resources requires the preparation of a Programmatic Memorandum of Agreement (PMOA) between the Federal agencies, the appropriate State Historic Preservation Offices, Native American tribes, and the President's Advisory Council on Historic Preservation. This document would be prepared under the authority of Section 106 of the National Historic Preservation Act. Developing a plan for the agreement would cost an estimated $35,000. Monitoring would probably cost $75,000 per year for a total of $110,000 in the first year. Five years of monitoring is projected. It is not possible at this point to project the extent and cost of mitigtion.

This PMOA will describe the John Day drawdown, the specific impacts on cultural resources, and identify the approved monitoring and mitigation plans. This latter plan will include stipulations and conditions for identification and documentation of type of effects, preservation, recommended protection and data recovery, and stipulations for curation.

The PMOA would also contain statements concerning provisions for Native American consultation and coordination under the authorities of the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act.

10.2 Utilities

Utility lines will require monitoring to see if they are exposed during the pool drawdown. Gas lines, sewer and water lines are not safe when exposed. Even though studies have not been conducted to identify these utilities there has been one natural gas line and a sewer line that will require backfill to bury the pipe.

10.2.1 Northwest Pipeline Company.

Description. This facility is located on the Washington shore at RM 286.3. There is a compressor station approximately 3,000 feet north of the shore of the river. There are two 20-inch diameter natural gas pipelines which cross the Columbia River from the compressor station south to Oregon. Normally, the pipes have approximately 3 feet of water over them.

Impact of Operation. At elevation 257 feet, the pipes would be uncovered for approximately 100 feet where they enter the water from the Washington shore. These pipes would have to be protected.

Economic or Other Measure of Damages. Without protection, the pipes would be vulnerable to damage. If damaged they would need to be shut down for repairs. This shutdown would affect natural gas supply for the area, affecting users such as the potato processing plants in Boardman and domestic users, as well.

Potential Mitigation Measures. The only mitigation measures would be to cover the pipes.

Costs and Schedule. Assumptions: Cover two 20-inch diameter steel natural gas pipes where they go down underwater. Construction is estimated to total $100,000.00. It is estimated that the construction work at this site will take approximately 2 months to complete.

10.2.2 City of Umatilla, Oregon, Treated Sewage Effluent Outfall.

Description. This facility is located on the Oregon shore in Umatilla at RM 289.8. The sewage treatment plant is immediately south of the shore of the river. There is one 24-inch diameter outfall pipe which empties into the Columbia River from the treatment plant. Normally, the pipe outlet is under water (and is required to be under water by their NPDES permit, to maintain the required mixing zone).

Impact of Operation. At elevation 257 feet, the pipe outlet would be uncovered and there would be approximately 40 feet of beach. This exposure would be in violation of the city's NPDES permit. The pipe would have to be extended so the outlet would be underwater during this low elevation operating period. Without the extension of the pipe, the city would be in violation of their NPDES permit and could be shut down by the DEQ. This shutdown would affect all users of the city's sewer system.

Potential Mitigation Measures. The only mitigation measures would be to extend the pipe.

Costs and Schedule. Assumptions: Extend 24 inch diameter steel outfall pipe approximately 60 feet farther north. Construction is estimated to total $100,000.00. It is estimated that the construction work at this site will take approximately 1 month to complete.

10.3 Transportation Routes

SR-14 borders the reservoir to the north while I-84 boarders to the south in Oregon. Surface inspections of the highway systems adjacent to the reservoir only one area was identified as being impacted by the drawdown to elevation 257 feet. Surface inspections or data study cannot anticipate all hidden physical conditions, flaws or adverse circumstances in geotechnical work. This area is located west of Alderdale, Washington, near mile post 147.6, between the highway and the Burlington Northern Railroad. This area should be instrumented before the reservoir is drafted to the new level. Survey level points in the area and at least one slope indicator should be installed to determine the depth and type of movement, should it occur during or after drawdown. Cost for surveys, slope indicator and monitoring is estimated at $100,000. If ground movement occurs in the area as a result of drawdown, considerable additional costs would be incurred to stabilize the slope, since there is a possibility for damage to the railroad and highway.

10.4 Blockage to Fish Passage at Umatilla River

Sediment processes would undergo a change in equilibrium during prolonged operation at or below minimum operating pool at elevation 262.5 feet. This change would be most notable in embayments and bars at the stream mouth of Umatilla River. Due to wave action at the shoreline and resuspension of silt and fine sand deposits, existing sediment would be redistributed within the stream mouth. Under certain conditions of sediment delivery from upstream sources these areas may form temporary blockages to fish passage. The persistence or frequency of such occurrences is unknown, but could be a significant detriment to fish migrations if allowed to go unchecked. Monitoring would be required. If a problem develops, these deposits could be removed by dredging and could be prevented from building to significant proportions by over-dredging the stream mouths to a depth which could hold the expected sediment infill volume without blocking the channel to fish migration. However, long-term maintenance dredging may be necessary to maintain stream mouth clear of sediment during low pool periods.

10.4.1 Umatilla River Dredging. The channel from the mouth of the Umatilla River with the Columbia River and upstream into the Umatilla could be dredged if necessary. This work would stop short of the Nugent Park recreation facility. This facility also requires dredging to make it accessible. The channel would be 100 feet wide and would be graded in its last 500 feet into the Columbia to preclude silt build-up from blocking off the mouth. Reducing bedload sediment accumulation at the mouth of the Umatilla River and the graded channel at the mouth will work to keep the Umatilla from being constricted and eventually closed by sediment during lower operation conditions.

At the pool elevation of 257, there would be an estimated 58,000 yd^3 of material to be excavated. The elevation of 259 was used as the base for the current channel bottom. A dredged bottom elevation of 253 was used as the interim elevation. The side-slope for the dredging was 1V on 3H. Mobilization costs were calculated as being $150,000 in all cases, which was in line with previous contract prices (table 10-2).

TABLE 10-1 *Cost Estimate for Umatilla River*

ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
Mobilization	LS	Job	150,000	150,000
Dredging	CY	58,000	2.50	145,000
CONSTRUCTION TOTAL				295,000

10.4.2 Periodic Maintenance. Without regard to the rate of sediment build-up at the mouth of these streams it seems reasonable to assume periodic maintenance will be necessary to keep them open for fish passage. For instance, every 5 years these streams are given to flashy storm events which produce extremely high sediment yields. Cost for maintenance work performed every 5 years would be $295,000. Average annual costs for operations and maintenance would be $50,000.

11. ECONOMICS

11.1 Regional Economy

11.1.1 Trade. Industries associated with the mid Columbia River area are predominately related to agriculture. The river services a large agricultural region that produces a variety of crops and food products. Trade revolves around grains, alfalfa, corn, fruit and vegetables, with grain being the largest export crop.

11.1.2 Population. The following table displays comparative population data for the respective counties within the study area and total population for the states of Oregon and Washington for 1980 and 1990.

TABLE 11-1 *Population for Oregon, Washington, and selected counties*

	1980	1990		1980	1990
State of Oregon	2,633,105	2,847,000	State of Washington	4,132,400	4,866,692
Gilliam County	2,057	1,750	Klickitat County	15,822	10,791
Morrow County	7,519	7,650	Benton County	68,211	112,560
Umatilla County	58,861	59,000			

Sources: Washington Yearbook, 1992 Center for Population Research and Census, Portland State University, Portland, Oregon (July 1, Certified Population Estimates).

11.1.3 Employment. Employment data for 1990 are provided below for Oregon and Washington counties adjacent to Lake Umatilla.

TABLE 11-2 *Oregon average annual covered employment by county, 1990*

	Gilliam	Morrow	Umatilla
Civilian Labor Force	970	3,830	30,600
Employment	920	3,380	27,450
Unemployment	50	450	3,150
Unemployment Rate	5.2%	11.7%	10.3%

TABLE 11-3 *Washington average annual covered employment by county, 1990*

	Benton	Klickitat
Civilian Labor Force	57,800	7.870
Employment	54,400	6,970
Unemployment	3,400	900
Unemployment Rate	5.9%	11.4%

TABLE 11-4 *Per-capita personal income for counties, states, and comparative statewide ranking, 1989*

Oregon			Washington		
	Income	Rank in state		Income	Rank in state
Oregon (36 counties)	$16,003	--	Washington (39 counties)	$17,895	--
Morrow	$17,015	7	Klickitat	$15,270	23
Umatilla	$13,805	25	Benton	$16,687	8
Gilliam	$18,965	3			

11.2 Economic Impacts of Drawdown

11.2.1 Flood Control. Lake Umatilla contains 500,000 acre-feet of storage space for flood regulation to meet the flood control objective of the Columbia River Basin. During 1991, the project prevented an estimated $13,000 in flood damage (Project Accomplishments Data, 1991). Cumulative damages prevented by the project since initial flood control operation in 1968 amount to approximately $7 million.

Maximum stream flow occurs annually on the Columbia River during the spring freshet (May through July). The drawdown period, May through August, would coincide with the spring-summer freshet on the Columbia River and would thus enhance the flood control capability of the project by maximizing storage availability for flood regulation during this period. Increasing the available storage reduces the potential for flooding and flood-related damage along the lower Columbia from unusually heavy runoff or storm events.

If, on the other hand, project operation does not allow use of available storage space to capture and retain excess runoff, the threat of downstream flooding would increase. The Portland-Vancouver metropolitan area, which is reliant upon upstream storage and local levee systems for protection from Columbia River flooding, could experience significant damage because the timing of drawdown coincides with high river stages attendant with spring-summer freshets.

Storage at Lake Umatilla is credited with approximately $1.7 million in flood reduction benefits on an average annual basis. Based on the timing of the proposed drawdown, the majority of these benefits would be foregone if excess runoff could not be temporarily stored as needed to control river stages along downstream reaches.

11.2.2 Hydropower Generation. Operation of all major dams and reservoirs in the Columbia River System is coordinated to maximize the power benefits provided by storage within the constraints placed on the system. Power production on the Columbia River System involves three primary objectives:

* meeting the region's firm energy commitments
* maximizing non-firm energy production to keep regional power rates as low as possible
* optimizing future energy through refill

Firm power contracts are long-term commitments that carry a guarantee to meet a customers specific load requirements over a defined period. These contracts are based on an estimate of the firm energy load-carrying capacity (FELCC) of the system. Non-firm generation is power in excess of that needed to meet firm power requirements, and is generally sold with no guarantee of continuous availability wherein delivery can be terminated on very short notice. As plans are formulated to draft reservoirs to meet firm power demand and generate as much non-firm energy as possible, flood regulation and other continuing needs for water must also be taken into consideration.

The 16 units at John Day are designed to operate through the minimum to maximum pool elevation range. Hydraulic capacity of the powerplant is 350,000 cfs. During years of relatively high runoff, John Day and the other Columbia River hydro plants are often operated at high levels in the spring to take advantage of the surplus water to generate non-firm or secondary energy. This has been the case under system management for the Water Budget. Generally, water managers attempt to maximize hydro output, keep thermal plants inactive, and avoid spilling water that might otherwise be used for power generation. In most water years, stream flows are sufficient to produce at least some non-firm generation. After January 1, initial runoff forecasts make it possible to estimate how much water will be available from snowpack runoff. In an average year, non-firm generation may comprise 25 percent or more to the hydro system's generating output.

Operating Lake Umatilla at elevation 257 feet will result in loss of head, thereby reducing the generating efficiency of the turbines. For a given amount of flow, reduced head requires more water to produce an equivalent amount of energy. From 1987 to 1991, a total of 39.8 billion kilowatt hours (kwh) of energy, or an average of nearly 8 billion kwh per year, was generated at John Day. Of this total, an average 3.65 billion kwh were generated from May through August each year.

The economic impact of drawdown to elevation 257 feet during the above months and year-round was measured using a computer model of the Pacific Northwest hydro/thermal generating system, PC-SAM. Based on system simulated hydro generation over a 50-year period, the system model dispatches resources (both existing and generic) on the basis of variable costs, with the least-cost resources being dispatched first to meet system load. The results of the model indicate that with the 4-month drawdown, the additional costs to meet system load demand amount to about $3.8 million annually. For the year-round drawdown the model results show a cost of $12.3 million annually. These costs represent the least costly alternative resources which would be required to compensate for the loss of energy production at John Day. Reducing the pool elevation at John Day while continuing to operate McNary project at normal pool elevations would result in increased head at McNary, thereby partially offsetting energy losses incurred by John Day during drawdown.

Operating the John Day power plant at MOP could also eliminate the operating flexibility which presently allows John Day to meet peak load demand. Because of the generating capacity of John Day and its proximity to Pacific Northwest load centers and the Pacific Northwest and Pacific Southwest (PNW-PSW) intertie, this project is used extensively for load factoring, or shaping the load on an hour-by-hour basis as needed to meet peak energy demand. With the reduced pool elevation, the capability of John Day to meet fluctuating instantaneous demand would be significantly reduced or eliminated. Demand fitting operations could be possibly be shifted to other storage projects in the system such as Grand Coulee or Chief Joseph, or can be achieved using alternative resources such as combustion turbine generators.

If the region's hydro-system could meet its share of firm energy production and provide equivalent non-firm energy with available stream flow, there would be no net economic loss. However, if capacity could not be replaced through existing hydro plants, its value would be the cost of producing peak energy using the next available alternative, combustion turbines, which can be placed in service and removed from service quickly to meet demand peaks. Operating costs of combustion turbines are approximately 70 mills/kwh. The additional costs of using combustion turbines, in addition to the value of non-firm energy sales foregone, would constitute economic costs resulting from reservoir drawdown.

For this analysis, it is assumed that load shaping and peaking operations could be compensated for within the existing system, and that economic losses attributable to drawdown would be manifested in an increase in system generation costs.

11.2.3 Navigation. Since the shallow draft fleet using the Columbia/Snake system has been designed for that purpose, access to the locks at lowered pool elevations may not pose a significant problem. Sill depths of the locks at Bonneville, The Dalles and John Day were designed to allow sufficient clearance over the range of normal operating pool elevations. Barge shipping and transfer operations are designed around MOP elevations, the water surface elevation at which the authorized 14-foot minimum channel is maintained.

The downstream lock sill elevation at John Day is 140 feet. The downstream approach channel to the John Day lock was originally dredged to an elevation of 139 feet. Assuming no change in pool elevation at The

Dalles, the downstream sill depth would not be adversely impacted by the John Day drawdown. The upstream lock sill elevation is 242 feet. At forebay elevation 257 feet, water depth over the upstream lock sill would be 15 feet. This would reduce underkeel clearance for vessels drafting 14 feet to 1 foot. Water depth over the downstream sill at McNary lock would also be reduced, however, at elevation 236 feet, minimum sill depth would still provide clearance of 20 feet. The downstream sill at McNary lock would also be subject to reduced clearance, however, at elevation 236 feet, minimum sill depth at McNary would be 20 feet.

The potential exists for navigation operators to a small increase in transportation costs from lowering Lake Umatilla to 257 feet. Such costs would result from the additional time required by shallow draft commercial tows to complete lockages. With reduced clearance at the upstream John Day lock sill, it is estimated that additional time will be required to safely complete lockages. Entry and exit times at the lock would increase because of lock hydraulics and reduced water volume. With several feet of depth, normal passage time over the sill for a full tow is approximately 10 minutes. At a minimum pool elevation, it is estimated that both entry and exit times at the John Day lock would increase from 10 to 35 minutes, a net increase in total lockage time of 25 minutes per lockage.

During the three years 1987 through 1989, the average number of lockages at John Day were 1,560 per year. Operating cost for these tow combinations is approximately $309 per hour or about $5.15 per minute (Small Scale Investment Plans, Corps of Engineers, 1991). Given an average 1,560 lockages each year at this project, each complete lockage would require an additional 25 minutes, or a total of 650 hours annually. The estimated economic impact of these delays for the drawdown periods are shown below.

Year-round: (650 hrs.) ($309/hr) = $200,800
4-month: ($200,800) (4/12) = $66,900

The average rate per ton for the 7.8 million tons of cargo which is locked through John Day is $5.05 (PMS, draft OA/EIS 1992) and the average annual revenue from the cargo is approximately $39.4 million. Therefore, an increase of $66,900 in annual operating costs could increase the average rate for cargo from $5.05 to $5.06 per ton (39.4 plus .0669 / 7.8). The year-round drawdown could increase the average rate by $0.03 per ton to $5.08.

The decreased maneuverability of larger tows plus the orientation of the downstream approach channel may also cause difficulty in approaching or leaving the lock downstream during fluctuating releases. Commercial barge traffic could also be adversely affected by increased flow velocity during the spring freshet at either the up or downstream lock approaches as inflows normally subject to ponding would instead be passed through the project. With lower tailwater elevations, turbulence could be a problem increasing the risk of damage to the lock and/or navigation equipment. At reduced river depths, potential hazards to commercial or other river traffic will be greater in areas immediately adjacent to the navigation channel within Lake Umatilla.

Under a plan that would require lower pool elevations over the designated period of time, there would be increased risk of encountering problems as reduced depths in and outside of the channel will reduce underkeel clearance for both commercial and recreational craft using Lake Umatilla.

11.2.4 Irrigation. Agricultural irrigation has been identified for 24 irrigators,irrigating approximately 138,850 acres from the John Day pool. The proposed temporary and permanent draw down of the John Day reservoir will impact the income of irrigators by increasing the cost to own and operate irrigation pumping systems. Increased costs include the capital costs necessary to modify the pumping facilities and the increased annual operation and maintenance costs plus the increased power consumed due to greater lift.

Impact to irrigators from reservoir drawdown is described in terms of changes in net farm income. Net farm income was estimated by reservoir for both temporary and permanent drawdown options by the System Operation Review Irrigation Work Group. Net farm income is the return to the owner, labor management and to the equity portion of the farm investment capital.

Representative crop yields were developed from Washington State University studies, Census of Agricultural information and information gathered from local County Extension Agents.

Prices of representative crops used to value production were a three year average (1990 - 1992) of prices received for Washington and Oregon farmers as reported by the Washington Agricultural Statistics Service and the Oregon State Extension Service. Representative crop production costs were obtained from publications issued by the Washington State University Cooperative Extension Service. Crop water requirements and monthly pumping requirements were based on data compiled by Agrimet, U.S. Department of the Interior, Bureau of Reclamation.

Pump modification costs were developed from reconnaissance level studies of pumping stations by consultants. Construction costs, including 35% contingency, is $14,041,000. The additional cost of operating and maintaining modified facilities is estimated at $395,000 each year.

Electrical power rates for pumping are the current irrigation rates charged by local utilities. For irrigators in Washington, the rate used is 25 mills per kilowatt hour; for Oregon irrigators, the rate is 33.5 mill per kilowatt hour.

Under current operating conditions, the annual net farm income is $54,6 million or $393 per acre. With temporary drawdown, annual net farm income is reduced to $50.6 or $365 per acre; a reduction of $4 million. With permanent drawdown, annual net farm income is reduced to $50.5 million or 364 per acre, a $4.1 million reduction from current condition net farm income.

11.2.5 Municipal and Industrial Water Supply. The city of Boardman will be impacted when the pool reaches elevation 264 feet. The city uses a Ranney system to supply their needs. At elevation 264 feet, flows into the Ranney laterals are reduced and at 257 feet the laterals have a 25 percent quantity loss. Also, reduced flows have increased levels of water hardness and alkalinity which requires treatment. Lowering John Day pool will lower ground water levels and decrease water production and quality.

11.2.6 Treaty Fishing Access. Treaty fishing access sites are used by Native American fishers because of their proximity to treaty fishing areas. With drawdown of Lake Umatilla to minimum elevation, existing access sites at Three Mile Canyon and Sundale would no longer be accessible for launching boats. One of the two boat ramps located at Le Page Park would remain usable for launching boats.

Because of distance and travel time, it is not feasible for Native commercial fishers to use the public facilities at Roosevelt Park on the Washington shore. Even if these facilities could be shared during the summer months, the extra space needed by commercial fishermen to dry and store their nets would not be available. To use the above park for access, Native commercial fishers would also incur increased operating costs traveling additional distance to and from their nets. They would likewise incur delay costs while waiting to launch and retrieve their boats.

