Appendix E
Water Supply Impacts Related to Salmon and O. mykiss

As noted in Section 4, the impacts of section 7 on water supply activities cannot be analyzed on a watershed basis, as these activities often affect multiple watersheds simultaneously. Attributing the impacts of section 7 consultations and the resulting modifications to a particular watershed is not appropriate, then, as designating critical habitat or applying section 7 generally to *any* of those watersheds would bring about the same result. Nevertheless, assessing the potential magnitude of these impacts is important. Below, this appendix summarizes several studies that assess these magnitudes for the Pacific Northwest and California, although not in the context of critical habitat designation. This appendix also describes major water supply projects in those states.

This appendix supports the analysis for both the seven California salmon and O. mykiss ESUs and the 13 Pacific Northwest ESUs. For that reason, the appendix contains references to data and methods specific to the Northwest Region.

E 1. Review of Selected Literature

E 1.1 Economics Literature

1) Hamilton, J. and N. Whittlesey, Cost of Using Water from the Snake River Basin to Augment Flows for Endangered Species, 1996

This paper examines costs associated with the NOAA Fisheries Recovery Plan for salmon species on the Snake/Columbia system. Costs are based on flow targets (as of the date of the study) for the lower Snake River at Lower Granite Dam in spring/early summer and midsummer. The paper develops five scenarios that cover a broad range of flow target interpretations.

Results indicate a range of annual costs to agriculture from $81 million to $292 million for proposed flow augmentation. The flow augmentation cost range is developed through estimation of agricultural land retirement and agricultural participation in an interruptible water market. Affected agricultural acreage ranges from approximately 25 percent of the total irrigated acres in the region to 18 percent more than the total irrigated acres in the region. Flow augmentation allows for increased power production that offsets the gross cost to agriculture. Net of increased electric power production revenues resulting from increased flow, the annual costs of flow augmentation to agriculture are estimated to be between $50 million and $160 million.

Caveats to the research include the consideration of willing sellers only, the assumption that interruptible markets would only deliver up to 600,000 acre feet in dry years, the exclusion of third party costs including water shortage costs to downstream irrigators (i.e., from changes in runoff or aquifer recharge), costs related to flow management facilities, legal costs, and secondary impacts. Nonetheless, the authors argue that costs are conservative for several reasons.

It should be noted that scenarios related to the NMFS recovery plan are outdated. Nonetheless, the Hamilton and Whittlesey research provides understanding of the magnitude of costs that may be attributable to future flow augmentation scenarios.

2) Huppert, D. et al., Economics of Columbia River Initiative, Final Report to the Washington Department of Ecology and CRI Economics Advisory Committee, 2003.

The Huppert et al. study examines the economic effect of increased water withdrawal from the mainstem of Columbia River in Washington. The analysis considers effects on agricultural production, municipal and industrial water supplies, hydropower generation, flood control, river navigation, commercial and recreational fishing, regional impacts, and passive use values. Five different "management scenarios" are evaluated. Though fisheries-related regulation is likely to decrease water withdrawal from the tributaries of the Columbia, this research provides useful dollar value estimates associated with specific changes in water availability. This section examines the Huppert et al. estimates of agricultural and regional impacts.

The management scenarios evaluated in the Huppert et al. research were developed by Washington's Department of Ecology. The scenarios prescribe variation in the quantity of new water rights, fees, contingencies, and other requirements. Table D-1 describes the five management scenarios.

Table E-1
Five Management Scenarios

Scenario	Quantity of New Water Rights	Fees	Contingencies	Other Requirements
I.	1 MAF	None	None	Meet BMPs and meter withdrawals
II.	1 MAF	$10/acre-foot annually	300 KAF (80% of existing rights complying with BMPs)	Meet BMPs and meter withdrawals
III.	1 MAF	$20/acre-foot annually	300 KAF (80% of existing rights complying with BMPs)	Meet BMPs and meter withdrawals
IV.	None	$30/acre-foot annually	New withdrawals must be fully offset by transfers, conservation, or new storage	Meet BMPs and meter withdrawals
V.	Status Quo	None	Issuance of new rights follows current procedures & depends upon opinion of fishery managers	

The Huppert et al. research shows that the irrigation agriculture sector is significantly affected by allocation of additional water rights from the Columbia mainstem. New water rights allow the expansion of crop production. The analysis assumes that crop prices remain at current levels, and that the costs of production are reflected in crop budget studies. The study reports that new agricultural production will generate between $349.0 and $752.9 million in gross revenue, which corresponds to between $52.1 and $136.5 million in net revenue, as shown in Table D-2.