Since commercial fishing season is closed during the 4-month drawdown except to the month of August, the monetary impacts associated with the loss of access is expected to be relatively minor. Negative impacts, however, would be experienced via loss of access for subsistence and ceremonial activity by Native Americans. Under year-round drawdown the impacts would be greater if boat ramps were not extended.

11.2.7 Regional Impacts. Regional impacts include secondary costs and impacts incurred by local businesses and communities. Regional impacts extend beyond NED effects and reflect local and regional transfers and transactions. In addition to NED effects, regional (localized impacts) could be incurred in terms of diminished port activity, reduced employment and income, reduced farm production, and secondary effects on regional income and revenues associated with these losses. Also, land values for non-irrigated land are much lower than the value of irrigated land, suggesting a reduced tax base and lower revenues for local government, schools and other services.

11.2.8 Recreation. Visitation at recreation sites and facilities along Lake Umatilla, which exceeded 1.6 million during 1989, would be negatively impacted by the pool draw down. A lower operating pool during the spring and summer months would coincide with the months of peak attendance at the project. Draw down would impact both accessibility to the lake, (boat launching, swimming, etc.) and the aesthetic qualities of public areas. These factors would act to reduce visitation at the project with a resultant economic loss in recreational value.

Use of recreation facilities at John Day confirms its economic utility, and attendance demonstrates the willingness of users to pay, irrespective of access fee charges. Given diminished access to recreation areas, persons who presently use Lake Umatilla for recreation purposes would possibly move to other, less attractive areas, and incur higher costs in terms of travel time and distance to use recreation areas possessing similar amenities.

As more sites become unusable, the cumulative economic impact of reduced pool elevation on the region and nation will increase. The System Operation Review (SOR) estimated the impacts to recreation visitation with the operation of John Day at MOP, assuming no modification of the facilities as mitigation measures. The SOR estimated a 20 percent reduction in annual visitation on the reservoir with the drawdown as compared to the normal operation of the project. This was approximately a 440,000 annual reduction in recreation days for boating, fishing, camping, swimming and picnicking. If these losses in visitation are valued at the consumer surplus values recommended in the SOR, then the economic value of the lost recreation is about $6 million per year.

This appendix identifies the type of mitigation measures that would be required to make the recreation facilities usable during the operation at MOP. No estimation of the annual visitation with the mitigation measures were made in this study or the SOR, but, it is expected that visitation could be somewhat less. Economic losses could also be expected with regard to fishing and waterfowl hunting activities due to habitat impacts. Estimated costs will be included in the final report.

12. BIOLOGICAL EFFECTS

12.1 Introduction

Relationships between flow, travel time and smolt survival is currently an area of much discussion. Limited data and scientific uncertainty regarding analysis has led to varied interpretations of data. Presented in this discussion are results from a wide range of studies relating flow to travel time/survival and interpretations of biological data. It is not the intent of this discussion to select a "correct" analysis, but to discuss available information and interpretations of that information.

Throughout this section reference is made to "significance" and "correlation". These terms are used in accordance with their statistical definitions. Significance is a term used to describe a relationship other than "random chance". Significance indicates that a relationship exists, but does not indicate strength of that relationship. Correlation is used to indicate strength of a significant relationship. Correlation is described by r^2 and ranges from values of 0.0 to 1.0. A low value of r^2 shows that the predicted line (relationship) is a poor fit of the data. A high r^2 shows that the predicted line is a good fit of the data. Relationships which shows significance may be either weakly or highly correlated, higher r^2 values indicate a stronger relationship.

The majority of available information results from studies on the Snake River system with only limited information available for the Lower Columbia river (including John Day Pool). It is assumed that relationships found in the Snake River may hold true for the Columbia River. The degree of accuracy in this assumption is unknown. The general consensus is that there is a statistically significant relationship between yearling smolt travel time and river flow, at least over a range of flows (80 to 100 kcfs in Snake River and 190 to 240 in Columbia River). Degree of correlation varies with flow, species, location and season. While yearling smolt travel time is strongly correlated with flow for low flows, correlation decreases at higher flows. Also, effects of flow on some endangered stocks (Snake River fall chinook and sockeye) is unclear due to lack of stock specific data.

12.2 Current Information

12.2.1. <u>Previous Reports</u>. The following reports primarily summarize and analyze the current available data base from studies conducted over the period from 1973-1991.

CBFWA (1991)- Data used for analysis in this study is primarily based on information from studies conducted in 1973-79 and Sims and Ossiander (1981). Flow range for analysis was 115-340 kcfs in the Columbia River.

The authors conclude that "travel time is a key migrational characteristic reflecting the dynamics of the downstream migration of juvenile salmonids. Physiological condition of smolts change over the time they are migrating. Travel time determines whether the smolts arrive at the estuary during the biological window, so they can successfully survive transition to salt water. Travel time is inversely related to flow. With the present hydrosystem, even extremely high flows cannot achieve pre-dam conditions."

The authors recommend flows up to 300 kcfs in the Columbia River during the peak migration season of 1 April to 15 June. The report also states that the similarity of fish travel time to WPTT (water particle travel time) indicates that flow is a causative agent rather than a simple correlation to smolt travel time.

The authors conclude that flow affects survival of all species and life stages, even though spill, physiological state of fish, release times, and other factors have been found to be significantly correlated with travel time. They also suggest that predation of smolts may increase at lower flows because predators have "easier access" to prey due to lower water velocity and warmer water temperatures. Increased water temperatures may increase consumption rates of predators. Therefore, higher flows may increase survival even if travel time does not decrease significantly.

Berrgren and Filardo (1991)- This study examined relationships between flow and other variables in travel time of yearling chinook salmon and steelhead in the Snake River and subyearling chinook in John Day Pool (Columbia River) using available data. They conducted univariable and multivarible analysis with flow, release time and ATPase levels (indicator of smoltification).

Univariate analysis attempts to describe the relationship between two variables when one of the variables is thought to have a great effect on the second variable. For example, in most of the studies mentioned in this section travel time is thought to be heavily dependant on flow levels. Multivariate analysis is used when it is thought that several variables affect the relationship. In this case multivariante analysis is used in an attempt to describe the effects of variables other than flow on smolt travel time. Some variables used in multivariate analysis included physiological status (level of smoltification), release timing, and flow.

The study found that subyearling chinook travel time through John Day Pool was statistically significant, but weakly correlated ($r^2 = 0.33$) with flow. Multivariate analysis increased the strength of correlation to $r^2 = .60$. Univariate analysis of Snake River flows to yearling chinook gave a significant relationship ($r^2 = 0.43$). Multivariate analysis increased this correlation to give and $r^2 = 0.74$). This analysis shows that flow is one factor in determining travel time, but other factors such as level of smoltification and release timing are also important.

This analysis predicted that greatest effect of flow on travel time occurred at low flows with less pronounced effects at higher flows. The authors concluded that similarity in flows to travel time were a causative relationship not a simple correlation.

Kindley (1991)- Using analysis of recent data (1986-1990), from the Snake and Columbia Rivers. Kindley found that "flow levels up to a certain range decreases travel time for migrating juvenile chinook salmon.". Travel time estimates indicate that flows greater than 240 kcfs in the lower Columbia River do not significantly reduce travel time.

Kindley analyzed three regions for yearling chinook travel time relationships: head of Lower Granite Pool to Lower Granite Dam, Lower Granite Dam to McNary Dam, and McNary dam to John Day Dam (John Day Pool). Generally, when sufficient data was available, using multivariante analysis there appeared to be a relationship between travel time, flow, release date and ATPase levels. Because there was a significant correlation among these factors it was not possible to determine which variable had the greatest effect on migration rates.

Kindley found that flow in John Day Pool did have a significant relationship to fish travel time for the range of 135-285 kcfs ($p=.001$, $r^2=0.88$). Analysis of higher flows did not show a significant correlation, therefore he concluded that travel time in John Day Pool decreased as flows increased, but only to a flow level between 190-240 kcfs.

Kindley concluded that water particle travel time is an unreliable indicator of smolt travel time. Although there is some correlation between flow and travel time, travel time is a product of many factors. Physiological development and release timing are also factors which are involved.

Giorgi (1991)- Giorgi examined existing data on yearling chinook responses to flow in the same three regions investigated by Kindley (1991), and subyearling chinook in John Day Pool. He found that although there appeared to be some significant relationships between flow and yearling chinook travel time, they were unclear. He could not identify a relationship between subyearling chinook travel time and flow. He also found very limited information to develop a relationship between flow and smolt survival.

Review of data from Lower Granite Pool showed a relationship between flow and travel time, but it was not consistent. This is demonstrated by fish entering from the Clearwater River migrating more slowly than the fish from the Snake River. The author pointed out that other studies have shown that factors other than flow may be influencing smolt travel time.

Giorgi also found that yearling chinook travel time for the Snake River confluence to McNary Dam had varying results. While some data sets showed a strong correlation, others showed no relationship at all. This indicated that there are other factors than flow involved in travel time.

Two regression models were evaluated, a log and a polynomial model, to predict smolt travel time. The log model continues to show reduced travel times with increased flow where the polynomial model showed that travel time decreases up to 200-240kcfs (Columbia River, John Day Pool) and then levels off. Giorgi suggested that there may be a threshold flow at which travel time stops decreasing.

12.2.2. Summary of reports. These analyses indicate a correlation between flow and yearling juvenile chinook smolt travel time at lower flows. Several show a weak correlation that improve with a multivariate analysis including level of smoltification and release timing. This indicates that factors other than flow are related to travel time.

Available data for subyearling chinook travel time indicates that flow is not significantly related to travel time. This is probably due to their biology and time spent rearing in the reservoirs during migration. It is not expected that subyearling chinook salmon travel time will be decreased as significantly as water particle travel time.

Data relative to travel time of sockeye salmon is very limited. It is assumed that sockeye salmon (yearlings) have habits (relative to flow and travel time) similar to yearling chinook salmon.

12.3 Model Studies

12.3.1. Models. The effects on juvenile salmonids due to lowering John Day Pool to elevation 257' were estimated using CRiSP (Columbia River Salmon Passage model) and PAM (Passage Analysis Model) modeling. CRiSP is a fish passage model developed by the University of Washington to simulate and estimate juvenile fish survival through the Columbia River. Complete description of this model is found in CRiSP.1 Manual, release date:March 1993. This is a stochastic model which provides methods to include levels of uncertainty and variability in modeling. Survival estimates can be made for any stock of fish between any two points in the river. The PAM is a similar model developed by the Northwest Power Planning Council (NPPC). This model is described in ____________________. The PAM is not a stochastic model. The PAM model was run by staff of the NPPC and documented here.

Reliability of these models (as with any model) is largely based on input parameters used. Input parameters (and ranges of input values) were based on current data, research, and coordination. Parameters relating to dam passage established by NMFS (Model Coordination Team Memo, Jan. 1992) for use by the Model Coordination Team were used when applicable. Other model parameters (such as transportation survival) used were coordinated with System Operation Review (SOR) anadromous-fish work group. Due to limited data regarding sockeye salmon input parameters, CRiSP analysis was limited to yearling chinook, subyearling chinook, and steelhead.

Drawdown of John Day pool was analyzed using basecase survivals and inputs from System Operation Review (SOR) analysis. To analyze drawdown, all parameters (with the exception of pool elevation) were held constant and only pool elevation was changed. The difference between the basecase and the run with a lowered pool elevation (elevation 257': 1 May - 31 August) is the effect of John Day Pool drawdown. Models runs were conducted for both a with and "without transportation scenario. The with transportation scenario includes transportation as it exists in 1993, and the without transportation scenario eliminates transport from all facilities.

This CRiSP model was run in a Monte Carlo mode using a 50 year water record (1928-1978) to show some variability in inputs. Results are presented as an "average" flow condition. This analysis was run for multiple stocks to obtain potential effects of drawdown based on location of the salmonid stocks. Stocks used in the CRiSP analysis were as follows:

Location	Species
Deschutes River	Spring Chinook
Rock Creek	Steelhead
Dworshak	Steelhead
Wenatchee	Steelhead
Hanford Ferry	Fall Chinook
Methow River	Spring Chinook
Salmon River	Fall Chinook
Salmon River	Summer Chinook
Salmon River	Spring Chinook

The PAM model is not a stochastic model, therefore it must be run for a given year. The model was run for each of the 50 year flow record, and average results are reported. For this analysis, PAM was also run for the lowest 8 flow years as "critical" years. The PAM was used to analyze stocks of salmon from the Mid-Columbia (Yakima River) and Snake Rivers.

Both models calculate travel time of fish from the area of release to below Bonneville Dam. Using this information it is possible to show changes in travel time due to drawdown. This information shows change in travel time, but does not attempt to relate this to survival.

It is important to note that the modeling analyses do not include consideration of any of the factors discussed in subsection 12.3.2. below regarding potential impacts to rearing habitat, effects on predation levels, turbine survival and other potential effects.

12.3.2. Sensitivity analysis. For any analysis with a large number of unknowns and uncertainties, it is preferable to conduct a sensitivity analysis of the major uncertainties to more accurately interpret the results.

The CRiSP model is a stochastic model and includes levels of uncertainty for input variables. Therefore, some of the uncertainty in the variables is addressed and reduces the need for a sensitivity analysis of most of the variables. For factors where the effects of drawdown are largely unknown (turbine survival, FGE, OPE) sensitivity analysis was not conducted since the range of effects was unknown. However, based on the best available information, the effect of drawdown on these factors will result in a negative impact to fish survival, and not including them in the analysis gives an conservative (optimistic) range of potential benefits.

FISH RESOURCES

WITHOUT THE PROJECT

The Columbia River System provides essential habitat for anadromous species such as chinook, coho, and sockeye salmon; steelhead trout; white sturgeon; American shad; and Pacific lamprey.

The river in the project area is vital for passage of adult salmonids to spawning and rearing waters in the upper Columbia and Snake River systems. Each year, primarily from April through July, millions of juvenile salmonids migrate downstream through the project area to the ocean. Within the project vicinity the river and its backwater areas also provide habitat for salmonid rearing and, in the tailrace area, possibly spawning. For the 1981 to 1991 period, annual adult salmon runs passing over McNary Dam have averaged 198,000 chinook, 54,000 sockeye, and 2,700 coho. Steelhead counts for the same period have averaged 145,000. These numbers represent fish that escaped extensive sport, commercial, and Indian fisheries downstream.

Columbia River sockeye runs have decreased dramatically. Sockeye runs past McNary Dam have decreased from over 100,000 fish in the mid-1950's to as few as 41,000 in 1989. The Snake River sockeye run has almost vanished. Adult sockeye returning to the Snake River (counted over Ice Harbor Dam) were four, one, and nine for 1989, 1990, and 1991 respectively. For this reason the Snake River sockeye has been listed as a endangered species and is protected under the Endangered Species Act (56FR 58611. Nov.20,1991). Snake River spring/summer and fall chinook populations are also in a critical situation. Their runs have declined from about 123,000 in the 1950's to 23,000 in 1989. As a result of these diminishing returns, the Snake River spring/summer and fall chinook salmon have been listed as a threatened species (57FR 14653. April 22, 1992).

The John Day and Umatilla Rivers, which enter the John Day Reservoir, both have runs of salmon and steelhead. The John Day maintains runs of spring chinook and summer steelhead. A popular troll fishery for steelhead begins each August in the John Day River arm. The Umatilla supports runs of spring and fall chinook, coho, and summer steelhead. Spring chinook counts in the Umatilla have ranged between 500 and 2,100 fish the last three years. Fall chinook numbers have been steadily increasing with 522 returning adults in 1991. The coho run was about 4,000, 400, and 1,700 for 1989, 1990, and 1991 respectively. Steelhead returns average about 2,500 fish annually.

Both the Irrigon and Umatilla Fish hatcheries are located in the project area adjacent to the Columbia River near Irrigon. The hatcheries, operated by the Oregon Department of Fish and Wildlife, produce a total of over 5 million salmon and steelhead smolts annually. The water supply for rearing these fish is provided by wells. The wells are extremely dependent upon the level of John Day Reservoir. Severe water supply problems now exist at the hatcheries when the reservoir drops to elevation 261.

The American shad run in the Columbia River continues to increase. Counting stations at McNary Dam noted 1,147 shad in 1968 while 675,000 were counted in 1991.

The PAM model does not include variability in the input variables. An "average" value was used for input variables and sensitivity analysis was not conducted.

12.4 Model Results

12.4.1. Survival Changes-CRiSP Model. Based on the model input assumptions listed above, CRiSP modeling results showed no statistically significant increase in fish survival through the system due to drawdown of John Day Pool. This is true for all stocks modeled and both a with and without transportation scenario. Benefits are limited primarily for two reasons; 1) travel time through John Day Pool contributes to only a small portion of the total system fish travel time, 2) majority of the fish in the Snake River are transported prior to passage through John Day Pool and are therefore unaffected by any change in the pool. Estimated survivals with and without transportation are shown in tables 12-1 and 12-3. Absolute changes in fish survival were +/- 1 percent change from the basecase (basecase survival ranged between 26 and 67% depending on species and stock). This slight change is not statistically significant and is considered noise (due to stochastic variation) in the modeling process. It should also be noted the scenarios that did not include transport of juveniles had significantly lower fish survival than those with transportation.

TABLE 12-1 *Change in system survival with John Day at MOP-CRiSP (w/ transportation)*

STOCK	Base condition, % survival	With MOP operation, % survival	Change in survival, % (absolute)
Deschutes (Chinook 1)	67	67	0
Rock Creek (Steelhead)	55	55	0
Dworshak (Steelhead)	48	48	0
Wenatchee (steelhead)	30	31	+1
Hanford Ferry (chinook 0)	62	62	0
Methow Well Index (chinook 0)	32	33	+1
Methow (chinook 1)	27	26	-1
Wild Salmon River (chinook 0)	48	48	0
Wild Salmon River Stock (Summer)	41	41	0
Wild Salmon River Stock (chinook 1)	40	40	0

TABLE 12-2 *Change in system survival with John Day at MOP-CRiSP (w/o transportation)*

STOCK	Base condition, % survival	With MOP operation, % survival	Change in survival, % (absolute)
Deschutes (Chinook 1)	67	67	0
Rock Creek (Steelhead)	54	55	+1
Dworshak (Steelhead)	27	27	0
Wenatchee (steelhead)	33	32	-1
Hanford Ferry (chinook 0)	45	45	0
Methow Well Index (chinook 0)	24	24	0
Methow (chinook 1)	28	28	0
Wild Salmon River (chinook 0)	11	11	0
Wild Salmon River Stock (Summer)	31	30	-1
Wild Salmon River Stock (chinook 1)	25	26	+1

Due to the large number of input variables and levels of uncertainty on the input variable, the level of precision in the results is quite large. This leads to the conclusion that results must show very large changes (10-12% absolute change) to be statistically significant. However, changes in survival can be suggested by trends that occur in the results. For example, if results tended to be in the same direction (all positive or all negative) a potential change from the basecase may be suggested. It can also be said that if there is not a trend in the results (both positive and negative results) then there is no change from the basecase.

The CRiSP model was also used to estimate survival through John Day pool alone in an attempt to determine smaller changes in survival that may not be detectable when analyzing system survival. Results are shown in table 12-3. Base condition survivals (from McNary forebay to John Day forebay) are between 73 and 89%. The change in survival through the pool using CRiSP showed a slight increase for three of the four mid-Columbia stocks, with a negative result for spring chinook. Again, these results cannot be considered significant and would have to be interpreted as essentially no change in survival based on the CRiSP model variability.

TABLE 12-3 *Change in survival in John Day pool of juvenile salmonids with John Day at MOP-CRiSP*

STOCK	Base condition, % survival	With MOP operation, % survival	Change in survival, % (absolute)
Deschutes (Chinook 1)	n/a	n/a	--
Rock Creek (Steelhead)	n/a	n/a	--
Dworshak (Steelhead)	84	84	0
Wenatchee (steelhead)	84	86	+2
Hanford Ferry (chinook 0)	78	80	+2
Methow Well Index (chinook 0)	80	82	+2
Methow (chinook 1)	86	84	-2
Wild Salmon River (chinook 0)	73	73	0
Wild Salmon River Stock (Summer)	89	88	-1
Wild Salmon River Stock (chinook 1)	85	85	0

12.4.2. Survival Changes- PAM Model. Based on the assumptions used, the PAM analysis shows an increase in system survival for Snake River and Mid-Columbia River stocks of spring chinook salmon. Increases were from 2 to 7% gains in survival relative to the base case depending on stock and transportation levels. (note: absolute changes were not included in NPPC report; the Corps estimates absolute changes would be 1 to 3% for comparison with the CRiSP values presented in the above tables) Increases in survival (between normal operations and drawdown) were the greatest when transportation was turned off, but with transport off, fish survival was significantly less than the basecase which includes transport. This is due to the relatively larger number (and percentage) of fish arriving at John Day Pool without transportation. With transportation turned on, very few Snake River fish arrive at John Day Pool, and therefore system survival is not significantly affected.

12.4.3. Travel Time-CRiSP. Calculated fish travel time (using CRiSP) from the place of origin to below Bonneville Dam shows no significant change in fish travel time due to John Day drawdown. Travel time (through the system) ranged between 12 and 49 days depending on stock and species. All results are within a level expected to be model "noise" and are non significant changes from the basecase.

CRiSP also calculated fish travel time through John Day Pool. Travel time from McNary forebay to John Day forebay was between 5 and 16 days. Results showed no significant difference from the basecase for all stocks analyzed. Reasons for not detecting any differences are likely due to the variation in the input variables and the flows.

12.4.4. Travel Time-PAM. Fish travel time was not reported for the PAM analysis. However, the PAM model uses a flow survival relationship based on Sims and Ossiander (1981) which shows a positive relationship between flow and fish travel time. Therefore any increase in flow or river velocity will result in a decrease in fish travel time.

Water travel time decreased with John Day drawdown (table). Based on the relationship between travel time and survival used in PAM, this would suggest a small decrease in fish travel time and an increase in survival for juvenile salmonids passing through John Day Pool.

12.4.5. Summary of Modeling Analysis. In summary, model results show limited potential benefit for most stocks from the proposed drawdown. CRiSP analysis showed no change in system survival nor any significant change in survival through John Day Pool. The PAM analysis showed relative increases in system survival for Snake River and Mid-Columbia Spring chinook salmon of 2 to 7%. CRiSP did not show a change in fish travel time through the pool whereas PAM does through its assumption of a direct relationship between flow and fish travel time. The differences in results from the models are likely related to each models' assumptions regarding the relationship between flow (water travel time) and fish travel time and the stochasticity of the CRiSP model. No attempt was made to adjust model parameters in this analysis with regard to other potential effects which will be discussed below due to uncertainties regarding these effect on these parameters or because the parameters are not included in the models.

12.5 Predation of Juvenile Salmonids

Predation is currently considered to be a major source of mortality of juvenile salmonids during migration through the Snake and Columbia river system. Predation is believed to cause mortality equal to or greater than passage losses at the dams (Poe and Rieman, 1988). Predation studies (Poe and Rieman, 1988) estimate that between 1.9 and 3.3 million juvenile salmonids were consumed by predators annually (1983-1986) in John Day Reservoir alone.

12.5.1 Major Predators. It has been shown (Palmer et al., 1986, Rieman et al., 1986) that northern squawfish (*Ptychocheilus oregonensis*) are the major predator of juvenile salmonids in John Day pool. Other predators include smallmouth bass (*Micropterus dolomieui*), walleye (*Stizostedion vitreum*) and channel catfish (*Ictalurus punctatus*). It has been estimated that approximately 78 percent of predation of juvenile salmonids in the Columbia River is by northern squawfish.

12.5.2 Predation Levels. Predation levels vary greatly within a reservoir. In general, predation is highest in tailrace and forebay areas where smolts are concentrated. Tailrace areas have been found to have particularly high concentrations of predators. It has been estimated (Poe et al., 1988) that up to 22 percent of predation losses of juvenile salmonids occurs in boat restricted zones (BRZ) in tailrace areas. The BRZ is an area approximately 500 feet immediately below the dam where boat traffic is restricted for safety reasons. Northern squawfish are the major predators in the BRZ. Bass, walleye and channel catfish are also found in the BRZ, but have higher predation rates in mid to lower reservoirs.

12.5.3 Reducing Predation. A number of methods have been proposed for reducing predation within Columbia River and Snake River reservoirs including reducing predator numbers by removing or sterilizing northern squawfish. Currently, Bonneville Power Administration (BPA) is sponsoring a "bounty" of $3 per squawfish (over 11 inches long) for sport-caught fish. Other methods to reduce predation include releasing juvenile salmonids from hatcheries and bypass system outfalls in areas where squawfish population is thought to be low.

12.5.4 Effect of Drawdown on Predation. The drawdown may effect predation several different ways. Possible factors which may affect predation during drawdown and potential effects are listed below.

Increase Predator/Prey Concentration. Lowering pool elevation will most likely increase concentrations of both predators and juvenile salmonids which may increase encounter rates of prey by predators. This increase in encounters may increase the amount of predation (Eggers, 1977). Drawdown will also reduce important rearing areas for subyearling chinook where predation has been shown to be low (Zimmerman and Rasmussen, 1981). This will force subyearlings to use other areas of the river for rearing, possibly deeper or "new" shallow water areas with less cover where predation is higher.

Decreased Travel Times. It has been suggested by Sims, et al. (1984) that an increased river flow (minimum 111,000 cfs increase between McNary and John Day dams) may slightly decrease travel time for steelhead in the John Day reservoir. If this is the case, it may be argued that this reduction in travel time will decrease the amount of predation on the juvenile salmonids. Decreased travel time will lessen the amount time smolts are exposed to predators. However, it has been suggested that instream flows (velocities) do not significantly affect either rate of movement or residence time of subyearling chinook in the John Day reservoir (Sims and Miller, 1982). If this is the case, then a decrease in total predation will most likely be minimal if at all.

It is also possible that an increased river flow will lessen predation by decreasing the amount of time squawfish are in the main flow of the river. It has been shown that during periods of high flow (such as spring and early summer), squawfish tend to remain in protected areas near the shoreline. This same pattern was seen for daily changes in flow pattern due to spill. When flows decrease (late summer) squawfish move into tailrace areas where predation is high (Fahler et al.,1988). This response to flow is apparently due to increased water velocity rather than just high flows. The drawdown will increase river velocity (decreased water particle travel time) as explained in section 3, while not increasing flows. However, the actual effect this increased velocity will have on predation is uncertain.

Change in Water Temperature. Any change in water temperature in the John Day reservoir due to the drawdown may have an effect on predation. It has been shown that an increase in temperature will increase the daily consumption rate of squawfish (Poe and Rieman, 1988). Therefore, any increase in temperature may increase the number of salmonids consumed by squawfish per day. On the other hand, a decrease in water temperature may reduce the consumption rate of the predators, which will reduce mortality due to predation. Water temperature may increase slightly during drawdown period, but the extent of temperature increase is not known. USACE (1992) suggests that average river temperature may not change, but due to reduced volume and heat buffering capacity the maximum temperatures may be reached earlier than normal.

Loss of Predator Spawning Habitat. It is also possible that lowering the pool will result in a loss of spawning habitat for the predators. Many predators, including bass and squawfish use shallow water habitat for spawning. Lowered success of predator spawning may create lower predation after several years due to lowered reproductive success. This benefit would not be seen initially, but future predator populations may be reduced. Reduction of predator population size should decrease total predation on juvenile salmonids.

It is also possible that lowering the pool will allow spawning of predators in areas that contain proper substrate but are currently at a depth not conducive to spawning. If this is the case then spawning success of predators may be increased as a result of drawdown. At this time the substrate composition of the drawdown zone and resulting "new" shallow water habitat is not known. Testing of the substrate composition is needed before the effects of the drawdown on spawning predators can be determined.

12.5.5 Summary of Predation on Juvenile Salmonids. In summary, due to limited data available at this time, effects of drawdown on predation of juvenile salmonids is not known. Drawdown may decrease or increase predation on juvenile salmonids. Actual effects can only be speculated at this time due to a lack of information regarding present status and variables of predation in the pool.

12.6 Juvenile Salmonid Rearing Areas

12.6.1 Shallow Water Habitat Use. Juvenile salmonids rear in the John Day pool during downstream migration. In most cases they rear in shallow backwater areas where food is abundant and predation is generally low (Zimmerman and Rasmussen, 1981 and USFWS, 1980). Juveniles use backwater areas mainly from late April through July, but may be present throughout the year.

Although many species of juvenile salmonids have been found in backwater areas, it is generally subyearling smolts, which migrate soon after emergence, that are the main users of these areas. This includes fall run chinook and some upper Columbia River summer run chinook salmon (*Oncorhynchus tshwaytscha*). Fall chinook emerge in late March or April, rear for a few weeks in their natal streams, and migrate downstream in early to mid summer (USACE, 1992). These fish migrate slowly, spending time rearing in shallow water areas during migration. Time spent rearing in individual backwaters varies from a few days to weeks (Parente and Smith, 1981). Fish growth in backwaters is expected to be good (Parente and Smith, 1981) with food sources including mainly zooplankton and benthic invertebrates.

Other salmonids that use shallow water habitats include sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), steelhead (*O. mykiss*), and spring/summer chinook salmon. These fish are generally yearling smolts. They rear mainly in their native streams and then actively migrate downstream. They are typically found in the main river channel during outmigration but some backwater areas use does occur. Yearling salmonids probably use these backwater areas for resting (low velocities), feeding and possibly a small amount of rearing (Zimmerman and Rasmussen, 1981).

Paterson Slough is probably one of the most important shallow water rearing areas in the John Day pool both by acreage and production. Paterson Slough is located at RM 278 on the Washington shore. At full pool (elevation 268 feet), it has a surface acreage of 1,058 and a maximum depth of 20 feet. Production of zooplankton and benthic invertebrates include 11 species within the slough, and only two species in the river immediately adjacent to the slough. Zooplankton populations consist of cladocerans and copepods. Cladocerans are the preferred prey of juvenile chinook in this slough. Zimmerman and Rasmussen (1981) found that although *Daphnia sp.* were not the most abundant zooplankter, they appeared to be preferred prey of juvenile salmonids (93 percent of prey ingested).

12.6.2 <u>Impacts to Juvenile Salmonid Rearing Habitat</u>. Lowering of John Day pool to MOP will likely have a negative effect on rearing areas of juvenile salmonids. An estimated 5,200 acres of the 8,400 shallow water habitat which will be lost at elevation 257 feet is accessible for juvenile salmonid rearing. Subyearling chinook (mainly the fall and upper Columbia River summer runs) will be most affected since they generally migrate slowly, rearing for extended periods in the reservoirs during migration (Zimmerman and Rasmussen, 1981). Backwater areas are used as resting and feeding areas. Backwaters of the Columbia River are good habitat for invertebrates and zooplankton which appear to be a preferred prey of juvenile chinook salmon (Zimmerman and Rasmussen, 1981, Dauble et al., 1980). The drawdown has the potential for eliminating much of the water from many of these rearing sites. Loss will include most of Paterson Slough (approximately 1,050 acres) described above. shoreline habitats, bays and coves which are highly productive and contain good cover may be lost. Resulting new shallow water sites may have less cover and productivity than is present in existing areas. It is also expected, due to the annual and short duration of drawdown, that production (vegetation, plankton, and benthos) of new shallow water habitats will be relatively low. It is possible that seeds which have been dispersed to the deeper waters and have remained dormant for many years may germinate when the pool is lowered and conditions improve in the "new" shallow water habitat. It is expected that this productivity will be short-lived due to annual pool fluctuations of 8 feet which will expose habitats during the summer months and then flood them when the pool is raised.

Juvenile outmigration past McNary Dam typically begins in late March or early April (Koski et al., 1989). This early portion of migration is generally composed of yearling smolts. It is likely that some will be in backwaters during initial drawdown. It is also likely that this will result in juvenile salmonids being stranded in drying pools or areas with degrading water quality, especially in culverted backwaters and open backwaters with entrance sills above 257 feet. Even if water flow is not eliminated, but substantially reduced, it is possible that water quality in backwaters will be degraded. Reduced flow may also make it more difficult for migrating salmonids to find outflows which may delay migration.

The importance of shallow backwater areas to total salmonid population in the lower Columbia River is not known at this time. Extensive use by juvenile salmonids indicates shallow backwaters may be important for overall survival. These areas are probably most important for subyearling chinook which typically rear in the mainstem Columbia River prior to migration to the ocean as smolts, but are also important for yearling migrants. The drawdown will also negatively affect production of benthic invertebrates and plankton (used as food for other salmonid species) commonly present in backwater areas.

12.7 Effects on Juvenile Fish Passage

The effect on fish guiding efficiency (FGE) with the existing standard length screens under the proposed lowered pool condition has not been tested. It is generally assumed that the effects would be minor. However, a minor change in this parameter could be important given the potential magnitude of the changes in survival due to travel time associated with the proposed operation. Verification of the effects on FGE would also be recommended for the next phase of study.

Questions have also been raised by resource agencies regarding the effects on orifice passage efficiencies (OPE) with the lower pool operation. The orifice of concern is the passage between the gatewell and the bypass system through which the juveniles must pass. This issue will need to be addressed in the next phase of study to verify that OPE is within acceptable criteria or to determine what modifications would need to be made.

A relationship appears to exist between turbine efficiencies and juvenile survival. This would suggest that lowering John Day pool could have adverse impacts on migrating juvenile anadromous fish. At John Day Dam, lowering the pool reduces the head on the John Day turbines which reduces the overall efficiency of the turbines and can increase turbine cavitation. At McNary Dam, the lowered John Day pool would reduce the tailwater elevation and submergence of the turbines which can effect the occurrence and magnitude of shear flows within the turbine environment. The degree of tailwater reduction would vary with flow. Increases in cavitation or shear flows would be expected to have adverse effects on survival,although these would presumably be small, given the relative changes involved.

12.7 Summary & Conclusions

Previous studies suggest that there may be some correlation between flow and yearling chinook travel time, but there are likely other factors. Available data on subyearlings travel time show no significant relationship. The CRiSP modeling showed no significant nor consistent change in survival for the stocks analyzed, while the PAM model showed an increase in system survival of 7% for the mid-Columbia spring chinook stock analyzed. Given the available information, it is not possible to suggest which model provides the more realistic answer for spring chinook. The available data, the magnitude of the physical changes in flow, and the models suggest that any change in survival resulting from the change in travel time would be relatively small. The other potential effects of the drawdown not modeled include; changes in turbine mortality, effects on FGE (fish guidance efficiency, effects on OPE (orifice passage efficiency), loss of juvenile salmonid rearing habitat (shallow water habitat), effects on predation levels, and potential loss of benthic production in the shallow water areas. These are all factors which could conceivably reduce any potential benefit to drawdown shown in this report. These factors were not included in the modeling effort due to lack of information, a high level of uncertainty, or because they are not parameters analyzed by the models (such as loss of shallow water habitat).

Literature cited

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13. COSTS AND SCHEDULES

13.1 Costs

The estimated costs of mitigation discussed in previous sections are summarized for 4-month and year-round drawdown in tables 13-1 and 13-2. The tables present construction, operation and maintenance costs associated with mitigation required to provide replacement facilities. All costs are based on November 1992 price levels. A contingency of 35 percent was used based on the limited information available for the impacted facilities and the reconnaissance level of design. Planning, engineering and design of 30 percent, and construction supervision and administration of 10 percent were assumed. Costs for economic impacts are discussed in Section 11. Economics. Also see section 11 with regard to economic costs due to impacts to recreation as reported in the System Operation Review. That study evaluated the economic losses due to reduced recreation visitation assuming no mitigation.

The estimated costs for the 4-year drawdown has decreased since publication of the Interim Report. This is primarily due to revised assumptions regarding the effects that the drawdown would have on the hatchery water supplies. Also, in terms of annual economic costs, the impact to hydropower production has been reduced based on adjustments to the HYSSR model with regard to tailwater levels at McNary with John Day forebay at MOP.

The purpose for considering the year-round drawdown was to reduce the overall habitat impacts of drawdown and minimize the need for off-site mitigation. While the information is preliminary, the mitigation costs are only reduced by 25%, reflecting the amount of similar shallow water and marsh-riparian habitat that would be expected to develop given the topography. On the other hand, costs to meet peak hatchery water supply requirements, greater loss of hydropower production, and the additional impacts to groundwater supplies serve to significantly increase the cost of year-round operation at MOP.

TABLE 13-1 *Summary of costs for 4-month operation*

Description	Construction cost w/ cont.[1]	Annual constr cost	Annual O&M cost	Annual econ impact	Total annual cost
PROJECT IMPACTS					
Navigation:					
Lockage Delays				66,900	
Dredging to Irrigon Marina	$ 202,000				
Dredging to Plymouth State Park	202,000				
Navigation Aids	13,000				
Hydropower Generation				3,800,000	
Adult Fish Passage:					
John Day Dam					
South Shore	208,000				
North Shore	674,000				
McNary Dam	62,000				
HABITAT IMPACTS					
Site Aquisition & Development	13,500,000				
RECREATION SITES					
Total for all sites (see tables, Section 7)	12,972,000				
WATER SUPPLY					
Boardman Mun Water Supply	1,800,000		100,000		
Private, Municipal, Commercial and Irrigation Wells	1,840,000		unknown[2]		
Irrigon and Umatilla Hatcheries	0				
IRRIGATION					
Total for all sites (see table 9-2 for details)	14,041,000		816,200		
OTHER IMPACTS					
Cultural Resources	148,000		75,000		
Utilities:					
Northwest Pipeline Company	135,000				
Umatilla Sewer Outfall	135,000				
Monitor SR14 Slide	135,000				
Dredging @ Umatilla River	398,000		50,000		
TOTAL CONSTRUCTION	$46,465,000				
Plan, Engr, Design (30%)	13,939,000				
Supervision & Admin (10%)	4,646,000				
TOTAL PROJECT COST	$65,050,000	$5,646,700[3]	$1,041,200	$3,866,900	$10,554,800

[1] Contingency = 35%
[2] Increased cost of operation for groundwater wells not quantifiable.
[3] Interest rate = 8%

TABLE 13-2 *Summary of costs for year-round operation.*

Description	Construction cost w/ cont.[1]	Annual constr cost	Annual O&M cost	Annual econ impact	Total annual cost
PROJECT IMPACTS					
Navigation:					
Lockage Delays				$ 200,800	
Dredging to Irrigon Marina	$ 202,000				
Dredging to Plymouth State Park	202,000				
Navigation Aids	13,000				
Hydropower Generation				12,300,000	
Adult Fish Passage:					
John Day Dam					
South Shore	208,000				
North Shore	674,000				
McNary Dam	62,000				
HABITAT IMPACTS					
Site Aquisition & Development	10,100,000				
RECREATION SITES					
Total for all sites (see tables, Section 7)	12,972,000				
WATER SUPPLY					
Boardman Mun Water Supply	1,800,000		100,000		
Private, Municipal, Commercial and Irrigation Wells	4,252,000		unknown[2]		
Irrigon and Umatilla Hatcheries	24,907,000		1,500,000		
IRRIGATION					
Total for all sites (see table 9-2 for details)	14,041,000		895,000		
OTHER IMPACTS					
Cultural Resources	148,000		75,000		
Utilities:					
Northwest Pipeline Company	135,000				
Umatilla Sewer Outfall	135,000				
Monitor SR14 Slide	135,000				
Dredging @ Umatilla River	398,000				
TOTAL CONSTRUCTION	$70,384,000				
Plan, Engr, Design (30%)	21,115,000				
Supervision & Admin (10%)	7,038,000				
TOTAL PROJECT COST	$98,537,000	$8,550,200[3]	$2,570,000	$12,500,800	$23,621,000

[1] Contingency = 35%
[2] Increased cost of operation for 2,000 wells not quantifiable.
[3] Interest rate = 8%

13.2 Advanced Planning and Design Schedule

Advanced planning and design (AP&D) efforts have been initiated and are ongoing while Phase I studies are being completed. Subject to an alternative recommendation and decision as a result of this Phase I study, AP&D activities would continue as outlined below. The current schedule for AP&D and potential implementation of a drawdown is shown on figure 13-1. Under AP&D, designs for mitigation measures would proceed concurrently with biological and other studies to evaluate the feasibility of the proposal. The intent would be to expedite implementation with a decision to do so. A draft decision document and environmental impact statement (EIS) would be prepared by January 1996 under this schedule. Implementation of the MOP operation is projected for May 1999 under this schedule. A fully funded cost estimate based on the current cost estimate and the current schedule for implementation. Table 13-3 presents the fully funded cost for the 4-month alternative.