Table E-2
Summary of Effects on Agricultural Production and Value

Scenario	Gross Revenue ($ millions)	Net Revenue ($ millions)
I.	$752.9	$136.5
II.	$476.2 - $752.9	$79.8 - $136.5
III.	$349.0 – $752.9	$52.1 – $136.5
IV.	Unknown	Unknown
V.	None	None

Regional economic impacts are determined using the 1987 Washington Input-Output model. First, Huppert et al. estimate direct impacts, which consist of increased sales of raw and processed agricultural products, then estimate full effects, which consider the total (multiplied) effect of the direct impacts on the economy as a whole. The estimated Output impact measures the change in sales of all products, including raw materials, wholesale products, plus a retail sales margin. In addition, the Input-Output model estimates employment and value-added impacts. Results of the regional economic analysis are presented in Table D-3.

Table E-3
Summary of Economic Impacts of Agricultural Section Expansion

Scenario	Total Output Impact $2002 (in millions)	Total Employment Impact	Total Value-Added Impact
1 MAF	$4244.580	44,656	$2,023.6
700 KAF	$2195.634	23,812	$1,059.4
569 KAF	$1,570.09	17,160	$759.6

E 1.2 Engineering Literature

1) Snake River Flow Augmentation Impact Analysis Appendix, Prepared for the U.S. Army Corps of Engineers, Walla Walla District's Lower Snake River Juvenile Salmon Migration Feasibility Study and Environmental Impact Statement, United States Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho, February 1999.

The USBR Snake River Flow Augmentation analysis uses a hydrology model of the upper Snake to predict the impacts from water shortage, then uses economic modeling to estimate the related dollar value impacts.

On March 2, 1995, NOAA Fisheries issued a biological opinion on the operation of the FCRPS with respect to endangered Snake River spring/summer chinook salmon , Snake River fall chinook salmon, and Snake River sockeye salmon. This biological opinion concluded that the effects of the proposed operations of Federal hydroelectric dams in the Columbia and Snake River basins would jeopardize the continued existence of the listed Snake River salmon stocks. Flow augmentation in the lower Snake River and the Columbia River is a key component of the 1995 biological opinion. Reclamation agreed to provide 427,000 acre-feet of flow augmentation.

In this study, USBR analyzes the effects of providing a flow augmentation in the following scenarios:

I. Base Case: Provide 427,000 acre-feet of flow augmentation water each year.
II. No Augmentation: Provide no water for flow augmentation (condition prior to 1991).
III. Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs (i.e., storage reservoirs are operated to minimize the impact on irrigation).
IV. Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation (i.e., storage reservoirs are operated to minimize the impact on recreation).

Changes in agricultural production, hydropower generation, and recreation due to the flow augmentation scenarios would have national and regional economic impacts. National economic impacts were identified for agriculture, hydropower, and recreation. Regional impacts were identified using input-output modeling (IMPLAN) for agriculture and recreation. National economic impacts on agriculture are provided in Table D-5, while regional economic impacts on agriculture attributable to flow augmentation are presented in Table D-5.

The national effects presented are direct effects (i.e., no multiplier effect is considered in the analysis). For agriculture, the direct effects are calculated using the value of production, or gross revenue, measured as the total production of an irrigated crop multiplied by its market value. A change in the value of production provides an estimate of the total direct loss in economic activity resulting from the prescribed water acquisition program. Water acquisition costs are calculated based on recent water acquisitions.