13.3 AP&D Plan of Study

AP&D includes a combination of feasibility study efforts and an accelerated program for design of facilities to mitigate the impacts of the potential MOP. Biological, habitat, economic, engineering and design, real estate and institutional studies would be undertaken. Products would include a decision document (feasibility report) and EIS, various design memoranda and letter reports, and plans and specifications for contracts to construct modifications to impacted facilities or monitor effects.

Biological Effects. To address biological uncertainty issues, hydraulic model and field studies would be conducted to address the questions with regard to the adverse effects the lowered pool operation would have on fish guidance efficiency, orifice passage efficiencies, and turbine mortality. To assess the effects on shallow water habitat baseline data would be collected on benthic organisms (including macro-benthic invertebrates), vegetation, water quality, plankton composition and abundance. Testing of travel time/survival relationships would be conducted subject to the installation of a smolt monitoring facility at the project. At least two years of data would be desirable, which would serve as baseline information against which data from the revised operation could be measured should the decision be made to implement. The schedule for installation of the smolt monitoring facility has not been finally established as yet.

Habitat Impacts. Studies are required to establish without project conditions and assess the impacts of mitigation requirements for effects MOP operation on habitat for resident fish and wildlife. The overall project shoreline and lands will be considered, but studies will focus on the Umatilla National Wildlife Refuge, operated by the U.S.Fish and Wildlife Service and two wildlife management areas operated by the State of Oregon on project lands. The work would be conducted in cooperation with the Fish and Wildlife Service and State agencies. Studies would include hydrosurveys, a Habitat Evaluation Process (HEP) analysis, wildlife field studies, and studies of submergent plant communities. With the baseline data, on and off-site mitigation alternatives for acquisition and/or development will be identified and evaluated.

Engineering and Design. Detailed studies and preparation of various design reports and cost estimates would be conducted on all of the potentially impacted facilities. Hydrosurveys to define the actual conditions expected under MOP operation and establishment of as-built conditions and operating characteristics will be required. Work will be conducted in cooperation with the owners of the facilities. Some work may be done on a cost-reimbursable basis by the owners. With approval of design reports, plans and specifications preparation for modification of the facilities will be initiated and will continue unless a decision to not implement the operation is made. Plans and specifications would be "on-the-shelf" if completed prior to a final decision. Designs for habitat mitigation development requirements for evaluation of alternatives and subsequently for preparation of plans and specifications will also be conducted.

<u>Real Estate and Institutional Studies</u>. **Detailed analysis of obligations and authorities with regard to compensation to impacted parties will be conducted and the results reported in the decision document. Both facilities on project lands by way of existing lease agreements and off project impacts to groundwater users will need to be evaluated. Studies of aquisition alternatives for off-site lands for potential habitat mitigation will be conducted. With approval to proceed toward implementation, aquisitions as necessary will be initiated as would relocation agreements with owners of impacted facilities as appropriate.**

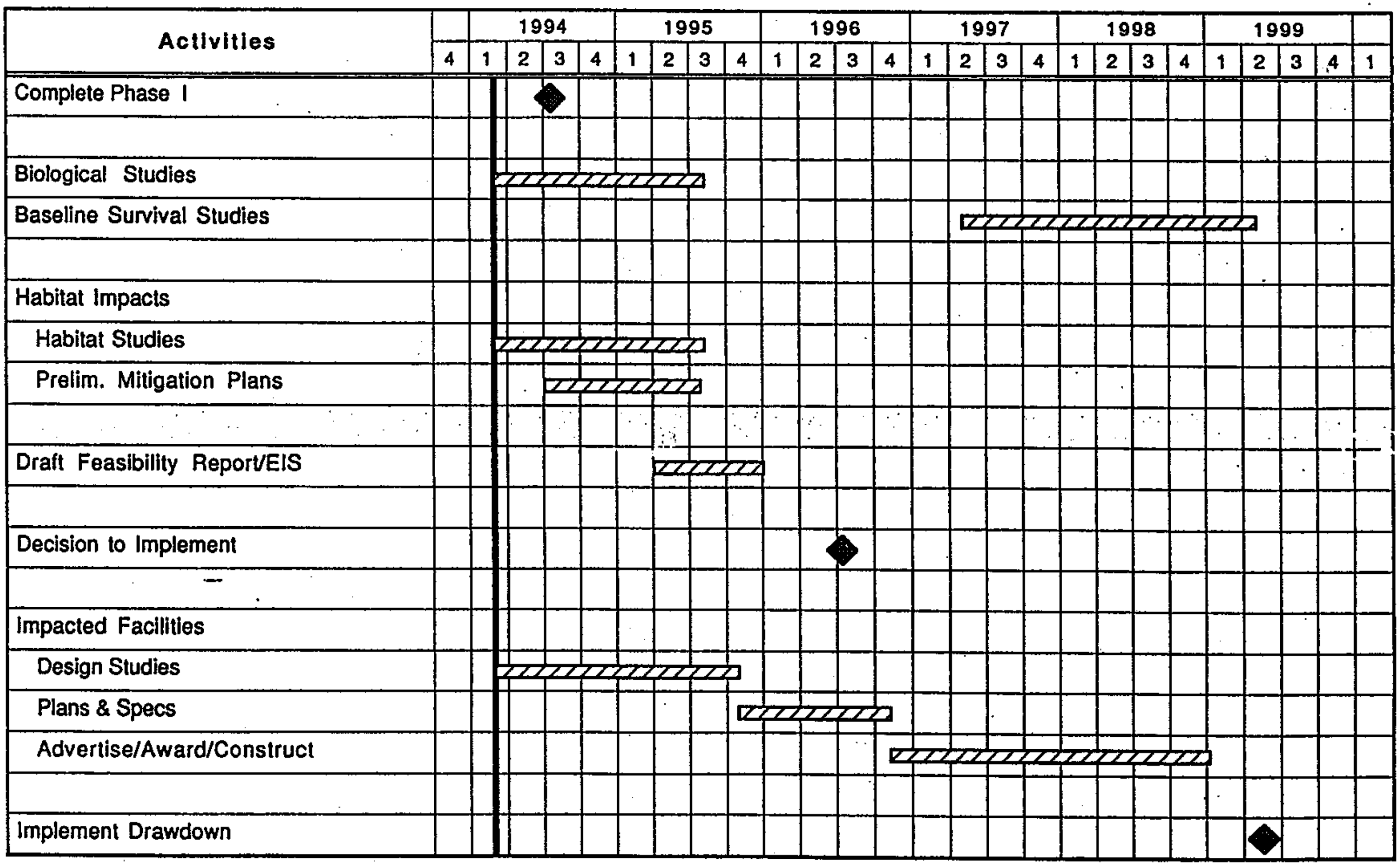

FIGURE 13-1 *Preliminary Schedule for John Day AP&D*

TABLE 13-3 *Fully-funded cost estimate for implementation of John Day operation at MOP*

****TOTAL CONTRACT COST SUMMARY****

PROJECT: COLUMBIA RIVER SALMON MITIGATION ANALYSIS — DISTRICT: PORTLAND
SYSTEM CONFIGURATION STUDY - PHASE I
JOHN DAY OPERATION AT MINIMUM OPERATING POOL
Summary of costs for 4-month operation
LOCATION: COLUMBIA RIVER, OREGON & WASHINGTON.

CURRENT MCACES ESTIMATE PREPARED:		Jan-94				AUTHORIZ./BUDGET YEAR: 1995				FULLY FUNDED ESTIMATE				
EFFECTIVE PRICING LEVEL:		Oct-93				EFFECT. PRICING LEVEL: OCT 95								
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
06 - - -	FISH & WILDLIFE FACILITIES													
	JOHN DAY OPERATIONS @ MOP	34,419	12,046	35%	46,465	6.7%	36,725	12,854	49,578	Nov-97	7.5%	39,479	13,818	53,297
	TOTAL 06 ACCOUNT = = = = >	34,419	12,046		46,465		36,725	12,854	49,578			39,479	13,818	53,297
	- - - FUNCTIONAL COSTS - - -													
30 - - -	PLANNING, ENGINEERING AND DESIGN													
	E&D PROJECT MANAGEMENT	10,722	3,217	30%	13,939	0.0%	10,722	3,217	13,939	Jan-95	8.1%	11,591	3,477	15,068
	TOTAL 30 ACCOUNT = = = = >	10,722	3,217		13,939		10,722	3,217	13,939			11,591	3,477	15,068
31 - - -	CONSTRUCTION MANAGEMENT													
	SUPERVISION & ADMIN.	4,224	422	10%	4,646	9.2%	4,612	461	5,073	Dec-97	9.7%	5,060	506	5,566
	TOTAL 31 ACCOUNT = = = = >	4,224	422		4,646		4,612	461	5,073			5,060	506	5,566
	TOTAL 06, 30, & 31 ACCOUNTS = = = = >	49,364	15,686	32%	65,050		52,059	16,532	68,591		7.8%	56,129	17,801	73,930
											Total project costs =			$73,930

Functional costs and contingencies were provided by the design.
Authorization Year for 06 & 31 accounts assumed to be FY 1995

14. CONCLUSIONS

14.1 Study Conclusions

Operating John Day at its minimum operating pool can reduce average water particle travel time (WPTT) in the reservoir an estimated 12-15%. From the Granite pool on the Snake river or from Wells pool on the mid-Columbia to below Bonneville, the calculated change in average WPTT ranges from 2-5%. Based on these estimates, under average flow conditions in May, an approximate 15 day travel time would be reduced by 0.5 days. Under average August conditions, an approximate 56 day WPTT from Granite would be reduced by about 1.7 days. From Wells pool in August, an approximate 30 day WPTT would be reduced by about 1.5 days.

Uncertainty continues over the flow/survival relationship, in general. Ongoing and planned research including that of the National Marine Fisheries Service and the biological drawdown test of Lower Granite pool on the Snake River are intended to further the understanding of the relationship and the effects of drawdown.

Biological issues with regard to John Day operation at MOP may or may not benefit from the current and planned research. Because it would provide a smaller change in flow relative to drawdowns being considered on the Snake River and because of its location in the system, results may not be applicable. Research on flow/survival in John Day pool itself would not appear to be of value until smolt monitoring using PIT tags could be employed. A smolt monitoring facility is scheduled to be in place at John Day by 1997. It is highly possible that even with smolt monitoring the effects of the proposed operation would remain uncertain.

Review of existing information is inconclusive with regard to the benfits of the operation at MOP. Modeling of benefits using regional fish passage models show varied results. Estimates, using CRiSP passage modeling of juveniles through the system from point of origin to below Bonneville showed virtually no change from the basecase survival for any of the stocks analyzed (absolute changes ranged from -1% to +1%). Estimates of system survival using PAM modeling showed a potential relative increase in survival of 7% (3% absolute) from the base condition for mid-Columbia spring chinook.

Discussion of the modeling results is limited to effects on mid-Columbia stocks as the effects on Snake River stocks with transportation in place are negligible due to the number of fish transported past the project. Benefits of John Day MOP operation alone for Snake River stocks without transportation yields negative results with respect to the base condition.

Other potential effects on migrating juveniles due to drawdown of John Day to MOP have been identified and include: changes in fish guidance and/or orifice passage efficiencies, turbine passage survival, shallow water habitat (rearing areas) and predation. It is possible that these changes would have adverse effects on juvenile fish which might offset any benefit derived from reduced travel time. Some studies are planned for AP&D to improve the understanding of the potential extent of these effects to reduce the level of uncertainty.

Impacts to the Umatilla National Wildlife Refuge and other habitat for resident and anadromous fish and wildlife would occur and some losses would be expected. This appears to be the case with regard to resident fish, due to the alternate dewatering and refilling of existing shallow water areas. Preliminary estimates indicate year-round operation could provide replacement of about 25% of the current acreage of shallow water and marsh/riparian zones, after a recovery period. The actual amount of loss and potential replacement would need to be evaluated through hydrosurveys and habitat studies. Off-site mitigation is projected to be necessary for wildlife habitat impacts under either drawdown alternative.

Reservoir users, particularly agricultural irrigation operations, and groundwater users in the project area will be adversely impacted. Not all impacts to users are likely to be compensable by the Federal Government without special authorization.

Most mitigation measures for recreation sites are relatively straightforward and low cost. Some potential major work involving removal of rock to restore channel depths at marinas may not be justified.

Year-round drawdown is estimated to be significantly more costly than an annual 4-month drawdown due primarily to impacts to fish hatchery water supplies and lost hydropower production. Project cost estimates range from $65 million for 4-month drawdown to $98 million for year-round drawdown. Average annual costs are about $10 million and $23 million , respectively. Cost effectiveness of the alternative relative to other measures under study on the lower Columbia will be addressed in the summary report.

14.2 Potential Courses of Action

The Corps of Engineers has initiated Advanced, Planning and Design (AP&D) concurrent with the Phase I SCS study in response to the regional (NPPC) and legislative direction. The scope of work includes studies to further evaluate and quantify environmental and user impacts, address mitigation alternatives, develop mitigation plans, and design mitigation measures for the impacted users in anticipation of a decision to implement. The scope also includes biological studies intended to address some of the uncertainties with regard to the biological effects of the proposal and, with completion of a smolt monitoring facility at the project, to obtain baseline flow/ survival data prior to potential implementation. The projected date to complete a draft decision document and EIS is 1996. With a positive decision to implement, MOP operation could begin in 1999.

The results of Phase I provide little information to reduce uncertainties surrounding the biological effectiveness of the proposed operation. This uncertainty results from general flow/survival issues as well as the relatively small physical change in pool levels and water travel time which would be achieved by the operation. Operation of John Day at MOP may not provide a sufficient benefit to justify the costs and impacts that have been preliminarily identified, uncertainties aside. There appear to be two courses of action that may be pursued beyond Phase I for this alternative; 1) continue the AP&D process now underway, or 2) discontinue study of John Day operation at MOP as an alternative. The following discusses the premises and options for selection of one of these courses of actions;

1). Continue AP&D. Under this course of action biological, environmental and design studies would continue as described. The prospect of a future negative decision risks sunk engineering and design efforts and costs. Pursuing this alternative would be considered to be optimistic with regard to the biological effectiveness of the proposed operation relative to costs and impacts. There is a high probability that uncertainties with regard to the biological effectiveness of the alternative may not all be resolved.

This is the course of action for which the Corps has been funded and is currently pursuing. The current working estimate for AP&D is about $12 million. Approximately $8 million would be expended prior to a final decision in 1996 under the current schedule. Continuation on this course of action is contingent on regional comment and decisions resulting from review of this Phase I report.

An option under this course of action would be to proceed to design and construct modifications to implement the drawdown operation without further biological studies. This option is most optimistic and presumes uncertainties are insignificant, there is little risk, and the proposed operation is biologically effective. Under this option study of habitat and other user impacts would be continued toward preparation of an EIS and mitigation plans. The implementation schedule would be approximately the same (ie. 1999 MOP operation).

2. Discontinue study. Further evaluation of John Day operation at MOP would discontinue under this course of action. It presumes that the information to date suggests that the biological effects are or would likely be shown to be negligible, adverse, or not sufficient to justify incurring the impacts and mitigation costs of implementation. The alternative could be resurrected if new information derived from flow/survival studies, including potential survival studies at John Day upon installation of smolt monitoring facilities, gave cause to reconsider the conclusion.

An option under this course of action would be to continue research studies to evaluate the potential biological effects. Again, uncertainties may not be resolved. Studies of impacts, design and construction of mitigation measures could be resumed at some future time, if warranted by the research. A delay of at least two years in implementation beyond the current AP&D schedule would result.

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ATTACHMENT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Station
2600 S.E. 98th Avenue, Suite 100
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September 15, 1992

Colonel Charles A.W. Hines, District Engineer
Portland District, Corps of Engineers
Attn: CENPP-PE-RP
P.O. Box 2946
Portland, Oregon

Dear Colonel Hines,

This is our planning aid letter (PAL) describing the impacts on fish and wildlife from the proposed drawdown of the Columbia River John Day Reservoir to elevation 257. Information in this letter is based upon general project data provided by your District prior to May 8, 1992. Information is at the reconnaissance level, consistent with the Corps of Engineers (Corps) level of study for the proposed project. This PAL has been coordinated with the Oregon Department of Fish and Wildlife, Washington Department of Wildlife, Washington Department of Fisheries, National Marine Fisheries Service, Columbia River Inter-Tribal Fish Commission, and Confederated Tribes of the Umatilla Indian Reservation and they have provided comments. The scope of this letter is general in nature and does not constitute the formal report on the project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act.

DESCRIPTION OF THE AREA

The John Day Lock and Dam Project is located near Rufus, Oregon on the Columbia River at river mile (RM) 215 (Figure 1). The project was built and is operated by the Corps of Engineers. The project, which began operation in 1968, was authorized for the purposes of power, navigation, irrigation, and flood control. The dam creates a 76-mile-long impoundment which extends upstream to McNary Dam (RM 291). The reservoir surface area measures about 48,000 acres. The powerhouse contains 16 generators with a total capacity of 2,160,000 kilowatts.

DESCRIPTION OF THE PROJECT

The proposed project would involve a reduction in the current pool elevation in the John Day Reservoir from May 1 to August 31. Under the existing operation, John Day Reservoir ranges from elevation 265 (measured at the dam) in May to elevation 268 in August. The proposed change in operation would result in an annual drawdown of the reservoir to elevation 257 by May 1 and then maintain that level until August 31. This drawdown is intended to increase river velocities to reduce the travel time it takes for salmon and steelhead smolts to move downstream through the reservoir. A reduction in juvenile salmonid travel time in route to the ocean is expected to increase

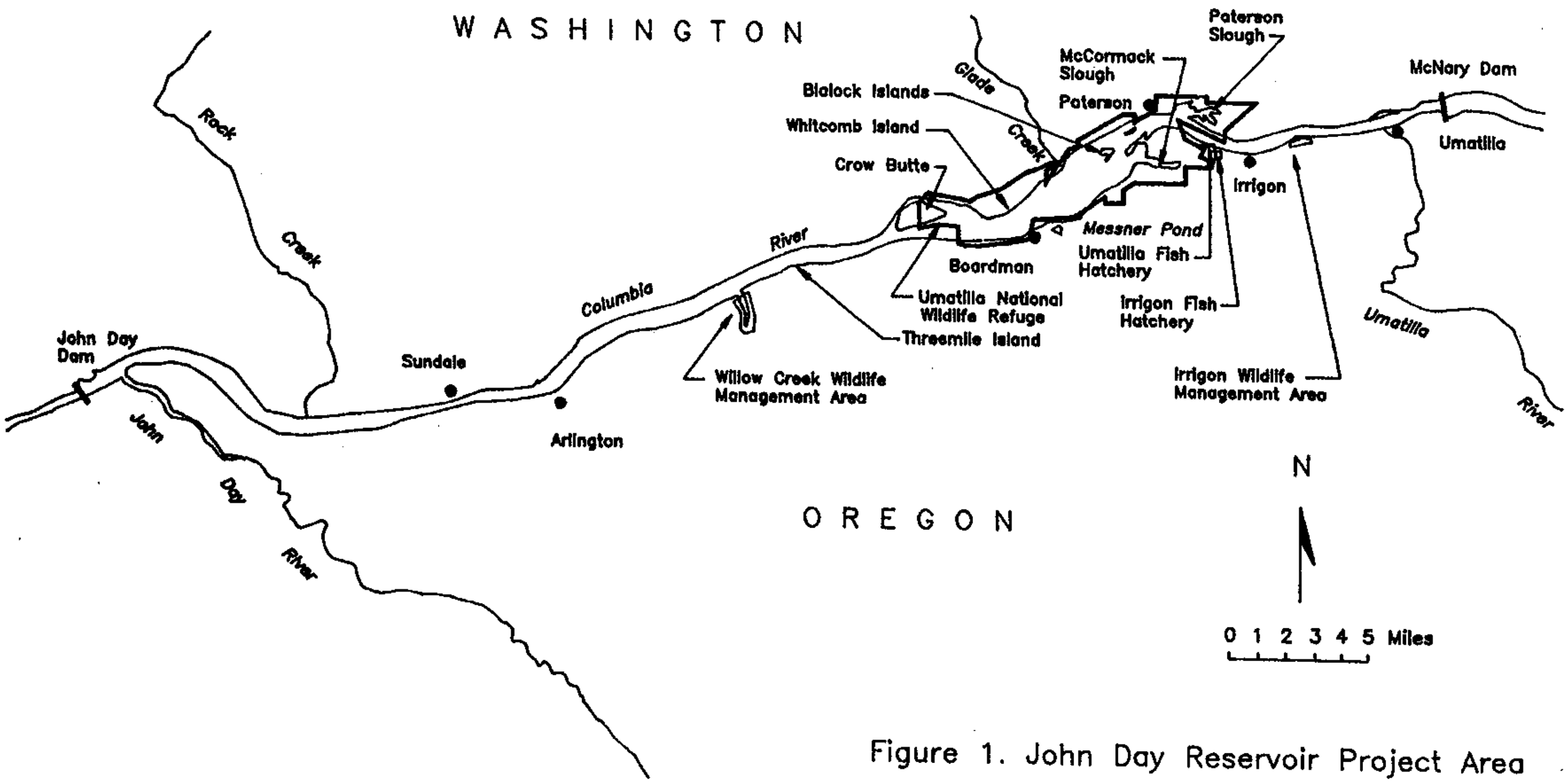


Figure 1. John Day Reservoir Project Area

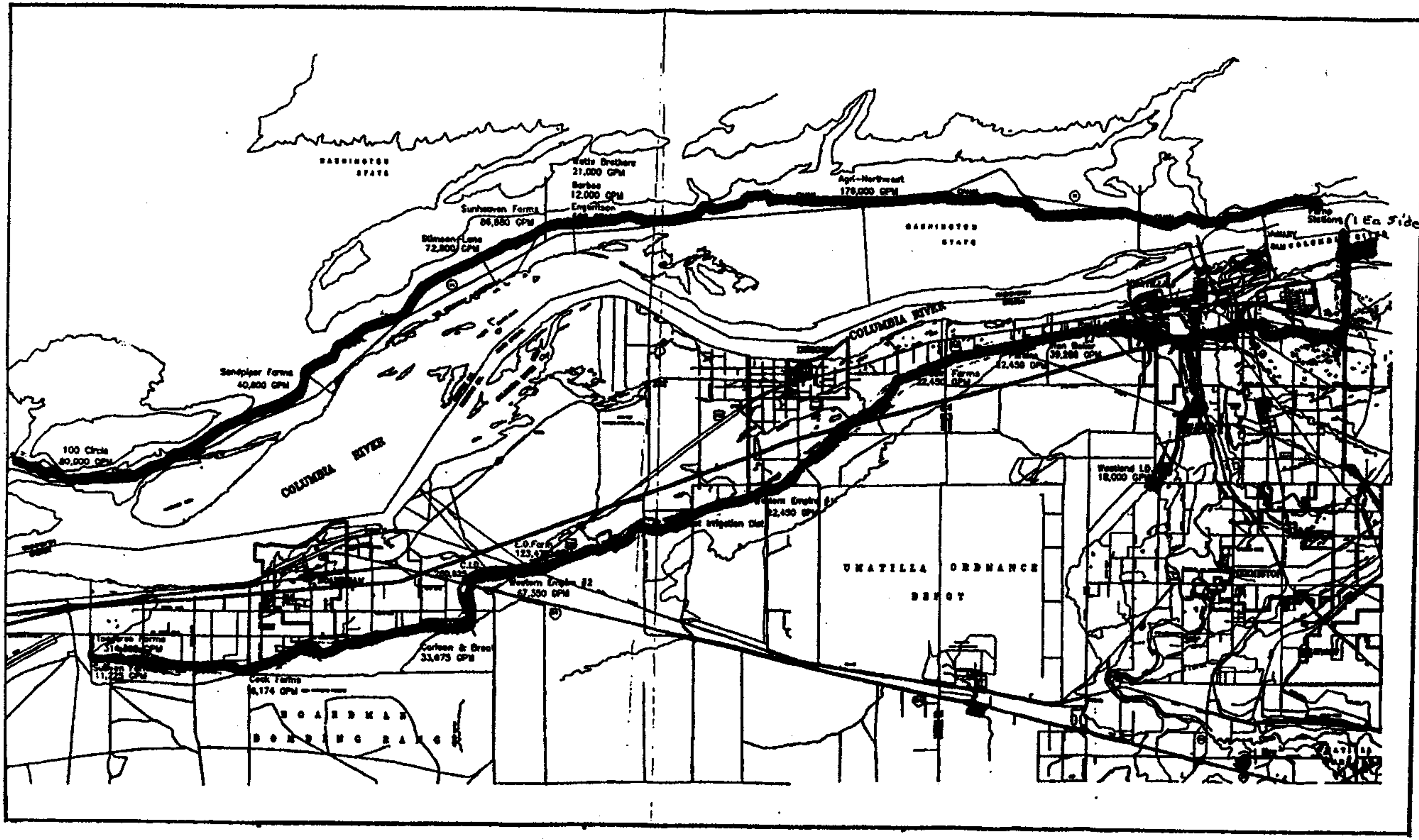
their survival rate and thereby improve Columbia River adult returns. Several agencies suggested in their comments that the draft PAL should include identification of the anadromous fish benefits that would result from the decrease in smolt travel time through John Day Reservoir. While we believe this information would be valuable, the scope of work for this project did not include calculating juvenile survival and resulting increases in adult returns. The drawdown proposal itself is recommended in the Columbia River Basin Fish and Wildlife Program (Pacific Northwest Electric Power Planning and Conservation Act of 1980, P.L. 98-501) to improve fish runs as a result of input from regional fishery agencies.

The PAL responds to "given that the John Day Reservoir is lowered to 257 to increase smolt survival and adult returns, what are the impacts to other fish and wildlife resources?" Therefore the PAL does not provide a benefits analysis to anadromous fish from the drawdown. Additionally, several comments suggested that the information to develop these benefits (relationship of water particle travel time to smolt travel time, increased survival, etc.) was not readily available and would require extended and careful study to document. It will be important to demonstrate the potential benefits and adverse impacts of drawdown, before a decision is made to implement some action. Accordingly we are providing copies of the comments received on the draft PAL, so the Corps is fully aware of the nature and extent of these concerns.

The construction of two irrigation distribution canals is proposed to provide water to irrigators that would be impacted by the reservoir drawdown. These canals would replace water lost to existing irrigators as the reservoir water level dropped below their existing pump intakes. One canal would be constructed on the Oregon side of the Columbia River and one would be on the Washington side (Figure 2). The canal in Oregon would be designed to carry about 2,100 cfs and would generally follow the alignment of the existing West Extension Irrigation District (WEID) canal. Extensive reconstruction of the WEID canal would be necessary since it is now capable of carrying only about 180 cfs. This canal would begin just upstream from McNary Dam and terminate about 4 miles West of Boardman. Total length of the canal would be about 32 miles.

The canal in Washington would be designed to carry about 1,250 cfs. Two possible alignments are being considered for this canal. Both would begin just upstream from McNary Dam and terminate near the Crow Butte turnoff from State Highway 14. However, one would generally follow the 700-foot elevation contour while the other would go through existing irrigated agricultural lands just upslope from the Columbia River. The canal would be around 29 miles long.

Water for the canals would be provided by two pump stations located on the Columbia River approximately 1/2 mile upstream from McNary Dam. The intakes for these pump stations would be located in the McNary pool at a minimum operating depth of elevation 325. This would place the intakes 15 feet deep when McNary Pool is at elevation 340 (normal full pool). The screens would be the Johnson Wedgewire type with 1/8" open mesh. Water velocities through the screens would not exceed 0.4 feet per second and velocities across the face of the screen would be equal to or greater than 0.4 fps.



Proposed Alignment-

Figure 2. Proposed Irrigation Canal Alignment for Oregon and One Alignment for Washington

pal resident game fish found in the vicinity of McNary Dam are rainbow whitefish, channel catfish, bullhead, black and white crappie, yellow largemouth and smallmouth bass, walleye, bluegill, and pumpkinseed.

lumbia River in the project area supports a significant sport fishery rmwater game fish. A popular walleye fishery exists on the main river Nary Dam down to the Boardman area. At least ten bass or walleye nents have taken place on the John Day Reservoir each year for the last s. However, about 50 percent of the angling for resident game fish in the many protected backwater areas. The John Day River backwater, mple, supports a popular smallmouth and channel catfish fishery.

hallow backwater areas are of vital importance to warmwater game fish wning and rearing activities. Studies in the area have shown that bass up to 40 miles in the Columbia River to spawn in the sloughs mery and Fickeisen, 1978). Major backwater areas include Paterson (494 acres), Glade Creek (30 acres), and the John Day River. Other nportant to resident fish include Plymouth Park, Paterson, Whitcomb and Crow Butte.

fish populations including squawfish, redside shiner, dace, peamouth, outh, sculpin, stickleback, sand roller, sucker, carp, and goldfish nabit the Columbia River. Of special significance is the sand roller s being considered for sensitive species status by ODFW. Large numbers often occupy the shallower waters and eliminate much of the aquatic on. This has resulted in depressed game fish populations and reduced waterfowl.

PROJECT

el time for upper Columbia River system smolts migrating to the ocean eased significantly from historic conditions because of the numerous slow moving water in the reservoirs. Lengthening smolt travel time Columbia River reduces their chances for survival. There are several that increased smolt travel time can be detrimental. The gical condition of smolts changes as they migrate, preparing them for sition to salt water. Increased travel time subjects the smolts to bility of missing their "biological window" for arriving in salt dditional migration time also increases the migrants exposure to nd predators within the Columbia River reservoirs. Some salmonid (particularly steelhead) do not migrate but become "resident" fish. their migration time increases this rate of residualism.

ation of the project (reservoir drawdown) would decrease water travel time through John Day Reservoir. Depending on the volume of er particle travel time would be reduced a minimum of 0.9 days and a f 1.7 days at reservoir level 257. For example, at a flow of 300,000 May flow) water particle travel time would be 4.1 days at reservoir compared to 3.3 days at reservoir level 257. This is a reduction of travel time. Average flows are usually 300,000 cfs in May, peak),000 cfs in June, and drop off to 200,000 cfs in August. Table 1 r particle travel time for two reservoir levels at several flows. ase in water particle travel time is expected to result in decreased e for smolts moving through John Day Reservoir. This decreased

TABLE 1. Water Particle Travel Time (in days) Through John Day Reservoir
Source: Fish Passage Center

Flow (1,000 cfs)	Full Pool (el. 268)	Drawdown (el. 257)
300	4.24	3.34
200	6.36	5.02
160	7.95	6.27

travel time would increase smolt survival rates and thereby numbers of returning adult salmon and steelhead in the Columbia basin.

Further benefits to salmonids could result if the 257 reservoir elevation was maintained and not flucuatated daily and hourly as commonly occurs under the existing operation. A constant 257 level would improve fish guidance efficiencies at the dam and reduce delays in adult fish migration.

A number of adverse fishery impacts are anticipated as a result of the reservoir drawdown. Some of these include losses to migrating juvenile salmonids. For example, the lower pool level will result in a smaller size reservoir which will concentrate both smolts and the population of fish which prey on smolts. A reduced level of the John Day Reservoir tailwater will cause decreased submergence of the turbines at McNary Dam. This condition causes subatmospheric pressures which could increase mortalities to downstream migrants. This increased mortality could be in the range of 1 percent. Further losses could result if little or no water goes over the John Day spillway, thus forcing all downstream migrants to negotiate the turbine screens and bypasses.

The shallow water shoreline and backwater areas provide important foods and nutrients to the Columbia River ecosystem. Juvenile salmonid smolts, including large numbers of fall chinook fry, utilize these areas for feeding during their downstream migration. Dewatering the sloughs and backwaters would eliminate this important food source for migrating juvenile salmonids and a part of the food chain and nutrient supply in the Columbia River.

Significant losses of spawning and rearing habitat for warmwater game fish would occur with the reservoir drawdown. Dewatering shallow backwater areas would result in spawning habitat losses to species such as smallmouth bass which travel many miles in the Columbia River to reach sloughs and backwaters to spawn. If spawning, but not hatching, occurs prior to the water level drop, much of the new recruitment for that year would be lost. Beneficial effects would result if spawning areas of undesirable species (such as carp and squawfish) were dewatered. Increased water velocities in the river could adversely affect walleye spawning success which is best when the river is high and slow. As the reservoir level drops, fish of all species will be subject to stranding in isolated pools that remain in the backwater areas. Reservoir drawdown would also eliminate much of the shallow water aquatic invertebrate population. This is expected to cause additional losses to warmwater game fish which depend on invertebrates for a significant part of their food supply. Fluctuation induced losses of aquatic vegetation would mean a major reduction in essential cover habitat for warmwater species.

Some of the backwater fish habitat which would be adversely impacted by the drawdown include Paterson Slough, McCormack Slough, Willow Creek, the John Day River arm, Glade Creek, Plymouth Park area, the area between Whitcomb Island and the mainland, the area behind Crow Butte, Mesner Pond, and those areas between the railroad and highway fills along the Columbia River.

Angling opportunities and success would be significantly reduced. Popular shoreline angling areas in the backwaters would be dewatered and fishermen would then have to fish along the new barren shoreline created as the river receded. Angling in areas such as the John Day River arm, which supports a significant smallmouth bass and channel catfish, could be severely impacted.

It is expected that many of the boat ramps now used by anglers will be unusable when the river level drops to elevation 257. Some of the more popular ramps which would be affected are at Sundale, Threemile Island, Paterson Ferry Road, and the Umatilla River. Other more primitive boat launch sites around the reservoir would also be affected. There is also concern about potential impacts at several boat marinas located on the John Day Reservoir. Maximum pool drawdown could adversely impact marina operations at Boardman, John Day River (Lepage Park), Arlington, Crow Butte State Park, Irrigon, Umatilla, and Plymouth Park. The boat dock on the lower John Day River at Phillipi Park (about RM 3) would also be impacted by the low water. Low pool levels could affect access from the main river to the boat mooring areas and also affect use of the boat launch ramps at the marinas.

Reservoir drawdown is expected to expose large mud flats at the mouth of the Umatilla River. The Umatilla River carries a heavy silt load into the Columbia River. This silt has been settling out where the Umatilla flow meets the Columbia backwater since John Day Dam was completed in 1968. The reservoir at elevation 257 will be lower than the existing level of the Umatilla River mouth which was raised by accumulated sediments. This will likely result in the Umatilla River cutting a channel into the sediment deposit down to the new reservoir level. The removed sediment will be redeposited in the immediate reservoir area and/or, if there is enough flow in the Columbia, carried and distributed downstream throughout the reservoir area. There is also concern regarding the potential impact of this channel realignment on Umatilla River anadromous fish.

Adult spring chinook would be entering the Umatilla River during the reservoir drawdown period. If a well defined channel is cut into the sediment deposit area, upstream passage for spring chinook may not to be a problem. However, if the river mouth should spread out into many small channels, fish passage could be restricted. Further potential passage problems could occur upstream near Chinamans' Hole where channel modifications were recently made to facilitate passage. If any of these problems should occur, additional channel modifications would be required to provide passage.

The John Day River mouth is very deep (80-90 feet) and adult fish passage problems are not anticipated in that area. However, at elevation 257 the reservoir backwater will not extend nearly as far up the John Day River as it does at elevation 268. Large mud flats would be exposed further upstream and, depending on what kind of channel is formed, could present a passage problem. Observations should be made here and at the new location where the river and reservoir meet to determine if any barriers exist for spring chinook.

Group A (wild) steelhead returning to the John Day River congregate in the Columbia and lower John Day River each year before migrating upstream. Because the fish are quite vulnerable in that area, a sanctuary has been established prohibiting gill netting. Last year was the first year that the closure was observed. With the proposed drawdown, more fish will likely be waiting in the Columbia, making it imperative that the sanctuary area be protected.

Reservoir drawdown to elevation 257 is expected to cause severe impacts to the Umatilla and Irrigon Hatcheries. The well water supply for both hatcheries is directly dependent upon the level of the Columbia River. Hatchery operation is severely impacted when the John Day Reservoir drops as low as elevation 261. It is expected that if the reservoir drops to elevation 257 these hatcheries could not operate with the present water supply systems. This would mean an annual production loss of more than 5 million salmon and steelhead smolts.

The pump stations to be installed upstream of McNary Dam for supplying irrigation water to the proposed canals are to be designed in accordance with fish screening criteria acceptable to State and Federal fishery agencies. Therefore, impacts to juvenile fish from this facility are not expected. Although the specific alignments of the canals are not yet known, they are not expected to significantly impact fish resources.

WILDLIFE RESOURCES

WITHOUT THE PROJECT

Habitat surrounding the project area consists primarily of the shrub/steppe/grass type. Big sagebrush and rabbitbrush are the most common shrub species. Closer to the water, riparian herb, shrub, and tree habitats present a more varied vegetative cover. Common riparian shrubs include young trees, willows, and false indigo. The dominant riparian tree stands are black cottonwood, but Russian olive, large willow, and some alder are also present. Much of the reservoir shoreline is bordered by riprapped highway or railroad fill with no vegetation adjacent to the water. From John Day Dam upstream to the Whitcomb Island area almost all vegetation behind the riprap consists of shrub/steppe/grass. Riparian shrub and tree habitats generally occur from Whitcomb Island up to McNary Dam. Much of this riparian habitat is located on Umatilla National Wildlife Refuge around Paterson and McCormack Sloughs. Approximately 350 acres of emergent wetland and riparian vegetation are present on Paterson Slough and 270 acres are found on McCormack Slough. Other significant riparian habitat includes 228 acres on the Irrigon Wildlife Management Area (which is managed by the ODFW) Plymouth Park, Glade Creek, and Whitcomb Island. Important riparian and emergent wetlands are also found in the Willow Creek Wildlife Management area.

Some of the most valuable habitats in the reservoir are the islands. These are used extensively by a wide variety of wildlife species. Islands are used, almost to the exclusion of shoreline habitat, for nesting by Canada geese. Colonial nesters such as California and ring-billed gulls, Caspian and Forsters' terns, and great blue and black-crowned night herons also utilize the islands for nesting purposes. The black-crowned night heron populations are very low and are listed in Oregons' "Fish and Wildlife Habitats and Species of Special Concern." Threemile Island supports 7,000 to 10,000 nesting ring-billed and California gulls, some Forsters' and Caspian Terns, and about 35 nesting black-crowned night herons. Other species of waterfowl, shorebirds, and nongame birds also concentrate on island habitat. Prior to the construction of John Day Dam there were about 6,700 acres of islands in this section of river. Now only about 1,900 acres remain. These remaining islands are rapidly disappearing as a result of wind and wave erosion. This is readily apparent when looking at the acreages of five islands during the 1973 to 1989 period in the Paterson-Irrigon area of the John Day Reservoir (Table 2).