Table E-4
National Economic Effects on Agriculture (Direct Costs)*

Item	Scenario I	Scenario II	Scenario III	Scenario IV
Decrease in irrigated acres in average water-year	0[1]	0	$243,000	$360,000
Decrease in irrigated acres in dry water-year	([2])	([2])	$376,000	$643,000
Decrease in value of production in average water-year	0[3]	0	$90,204,000	$136,433,000
Decrease in value of production in dry water-year	([2])	([2])	$141,202,000	$243,737,000
Water acquisition cost (annual) low estimate	0	0	$10,414,000	$31,128,000
Water acquisition cost (annual) high estimate	0	0	$31,243,000	$87,157,000

* Direct costs include lost value of production, not broader market adjustments.
[1] Base Case average irrigated acreage is 3,364,000 acres
[2] Not estimated
[3] Base Case average value of production is $2,019,934,000

The study estimates regional economic impacts in three ways:

1) Reduced Irrigation. This estimate is of impacts stemming from the reduction in irrigated agricultural production only;
2) Reduced Irrigation With Payments to Farmers. This estimate adds the impacts of a hypothetical water acquisition program to those of a reduction in irrigated agriculture production; and
3) Reduced Irrigation With Forward Linkages. This estimate adds the effect of forward linkages to those of a reduction in irrigated agriculture production. That is, it adds the ripple

effects to industries such as livestock and agricultural processing that use irrigated crops as a part of their production process.

The study also states that the second estimate, Reduced Irrigated Agriculture Production With Water Payments, is the best estimate of regional economic impacts.

Table E-5
Regional Economic Effects on Agriculture

Item	Scenario I	Scenario II	Scenario III	Scenario IV
Employment–jobs lost (annual)	0 [1]	0	2,543	3,612
Income lost (annual)	0 [2]	0	$44,700,000	$51,976,000
Sales lost (annual)	0 [3]	0	$95,200,000	$130,400,000

[1] Scenario I regional jobs total 658,543
[2] Scenario I regional income totals $23,310,023,000
[3] Scenario I regional sales total $46,777,512,000

According to the 2001 biological opinion (U.S. Bureau of Reclamation Operations and Maintenance of its Projects in the Snake River Basin above Brownlee Dam from Date Issued through March 2002, 5/2/2001), USBR anticipated that the prescribed flow augmentation (427,000 acre-feet) would not be available in 2001 or similar dry years for a variety of reasons. The 2001 biological opinion states:

> *NMFS' expectations for flow augmentation for the long term acknowledge that in very low water years like 2001, the opportunities for significant flow augmentation volumes from the upper Snake River basin would be limited. When combined with the reductions in stream flow depletions anticipated by other water interests, the proposed action for 2001 will yield volumes of flow augmentation within the range expected by the USBR in a low water year such as this one.*

The terms and conditions of the 2001 biological opinion require that USBR work toward procurement of water in an effort to meet the prescribed 427,000 acre-foot flow augmentation. Specifically, prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by the 2001 biological opinion to any use other than salmon flow augmentation, the USBR shall consult under section 7. In addition, USBR shall seek out water savings programs, describe the potential outcome of such storage, and identify those programs with the highest potential for streamflow improvement in the event of future droughts.

In the context of the 2001 biological opinion, it seems unlikely that NOAA Fisheries will require a 300 percent increase in flow augmentation in the future (the USBR study models an additional one million acre feet of flow augmentation). According to the study:

It is important to recognize that the 1,427,000 acre-foot scenarios for this analysis are only conceptual, and therefore, the analysis is conceptual. In some cases, due to a lack of empirical data, estimations and assumptions were used in developing modeling simulations. The model results cannot precisely depict all future operations and circumstances. The implementation of an additional 1 million acre-feet of flow augmentation would, most certainly, have an affect that reaches far beyond the scope of this theoretical analysis (USBR 1999).

The 1,427,000 acre foot augmentation cost estimates are useful, however, when interpreted as an extreme upper bound scenario.

2) California Water System Operations Environmental Funding

The California Bay-Delta Authority (CALFED), established by legislation enacted in 2002, provides a permanent governance structure for the collaborative California State-Federal water management effort that began in 1994. A key component of CALFED's Water Management Strategy, the Environmental Water Account (EWA) was created to address two problems, declining fish populations and unreliable water supplies. Its purpose is to better protect fish by making it possible to modify water project operations in the Bay-Delta and still meet the needs of water users.

The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers and releases it as needed to protect fish and compensate water users. For example, EWA managers might coordinate with water project operators to curtail pumping at specific times to avoid harming fish, and then provide water to cities and farms to compensate for the reduced pumping.