Table 2. Acreage Figures for Islands in John Day Reservoir

Island	1973	1979	989
Straight Six	10.6	0	0
Blalock	92.8	86.8	82.6
Coyote	36.1	0	0
Long Walk	129.6	101.3	64.3
Sand	140.6	25.7	18.5
Total Acres	409.70	213.80	165.40

Mule deer is the principal big game species found in the project area. These animals are partially dependent upon islands for fawning where mammalian predators are not present. Deer populations are not high, but they represent an important part of the island and riparian community. About 200 deer presently utilize this habitat on the Umatilla Refuge.

Common upland game along the shoreline areas include ring-necked pheasant, chukar, valley quail, and mourning dove.

The river and riparian areas support a variety of fur animals. Common species include beaver, muskrat, mink, otter, skunk, raccoon, bobcat, and coyote. Some trapping occurs in the reservoir area.

Waterfowl are the most common and abundant wildlife species within the project area. This portion of the Columbia River attracts large numbers of mallard, American wigeon, pintail, green-winged teal, and three subspecies of Canada geese. Other species found in the area in lesser numbers include the white-fronted goose, snow goose, tundra swan, canvasback, lesser scaup, northern shoveler, cinnamon teal, redhead, and ruddy duck. Waterfowl numbers are highest during winter months but large numbers of waterfowl also use habitat in the project area for resting and feeding during spring and fall migration. In 1992 there were 12 species of waterfowl nesting on McCormack Slough. A 1-day survey in 1992 found 76 broods totalling over 600 ducklings on McCormack slough. In addition to waterfowl, there were also rail, coot, killdeer, common snipe, spotted sandpiper, avocet, black-necked stilt, long-billed marsh wren, grebe, and blackbird nests around the slough.

During the spring months, geese and ducks nest along shorelines and on river islands where suitable nest sites and brooding areas for young are available. Considerable duck nesting also takes place in the subimpoundments constructed on the wildlife refuges.

The Great Basin Canada goose, a year-round resident, nests primarily on river islands free of mammalian predators and requires suitable brooding pastures nearby for rearing the young. River island habitat, which is essential for goose nesting, was once numerous in the John Day pool. However, construction of John Day and McNary projects inundated most of the nesting islands. Only a few portions of the original islands in the John Day pool remain and they are continuously being reduced by erosion and flooding. Prior to the reservoir, goose production was distributed from John Day Dam to McNary Dam. Now, essentially all nesting is concentrated on the few remaining islands in the Paterson area.

Waterfowl hunting is a popular activity in the project area. Hunting occurs during the late fall and early winter and largely on the refuge and management areas.

Numerous species of songbirds, shorebirds, and raptors also inhabit the riparian zone. The northern bald eagle (classified as a threatened species) is among the raptors present in the project area. The white pelican and long-billed curlew are also found on the John Day Reservoir.

There are many species of small mammals found in the project area including mountain cottontail, blacktail jackrabbit, porcupine, short-tailed weasel, and a variety of rodents.

All of the aforementioned wildlife species provide environmental education, wildlife observation, and photographic opportunities. Most of these activities are concentrated within the managed wildlife areas.

<u>WITH THE PROJECT</u>

Major adverse impacts to wildlife and their associated habitat are expected with the proposed reservoir drawdown. Approximately 8,000 acres of shallow water habitat would be dewatered with a reservoir drawdown to elevation 257. These aquatic areas and adjacent riparian zones represent a valuable and unique habitat for fish and wildlife in the desert area of eastern Oregon and Washington.

Impacts would be most apparent in the backwater areas such as McCormack Slough, Paterson Slough, Willow Creek, Glade Creek, Whitcomb Island Slough, and Crow Butte Slough. Other established riparian communities and wetlands along the main reservoir area, such as the Irrigon Wildlife Management Area, would also be severely impacted. About 6,800 acres of shallow water habitat that would be impacted are within the Umatilla National Wildlife Refuge.

Exposing these shallow water areas during the months of May, June, July and August would be disastrous to aquatic plant communities. Submergent aquatic vegetation would probably suffer the most rapid and severe losses. Summer months represent the period of greatest growth and productivity for submerged plant species such as sago pondweed, a major waterfowl food. Large productive beds of sago and other aquatics would not be able to withstand exposure caused by the drawdown and would likely die. Emergent beds of bulrush and cattail are less vulnerable to exposure than submergent species but would likely undergo severe stress because of the length and timing of the drawdown. Many of these may also be lost over time. The benthic community of these shallow water areas would also be severely affected and much of it would probably be eliminated. This biomass of aquatic invertebrates represents a major food source for fish and wildlife and is a vital part of the aquatic ecosystem.

Loss of aquatic plant and benthic communities would create severe food shortages in a critical period for hundreds of thousands of waterfowl during their migration stopover each fall. In the spring and summer, waterfowl nesting and rearing activity would be eliminated in most of the dewatered backwater areas. This is expected to result in a significant reduction in waterfowl production. At McCormack Slough alone, a production loss of 400 ducks could occur. Production losses to rail, snipe, sandpiper, avocet, and stilt populations would also occur in these backwaters.

The loss of water, and subsequently the riparian habitat, in the many backwater areas would adversely impact aquatic furbearers. Animals such as beaver, muskrat, mink, and river otter would be forced to seek new habitat as the water receded. As the reservoir drops, existing beaver lodges would go dry and new ones would be built in the water. The new lodges would then be flooded out in September. Many furbearers would not survive the shoreline change because most of the area along the new waters edge would have inadequate cover. It is not expected that adequate cover would establish itself along the new shoreline during drawdown because these areas would be flooded after August and would remain flooded until the following May.

Numerous wetland areas not directly connected to but near the John Day Reservoir would also be severely impacted. These wetlands and ponds, like those in the Irrigon Wildlife Management Area, often respond quickly to water level changes in the reservoir. Many of them go dry almost immediately when the river level drops. Just as the backwater areas described above, these wetlands are very important habitat for many species of wildlife. Waterfowl, shorebirds, nongame birds, and furbearers all utilize this habitat. The western painted turtle, listed as a sensitive species by the State of Oregon would also be significantly impacted by the loss of these ponds.

Other impacts are expected along the main reservoir. The drawdown would create large exposed mud flats between the waters edge and the former shoreline. Canada goose goslings would have to traverse large, open exposed areas to and from feeding sites located above the original shorelines. This increased vulnerability to predators would cause additional losses to juvenile geese. This would occur along the main Columbia River shoreline as well as backwater areas like the Willow Creek arm. Many of the grass areas adjacent to the shoreline that are now popular grazing sites for goslings would be lost from lack of subirrigation from the reservoir.

Some of the existing islands within the reservoir would become connected to the main shoreline as the water level drops. This land-bridging would allow mammalian predators easy access to the islands. Significant losses to island nesters such as waterfowl, gulls, terns, and shorebirds would result. Approximately 50 nests each of great blue herons and black-crowned night herons would be vulnerable at the low reservoir level. Some of the islands concern are Threemile, Longwalk, and McCredie. On Threemile Island alone there is a potential impact to 7,000 to 10,000 nesting gulls. An evaluation of other islands and water depths is necessary to determine all potential land-bridge sites.

The riparian herb, shrub, and tree habitat that is adjacent to the main reservoir shoreline may be severely impacted. As the water recedes away from the shorelines, much of the riparian vegetation would die. The lack of water for 4 months during the growing season would be severe enough that most of the riparian zone would not recover. This would impact many species of wildlife dependent upon the riparian vegetation. Some of the impacted wildlife includes beaver, muskrat, mink, river otter, mule deer, California quail, songbirds, cottontail rabbit, heron, raptors (including bald eagles), and woodpeckers.

The Umatilla National Wildlife Refuge operates five wells along the Columbia River. Operation of these wells, which are utilized for irrigation and domestic purposes, would be significantly reduced or eliminated by the proposed drawdown. As a result, refuge operations would be adversely affected.

Construction of the irrigation canals in Oregon and Washington is expected to cause adverse impacts to wildlife resources. A primary concern is that mammals, especially deer, will become trapped and die in the canals. Impact along the canal in Oregon would primarily be to shrub-steppe habitat within the right of way of the existing WEID canal and is not a major concern.

Potential habitat impacts associated with the Washington canal are unknown because a canal alignment has not been identified. Alignments that cross wetland or riparian habitats would create serious adverse impacts since these kinds of habitats are very limited in the project vicinity. Potential loss of shrub-steppe habitat would be a concern because so much of this habitat type has already been destroyed or degraded. Much of the shrub-steppe Washington rangeland in the area has water rights that have not been used due to pumping costs. If irrigation water were delivered at the 700-foot level, current irrigators could receive a windfall of reduced pumping costs and additional water rights could be exercised below and above the canal. Additional irrigated acreage would remove wildlife habitat unless it were confined to areas that are now in winter wheat.

A possible beneficial effect, although probably short term, would be increased shorebird habitat. As the reservoir shoreline recedes, new mudflats would appear. These flats would attract many feeding shorebirds. However, since the water level would remain low, the flats would soon dry out, no longer providing good shorebird habitat. Increased nesting habitat may be available for killdeer and spotted sandpiper, and, where water remains nearby, avocets and stilts.

Some of the existing islands would increase in size (as the reservoir drops) without becoming land-bridged. If the additional island habitat is suitable, and available in time for nesting, colonial nesters such as terns and gulls could benefit from the drawdown.

DISCUSSION

The proposed project would be expected to cause both beneficial and adverse impacts to fish and wildlife in the John Day Reservoir area. Since the project purpose is to improve downstream travel for juvenile andromous fish, detailed benefits for the proposed action should be developed. Benefits in terms of increased smolt survival numbers, increased adult returns, and economic values should be calculated. These benefits could then be compared with the negative impacts in evaluating the proposed project. In addition, the John Day drawdown impacts should not be viewed in isolation, but must be combined with other river operation options such as spill and drawdown in other Columbia Basin reservoirs.

Major losses to backwaters, wetlands, riparian zones, and island habitat would result without measures to reduce the effects. Efforts to prevent major losses to the backwaters should be incorporated into project plans. Diking off Paterson Slough, McCormack Slough, Willow Creek, (and possibly other areas) in conjunction with a water supply from the new irrigation canals should be planned. Water should also be provided from the proposed Oregon canal to the numerous ponds and wetlands in the Irrigon Wildlife Management Area. Studies are necessary to determine how much water would be necessary to maintain existing backwater levels and the best way to distribute the water. Plans should be developed to irrigate key riparian habitats that would be dewatered by the drawdown. Further study efforts would also be necessary to develop detailed estimates of all fish and wildlife losses and measures to compensate these losses with little or no net loss between impact time and actual compensation.

Potential wildlife losses from habitat changes and drowning or injury in the canals is a primary concern. Canals can be designed so that losses are significantly reduced. It is important, therefore, that the appropriate State and Federal wildlife agencies are involved in the canal location and design.

Substantial fishery losses are expected with the drawdown. The Irrigon and Umatilla Fish Hatcheries would be practically inoperable at elevation 257. A production loss of 5 million salmon and steelhead is expected with the proposed project. Finding an alternative water supply for the hatcheries would be difficult because of the stringent water quality and temperature requirements for rearing salmonids. Studies would be necessary to determine if an alternative water supply for the hatcheries is available. If water is not available, a search must be made to determine if there are any satisfactory sites for constructing new facilities to replace the Irrigon and Umatilla Hatcheries.

Some of the project caused wildlife riparian habitat losses may be offset by improving conditions on existing islands. Important island habitat, which was once plentiful in this part of the Columbia River, is now very limited. Due to erosion, many islands are much smaller (or non-existent) than they were immediately after filling of John Day Reservoir. If properly designed, restoration of these islands would provide significant wildlife benefits. Reconstruction and protection of islands in the Irrigon-Paterson area could provide additional habitat and increased wildlife use. Islands which offer potential for improvement include Sand Dune, Straight Six, and Long Walk. Further investigation should also identify habitat improvement opportunities on other islands in the reservoir

Improving or creating other habitat may be necessary to compensate project impacts. One opportunity for wildlife improvements exists at the 2,860-acre Conforth Ranch east of Umatilla. This pothole area is presently overgrazed and degraded by intense land use activities. Significant habitat improvements could result with wildlife management objectives developed and implemented for this area. Additional methods to mitigate habitat losses include creating new wetlands and riparian areas with water from the Columbia River or from the proposed irrigation canals.

RECOMMENDATIONS

To protect fish and wildlife resources we recommend that:

1. If the proposal goes to a feasibility study, the Corps conduct a detailed level of study to document and quantify specific impacts to fish and wildlife resources, including potential anadromous fish benefits in terms of increase in smolt survival numbers, increase in adult returns, and the economic value of these increases. There should also be development of appropriate detailed and specific mitigation and enhancement recommendations under the Fish and Wildlife Coordination Act that involves:

    a) Project plans to maintain water levels in all or portions of McCormack Slough, Paterson Slough, Willow Creek backwater, Glade Creek, Mesner Pond, Whitcomb Island Backwater, Irrigon Wildlife Area ponds, and Crow Butte backwater. The water could be provided by the proposed canals or by pumping from the Columbia River.

    b) Identification of key areas of riparian vegetation that would be dewatered by the drawdown and plans to retain those habitats through irrigation.

    c) Close coordination with the Washington Department of Wildlife, Oregon Department of Fish and Wildlife, Fish and Wildlife Service, and Tribal interests in designing and locating the irrigation canals to minimize adverse impacts to wildlife.

    d) Development of an acceptable alternative water supply for the Irrigon and Umatilla Hatcheries or locating sites for constructing new hatchery facilities.

    e) Reconstruction or development of islands for wildlife habitat in the John Day Reservoir. This should include studies that will show the configuration of existing islands at the new pool level and which island areas will be land bridged.

f) Coordination with National Marine Fisheries Service, Oregon Department of Fish and Wildlife, Washington Department of Fisheries, U.S. Fish and Wildlife Service, and Tribal interests in designing the water intake structure in McNary Reservoir for the proposed irrigation canals .

g) Monitoring and Evaluation in follow-up studies.

Sincerely,

Roger E. [signature]

for Russell D. Peterson
Field Supervisor

Enclosures-Letters of comment from NMFS, CTUIR, CRITFC

cc: ODFW, J.Day, Pendleton, Portland
WDW
WDF
NMFS
Umatilla, NWR
Columbia River Inter-Tribal Fish Commission
Confederated Tribes of the Umatilla Indian Reservation

LR/bl:J.Day257

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UNITED STATES DEPARTMENT OF COMMERCE
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NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
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PORTLAND, OREGON 97232
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AUG 24 1992 F/NWO3

Mr. Roger E. Vorderstrasse
U.S. Fish and Wildlife Service
Portland Field Station
2600 S.E. 98th Ave., Suite 100
Portland, Oregon 97226

Dear Mr. Vorderstrasse: Roger

Thank you for the opportunity to review your draft planning aid letter detailing potential effects of the proposed drawdown of the John Day Pool on fish and wildlife. The National Marine Fisheries Service (NMFS) has responsibility for living marine resources, including anadromous fish stocks which migrate through the project area. Our comments, therefore, are limited to potential effects on anadromous fish.

General Comments

The primary purpose of a John Day Pool drawdown would be to improve the survival of salmon smolts which migrate through the pool. The draft presents a negative view of this proposed action based on impacts to resident fish and wildlife. Large non-endemic resident fish populations exist today as a result of the creation of favorable habitat from hydroelectric development, and hydroelectric operations are largely responsible for depressed upriver anadromous fish populations. These factors must be considered in weighing the potential adverse and beneficial impacts of the proposed action.

Specific Comments

Page 2, top of page: It is correct to say the document has been coordinated with NMFS, but to say we are in general agreement is premature.

Page 2, para. 2: There are 16 turbine units with a nameplate generation capacity of 2,160,000 kilowatts at John Day Dam.

Page 2, para. 3: Information on daily/weekly fluctuations in reservoir surface elevation should be provided for comparison with the proposed action.

Page 4, top of page: Johnson wedgewire-type fish screen openings should not exceed 1/8 inch in the narrow direction. The velocity component of water passed "normal" through the mesh should not exceed 0.4 feet per second. Technical details relative to design and operation of intake structures for the two pump stations supplying the new irrigation canals should be coordinated with NMFS' engineers.

Page 5, top of page: The number of adult O. nerka counted passing Ice Harbor to date this year is 22.

Page 7, para. 2: The basis for the "normal" riverflow level of 200,000 cfs in this paragraph is unclear. It appears to estimate an April through August average. The example of reduced water particle travel time appears to minimize the potential increased survival benefit of a drawdown.

Page 8, top para: Turbine units at McNary Dam are operated within one percent of peak efficiency whenever possible to optimize the survival of juvenile fish not guided from turbine intakes. Even with a tailwater elevation of 257 feet, unit operations could still provide for operation within unit efficiency criteria. We suggest you delete the sentence estimating annual loss of smolts as the reliability of any estimate would be questionable and could be misused if included.

We further understand that spill could be provided at John Day Dam with a 257-foot elevation forebay.

Page 8, para. 3: Potential effects of drawdown on squawfish populations should be inserted if they can be estimated. As stated in our general comments, warmwater fish habitat is an artifact of hydroelectric development, the primary reason drawdown is being considered.

With the pool drawn down, we expect daily fluctuations in reservoir elevation would be reduced. Our understanding is that daily fluctuations are responsible for reduced spawning success of warmwater fish.

Page 10, last para: We understand that the hatchery water supply problem for both hatcheries is that only about one-half of the design volume is presently available. It is our further understanding that the feasibility of adding new wells to correct this problem is currently being evaluated by the Corps of Engineers.

Page 17, para. 3: The existing MOP (257') was selected to protect goose nesting habitat from land based predators.

Page 19, Discussion: There should be a discussion of the relative magnitude of potential adverse and beneficial impacts. In our opinion, the information in the document does not substantiate the statement that severe impacts to warmwater fish resources could result from the proposed action.

Page 21, Recommendation C: We suggest the follow language be added at the end of the sentence "... or other means of compensating/mitigating for lost production."

Page 22, Recommendation E: Substitute the term "water intake structure" for pump station.

Thank you for the opportunity to provide comment.

Sincerely,

Merritt E. Tuttle
Division Chief

Literature Cited

Project Data and Operating Limits, Columbia River and Tributaries Review Study. 1985. Corps of Engineers, North Pacific Division, Portland, Oregon. CRT-49, 178 pages.

DEPARTMENT of
NATURAL RESOURCES

Administration

CONFEDERATED TRIBES
of the
Umatilla Indian Reservation

P.O. Box 638
PENDLETON, OREGON 97801
Area code 503 Phone 276–3447 FAX 276-3317

August 24, 1992

Mr. Peterson
Fish and Wildlife Service
Portland Field Station
2600 S.E. 98th Avenue, Suite 100
Portland, OR 97266

Dear Mr. Peterson,

The Confederated Tribes of the Umatilla Indian Reservation appreciates the opportunity to review and comment on your draft planning aid letter concerning the impacts on Fish and Wildlife from the proposed drawdown of John Day Reservoir. Most of the formerly productive anadromous fish populations throughout the Tribe's ceded lands in Northeast Oregon and Southeast Washington are either extinct, threatened, or endangered. Significant impacts to the wildlife resources used by the Tribes have also occurred as a result of the development of the Columbia River Corridor. The Tribes are becoming intimately involved with agencies having Indian trust responsibilities such as the U.S. Fish & Wildlife Service, U.S. Forest Service and U.S. Army Corps of Engineers in development of actions which will promote the recovery of fish and wildlife populations throughout the Tribe's ceded area.

We have emphasized a gravel to gravel concept for fisheries management and recovery. Columbia River anadromous fish passage is currently one of our major concerns in this comprehensive process. The Tribes and the Bonneville Power Administration have spent many years and many millions of dollars in the efforts to restore the salmon resources in the Umatilla Basin. Of great concern to the Tribes are the potential adult passage problems in the lower Umatilla River and the loss of groundwater supply and fish production at Umatilla and Irrigon Hatcheries that may occur as a result of the drawdown of the John Day Reservoir.

The Tribes have also been involved in basin wide efforts to mitigate impacts to wildlife habitats from the construction and operation of the Columbia hydropower projects. These efforts include the development of wildlife habitat restoration, enhancement and protection projects to be implemented as a part of the Columbia River Basin Fish & Wildlife Program. Our major wildlife concerns center around the potential for permanent loss of the riparian ecosystem surrounding the reservoir.

The tribes generally agree with the evaluation of the potential detrimental impacts to the fish and wildlife resources which are discussed in the draft PAL. However, the reconnaissance level surveys completed for the draft PAL are inadequate to assess the long term effect to fish and wildlife habitats and populations in the Columbia Basin. We concur with your recommendations for additional studies and mitigatory efforts but we question the significance of these efforts in the face of such enormous disturbance to the ecosystem.

In order to aid in the planning of the proposed drawdown, a thorough presentation of the potential positive aspects must also be presented. However, very little discussion exists regarding the potential benefits. It seems that not much is known and the brief discussion is based on large assumptions. It is unclear how smolt passage time relates to particle travel time. Nor is it clear as to whether a one-day decrease in John Day Pool smolt travel time in light of the additional potential impacts to smolt survival, will provide a significant increase in overall fish survival. Additional studies of these relationships are needed.

We suggest that your report conclusions recommend that the COE better define or study the potential fish benefits since that is the main reason for drawdown consideration in the first place. Without better understanding of fish benefits, there is nothing to weigh against all the potential negative fish and wildlife impacts which are more defined at this time. Also, your coordination in the development of recommendations should include appropriate tribes (not just state agencies) as comanagers of these resources in the Columbia Basin.

Sincerely,

Michael J. Farrow, Director
Department of Natural Resources

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
729 N.E. Oregon, Suite 200, Portland, Oregon 97232
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September 1, 1992

Mr. Roger E. Vorderstrasse
United States Fish and Wildlife Service
Portland Field Station
2600 S.E. 98th Ave
Suite 100
Portland, Oregon 97226

Dear Mr. Vorderstrasse:

The Columbia River Inter-Tribal Fish Commission (CRITFC) appreciates the opportunity to comment on the USFWS's draft planning aid letter (PAL) concerning the impacts on fish and wildlife from the proposed drawdown of the John Day Reservoir. This action has the potential to both positively and negatively affect critical tribal treaty resources for which the USFWS has a trust responsibility.

General Comments

With respect to presenting the potential positive aspects of the drawdown upon fish and wildlife resources, we concur with the comments on the PAL in the August 24, 1992 letters by the Confederated Tribes of the Umatilla Indian Reservation and the National Marine Fisheries Service. The final PAL should contain a detailed discussion of all potential benefits of drawing down the reservoir including increases in salmonid smolt survival at different river flows, potential for predator control by dewatering predator spawning areas, the potential for beneficial changes to in-reservoir salmonid habitat, and the potential to decrease adult salmonid travel time and increase survival through the reservoir. Further, John Day drawdown impacts must not be viewed in isolation, but must be combined with other river operation options including spill, and drawdowns in other Columbia Basin reservoirs, such as Lower Granite and Little Goose.

In addition, we request that the final PAL be supported by extant scientific literature and engineering protocol.

Specific Comments

Page 2 It is not clear to us why irrigation canals must be constructed. It would be simpler and more expeditious to extend pump intakes to the new reservoir level.

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Page 4 Lamprey are an anadromous fish species which are important to our member tribes, and therefore, should be included in PAL analysis.

Page 7 The PAL should provide, with assistance from the Fish Passage Center, an analysis of travel time benefits to salmonid smolts at a range of flows. Since John Day Reservoir accounts for 56% of the total water particle travel time in the entire lower Columbia River (Corps 1992), travel time benefits associated with reservoir drawdown correspondingly increase as river flows decrease. Reducing the John Day reservoir from elevation 262 to elevation 257 will reduce water particle travel time through the reservoir from 9-11%. In John Day Reservoir at a constant full pool elevation at 262, 160 Kcfs river flow results in an estimated smolt passage time of 9.1 days compared to 6.3 days at river flow 200 Kcfs. The combination of a lowered reservoir elevation and low flows should produce significantly increased water particle travel time and corresponding increased smolt survival through the John Day Reservoir. The PAL should examine, in detail, such relationships to smolt survival.

The PAL should also provide an analysis of survival benefits related to the drawdown, associated with different drawdown scenarios in the Snake River and different flows. For example, as a result of such combinations, the Corps (1992) reported estimated increases in smolt survival to range from 2-4% for low flows, 1-5% for medium flows, and 0-2% for high flows.

The PAL should document effects of the drawdown on sturgeon populations. USFWS researchers at the Cook, Washington station have indicated that sturgeon and anadromous salmonid survival are dependent upon similar flow scenarios.

The PAL should document expected changes in habitat which may be beneficial as well as detrimental to salmonid smolts. For example, changes in water quality parameters should be examined. Increases in turbidity from the drawdown could assist smolts in avoiding predators (Raymond 1988). Predator habitat could be dewatered if the drawdown was timed with predator spawning activities. Primary and secondary invertebrate production and diversity could be benefitted by increased nutrient flow and changes in reservoir hydraulic geometry. New salmonid spawning areas might be available due to changes in reservoir depth, substrate and velocities. Subsequent to drawdown, fewer shallow water areas and lower reservoir volumes may result in cooler reservoir temperatures which would be beneficial to all salmonid life histories.

Page 8 The PAL should examine operational effects of the McNary and John Day projects for impacts on salmonid survival as a result of the drawdown. Certain turbine units at each project may be capable of operating at lower heads and tailwater elevations to reduce cavitation and associated juvenile mortality. Restricting John Day reservoir to drawdown levels will eliminate daily and hourly fluctuations in reservoir elevations which contribute to lowered fish guidance efficiencies (Corps 1992) and delay of adult migration (Bjornn and Peery 1992).

Backwater areas may be benefitted by oxidation of benthic substrates when they are dewatered.

Page 9 Depending on Umatilla and Columbia River flows, the mouth of the Umatilla may or may not restrict adult chinook passage into the river. We suggest the USFWS conduct a channel survey and a sediment transport analysis to determine if this will really be a problem.

Page 10 We request that the PAL examine different options with respect to well water supplies for the Umatilla and Irrigon Hatcheries. For example, existing wells could be dug deeper, or new wells could be drilled.

Summary

The CRITFC concurs with the Confederated Tribes of the Umatilla Indian Reservation that affected Indian tribes must be consulted with respect to any John Day drawdown activity. We appreciate the opportunity to comment on the PAL. Should you have questions please contact Bob Heinith (503) 731-1289 of our staff.

Sincerely,

Ted Strong
Executive Director

cc: CRITFC Managers
Gary James-CTUIR
Rick George-CTUIR
FPAC

REFERENCES

Bjornn, T.E. and C.A. Peery. 1992. A review of literature related to movements of adult salmon and steelhead past dams and through reservoirs in the Lower Snake River. Draft Technical Report 92-1. For the United States Army Corps of Engineers. Walla Walla District. Idaho Cooperative Fish and Wildlife Research Unit. Moscow, Idaho. 107 pages.

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April 1994

Corps' Response To Fish and Wildlife Service Planning Aid Letter (PAL) Recommendations

The USFWS, in a Planning Aid Letter dated September 15, 1992, provided mitigation recommendations. Comments on the recommendations follow. There have been changes in the study since the interim report was released in November 1992 which are addressed in the responses to some of the recommendations.

Response to 1: During the next phase of study the Corps is funding the USFWS and State agencies, and conducting other studies, to document and quantify specific impacts to fish and wildlife resources during the next phase of study. The Corps will also develop and detail appropriate and specific mitigation measures, in conjunction with the resource agencies, to address impacts of drawing John Day Pool down to a lower operating level.

Response to 1a: The Corps' evaluation of soil permeability in the vicinity of McCormack Slough, Paterson Slough and other important wildlife areas indicates that soil permeability is very high. Thus, extremely large volumes of water would have to be pumped into these areas to maintain "normal" water surface elevations. The mitigation measure does not appear to be practical nor feasible due to the technical, economic and environmental problems associated with the large volumes of water required, providing power supplies, construction of large pumping stations, and dike and waterline construction. This measure would also bear a high annual operation and maintenance cost. It was concluded from this preliminary evaluation that alternative mitigation measures (off-site) would be more cost effective and practical. The "canals" proposal has been dropped from consideration because the cost substantially exceeded that for retro-fitting existing pump stations.

Response to 1b: Riparian habitat impacted by the proposed drawdown will be identified. The Corps does not believe irrigation is feasible. The construction of an irrigation system would be disruptive to the existing riparian habitat. Surface irrigation via sprinklers would have a high potential to destroy habitat values and productivity for small mammals and birds via continual soaking of the habitat. This is significantly different than the dry, desert climate in which these species currently reside. Drip irrigation is impracticable. Surface lines would be destroyed by natural factors and would be exceeding difficult to operate and maintain. Subsurface lines would be comparably difficult to operate and maintain plus and would be extremely disruptive to the habitat to install. Offsite mitigation would be more appropriate.

Response to 1c: Irrigation canals are no longer being considered.

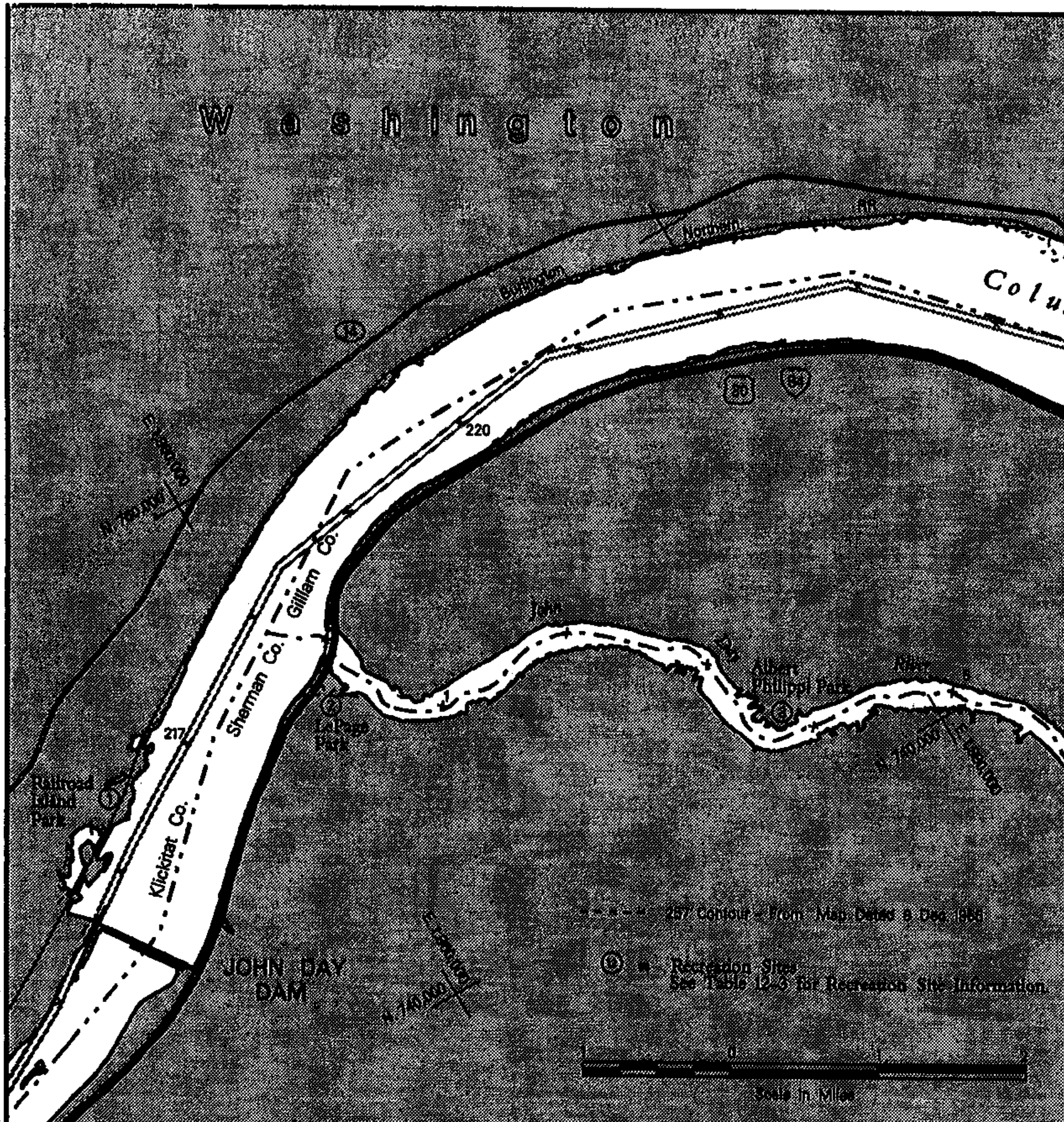
Response to 1d: Concur. Although current information from ongoing studies of the water supply problem at the hatcheries indicates that water supplies may be adequate during the 4-month drawdown. This would not be the case for the year-round option. See report section 8.

Response to 1e: The Corps initially considered reconstruction and/or development of islands for wildlife habitat purposes in John Day Pool. Several concerns have been identified. Constructed islands would suffer from the same problems with alternately desiccating and flooding areas within the 4-month drawdown zone. Island construction would require dredging to obtain material to form the islands. Dredging to construct island would be extremely costly. There is a strong likelihood that dredging actions would adversely impact cultural resources through physical destruction of cultural sites and artifacts. Dredging would take place in shallow water habitats utilized by salmonid stocks. The year-round drawdown would result in the establishment of larger islands in the Umatilla NWR area. The Corps is conducting hydrographic surveys to determine island and backwater areas that would form under a permanent drawdown condition.

Response to 1f: The canal alternative has been dropped from further consideration.

Response to 1g: We anticipate that monitoring and followup studies will be conducted to verify results of mitigation measures and habitat impacts if the project is implemented.

STUDY MAPS



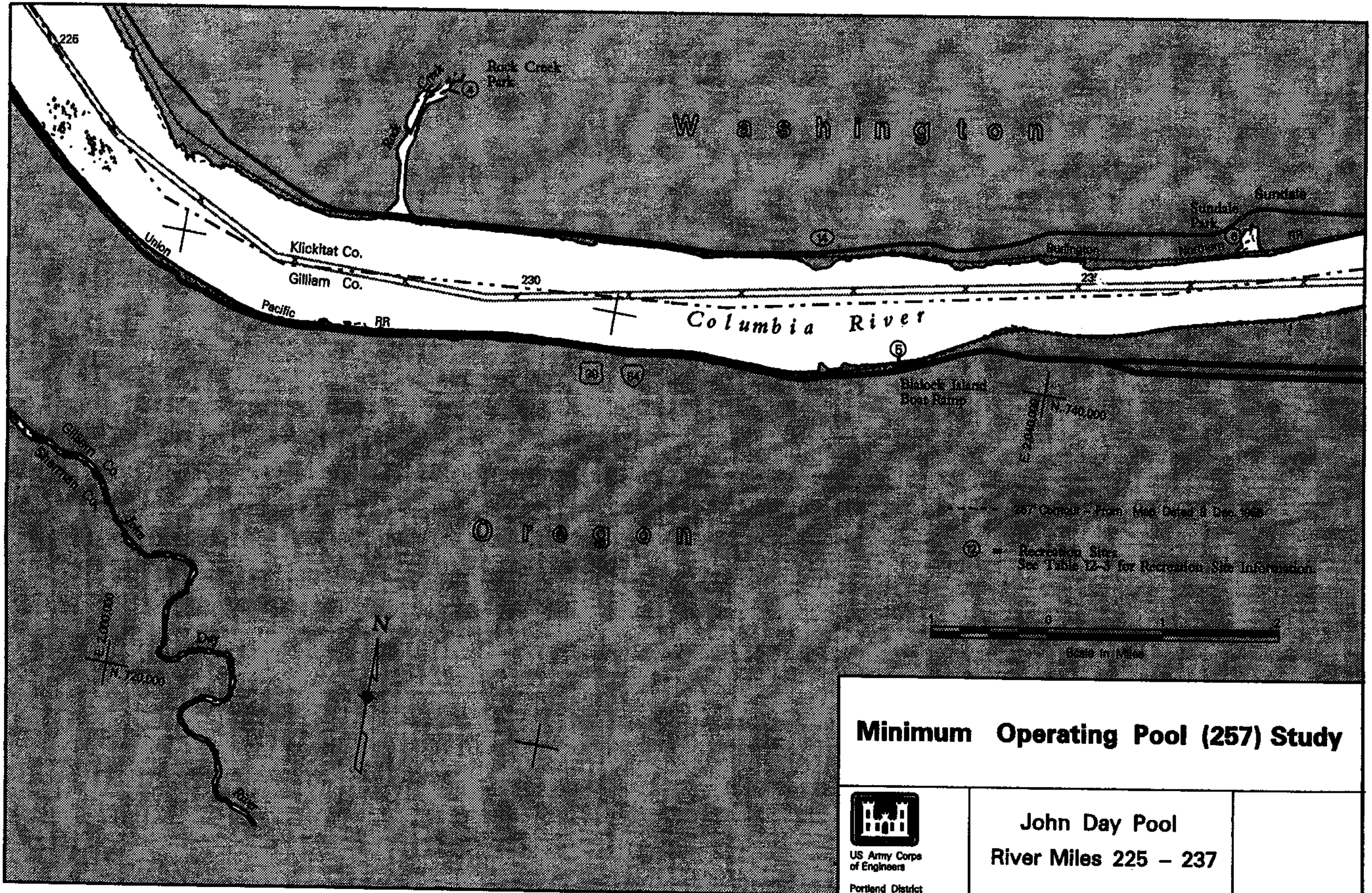
Minimum Operating Pool (257) Study

US Army Corps of Engineers

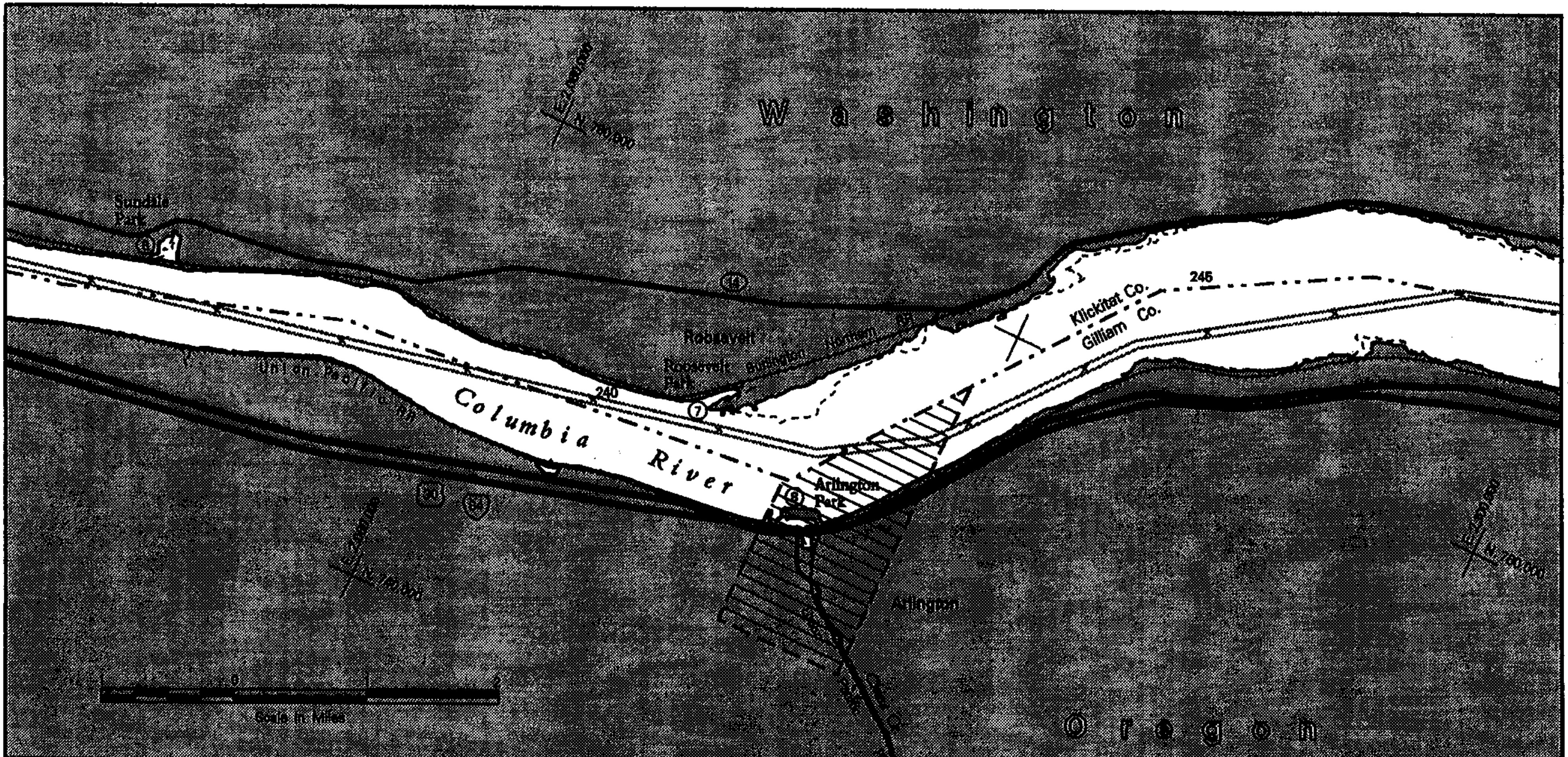
Portland District

John Day Pool

River Miles 215 - 229



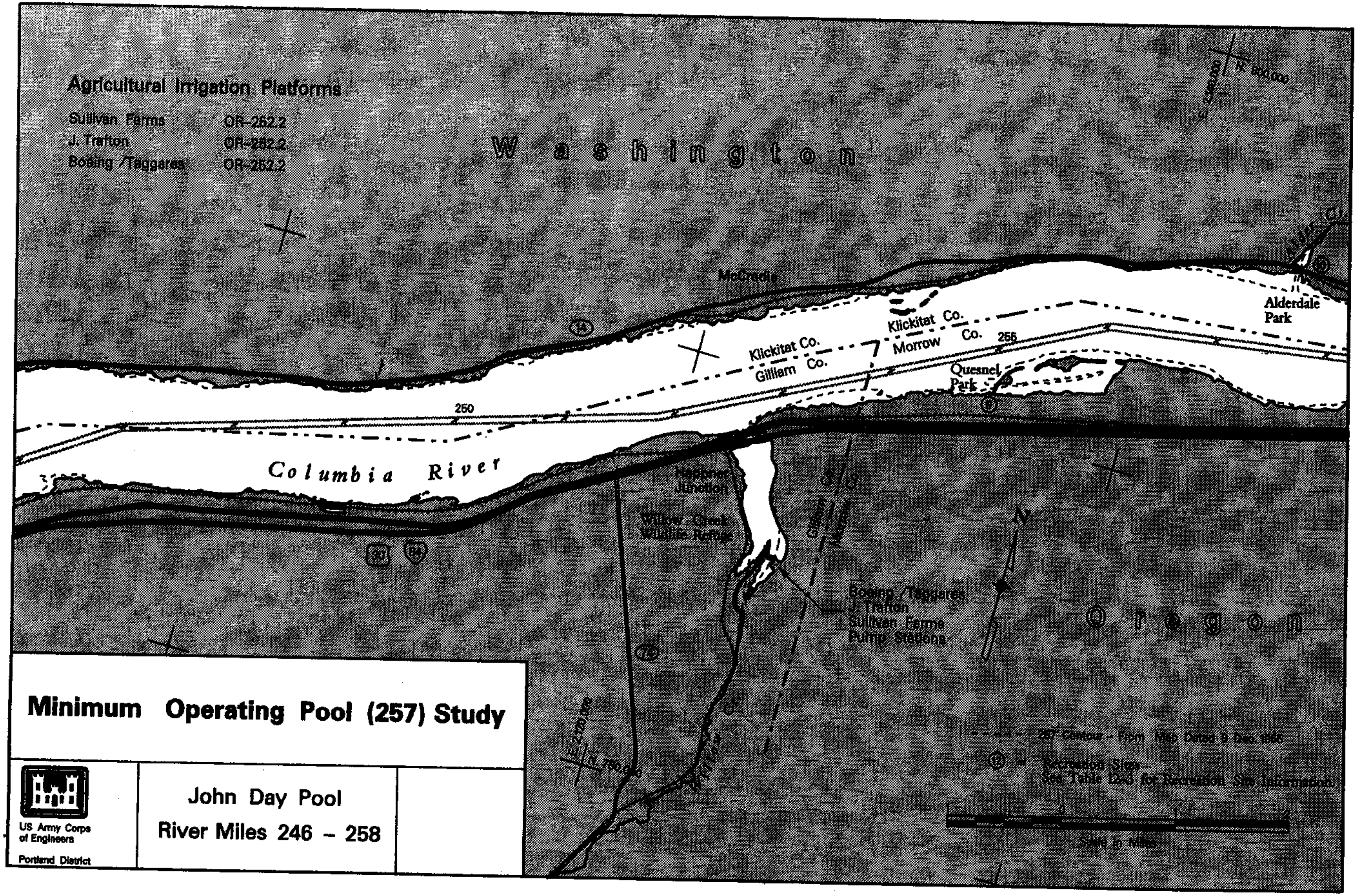
225
Rock Creek Park
Rock Creek
Washington
Sundale
Sundale Park
Klickitat Co.
Gilliam Co.
230
Union
Pacific
RR
Columbia River
Blalock Island Boat Ramp
N. 740,000
Oregon
Gilliam Co.
Sherman Co.
N. 720,000
N
Recreation Sites
See Table 12-3 for Recreation Site Information
1 0 1 2
Scale in Miles
Minimum Operating Pool (257) Study
US Army Corps of Engineers
Portland District
John Day Pool
River Miles 225 – 237



Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

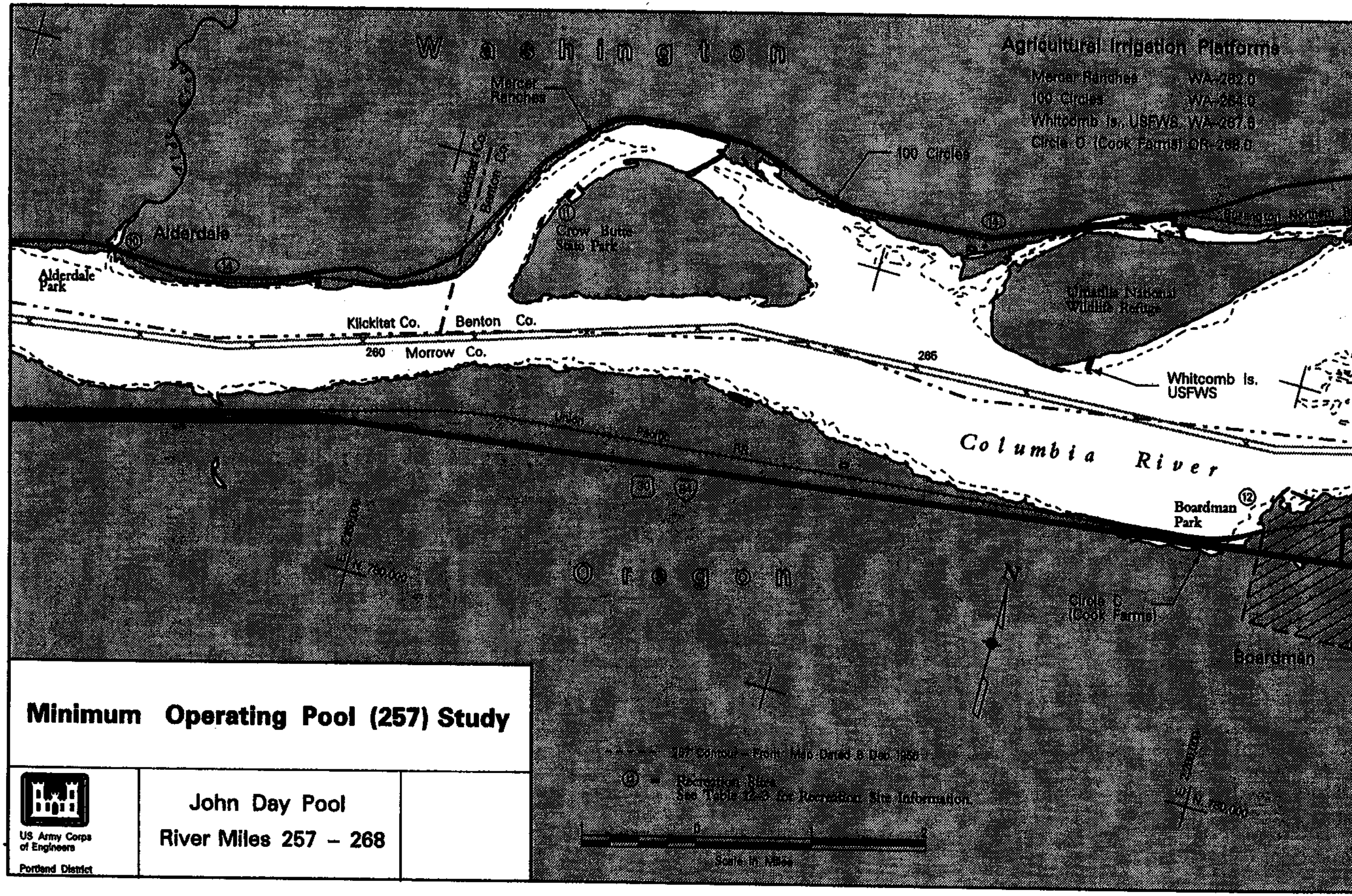
John Day Pool
River Miles 237 – 247



Minimum Operating Pool (257) Study

John Day Pool

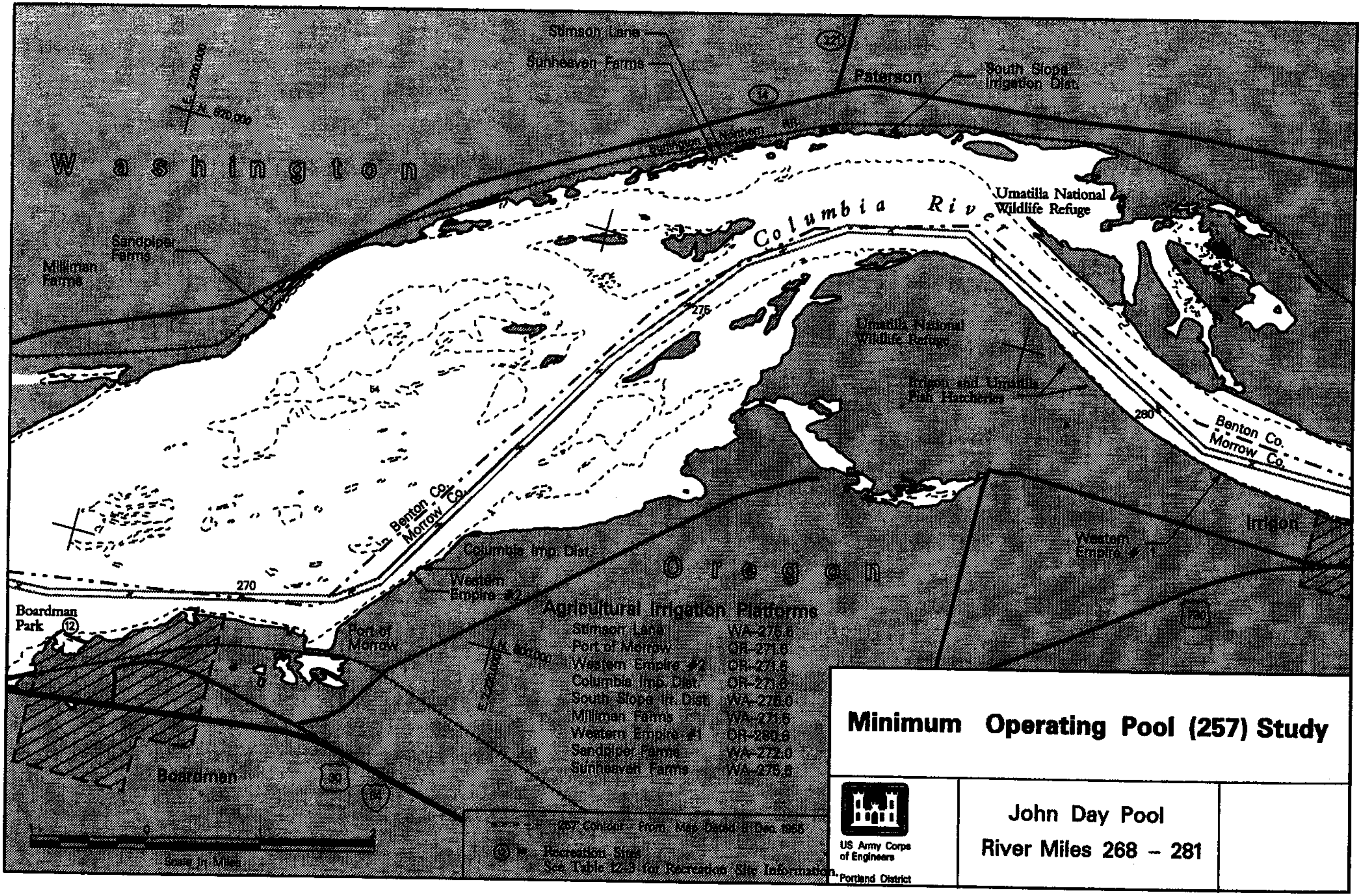
River Miles 246 – 258

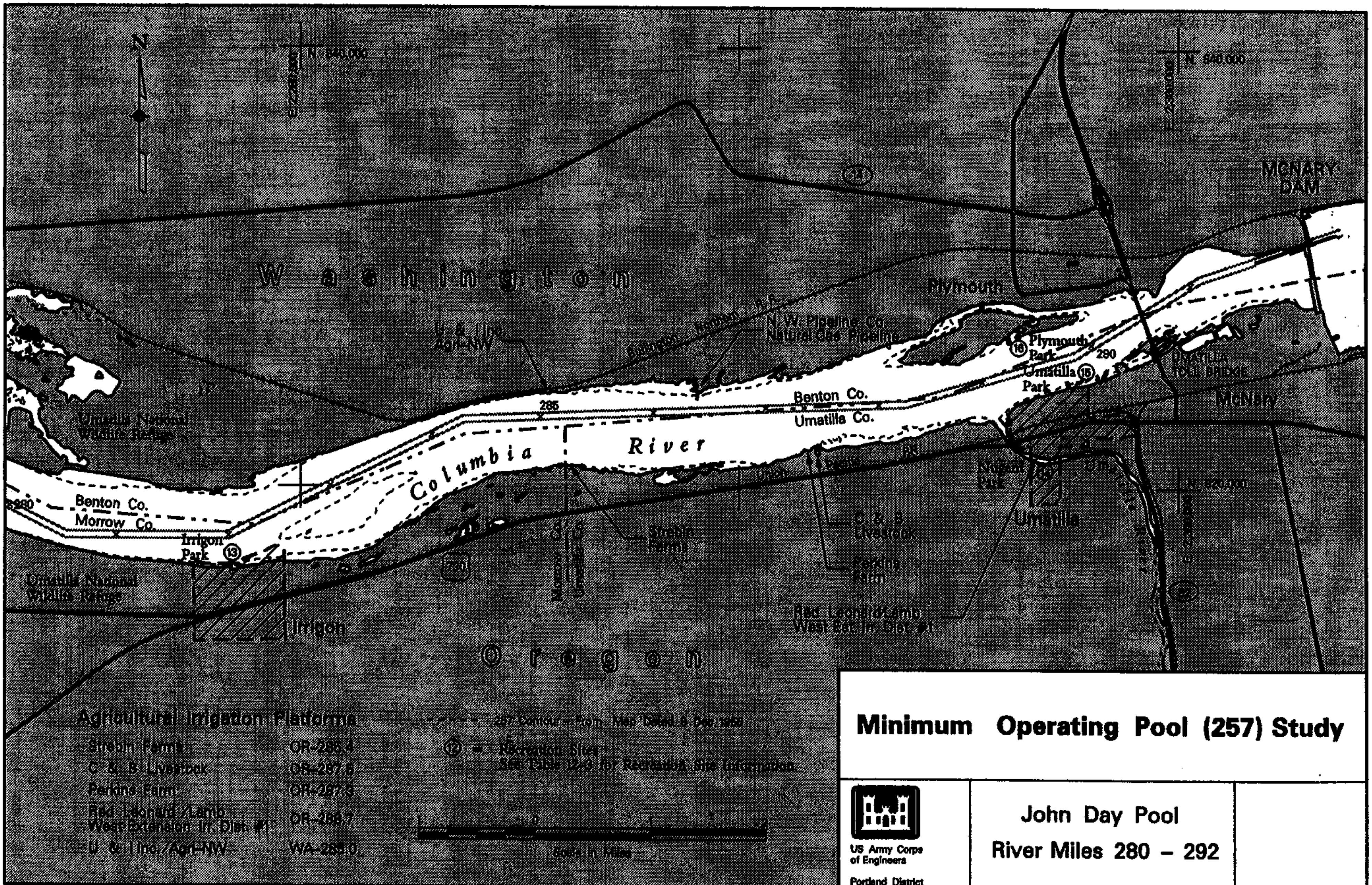


Minimum Operating Pool (257) Study

US Army Corps of Engineers
Portland District

John Day Pool
River Miles 257 – 268


Washington
Oregon
Columbia River
Stimson Lane
Sunheaven Farms
Paterson
South Slope Irrigation Dist.
Sandpiper Farms
Milliman Farms
Umatilla National Wildlife Refuge
Umatilla National Wildlife Refuge
Irrigon and Umatilla Fish Hatcheries
Benton Co.
Morrow Co.
Benton Co.
Morrow Co.
Columbia Imp. Dist.
Western Empire #2
Western Empire # 1
Irrigon
Boardman Park
Port of Morrow
Boardman
270
276
280
Agricultural Irrigation Platforms
Stimson Lane
Port of Morrow
Western Empire #2
Columbia Imp. Dist.
South Slope Ir. Dist.
Milliman Farms
Western Empire #1
Sandpiper Farms
Sunheaven Farms
Recreation Sites
See Table 12-3 for Recreation Site Information.
Scale in Miles
Minimum Operating Pool (257) Study
US Army Corps of Engineers
Portland District
John Day Pool
River Miles 268 – 281



Minimum Operating Pool (257) Study
John Day Pool
River Miles 280 - 292
US Army Corps of Engineers
Portland District
MCNARY DAM
Washington
Oregon
Columbia River
Plymouth
Plymouth Park
Umatilla Park
Umatilla
McNary
UMATILLA TOLL BRIDGE
Benton Co.
Umatilla Co.
Morrow Co.
Irrigon
Irrigon Park
Nugent Park
U & I Ino. Agri-NW
N.W. Pipeline Co. Natural Gas Pipeline
Strebin Farms
C & B Livestock
Perkins Farm
Red Leonard/Lamb West Ext. Irr. Dist. #1
Umatilla National Wildlife Refuge
285
290
Agricultural Irrigation Platforms
Strebin Farms OR-286.4
C & B Livestock OR-287.6
Perkins Farm OR-287.3
Red Leonard /Lamb West Extension Irr. Dist. #1 OR-288.7
U & I Ino./Agri-NW WA-285.0
257 Contour - From Map Dated 6 Dec 1959
Recreation Sites
See Table 12-3 for Recreation Site Information
Scale in Miles