The EWA does not provide all of the fish protection in the California water system. The regulatory baseline includes the biological opinions on winter-run salmon and delta smelt, the California State Water Control Board 1995 Delta Water Quality Control Plan, and 800,000 acre-feet of CVP water pursuant to the Central Valley Project Improvement Act (CVPIA).

EWA funding is representative of a portion of the costs associated with NOAA Fisheries' requirements related to operations of the CVP and SWP. In addition, the EWA funds additional recovery efforts above the regulatory baseline. EWA funding is presented in Exhibit A-6.

Table E-6 Environmental Water Account Funding ($ in Millions)								
	Program Year							Total
	2001	2002	2003	2004	2005	2006	2007	
Water & Power Acquisitions	$57.15	$31.48	$44.54	$40.40	$32.27			$205.84
Tier 3 Water			$6.25	$3.20				$9.45
Environmental Documen-tations	$1.39	$0.20	$0.25	$0.20	$0.20			$2.24
Oversight and Coordination	$0.36	$0.46	$0.36	$0.21	$0.06	$0.06	$0.06	$1.57
Actual and Expected Funding	$58.90	$32.14	$51.40	$44.01	$32.53	$0.06	$0.06	$219.10
Funding for years 1-2 (2001-2002) reflects actual State encumbrances & expenditures and Federal obligations. Funding for Year 3 reflects final State and Federal budgets. Funding for Year 4 reflects proposed Governor's and President's budgets. Expected funding in Years 5-7 includes remaining state bond funds until spent and ongoing State base funding, plus estimates for local matching to grants for years where bond funding is available. Note: Federal appropriations for Years 5-7 is dependent on a decision to continue the EWA beyond Year 4.								

E 2. Description of Major Water Projects in Critical Habitat Areas[1]

E 2.1 California

California's Federal Water Project - The Central Valley Project (CVP)

The CVP extends 400 miles from the Cascade Range near Redding in northern California to the Tehachapi Mountains near Bakersfield in southern California. Initial features of the project were built primarily to protect the Central Valley from water shortages and flooding. The CVP also improves river navigation, supplies domestic and industrial water, generates electric power, conserves fish and wildlife, creates opportunities for recreation, and enhances water quality. The CVP serves farms, homes, and industry in California's Central Valley as well as major urban centers

1. Note that this list includes all major projects in the CA, ID, OR and WA–some of these projects may fall outside of proposed critical habitat areas. This section is intended only to add context to the discussion above.

in the San Francisco Bay Area; it is also the primary source of water for much of California's wetlands.

The CVP consists of 20 dams and reservoirs, 11 powerplants, and 500 miles of major canals, as well as conduits, tunnels, and related facilities. CVP operators manage approximately nine million acre-feet of water annually, delivering about 7 million acre-feet of water for agricultural, urban, and wildlife use. The CVP provides roughly 5 million acre-feet for farms, 600,000 acre-feet for municipal and industrial use, 800,000 acre-feet per year to fish and wildlife, and 410,00 acre-feet to State and Federal wildlife refuges and wetlands. In addition, the CVP generates 5.6 billion kilowatt hours of electricity annually to meet the needs of about 2 million people.

California's State Water Project (SWP)

The California State Water Project extends for more than 600 miles from northern California to southern California. The main purpose of the SWP is water supply. In addition, the Project provides flood control, recreation, and water for fish and wildlife. The SWP stores water and distributes it to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. Of the contracted water supply, 70 percent goes to urban users and 30 percent goes to agricultural users.

Today, the Project includes 32 storage facilities, reservoirs and lakes; 17 pumping plants; 3 pumping-generating plants; 5 hydroelectric power plants; and about 660 miles of open canals and pipelines. The Project provides supplemental water to approximately 20 million Californians and about 660,000 acres of irrigated farmland. The Project makes deliveries to two-thirds of California's population.

E 2.2 Idaho

The Avondale Project

Rehabilitation of privately developed irrigation facilities on the 880 acre Avondale Project by the Bureau of Reclamation in 1954-1955 required the reconstruction of a pumping plant at the source of supply, Hayden Lake, and the construction of an elevated equalizing tank with a main water line and distribution system for sprinkler irrigation. However, the water source is now four deep wells drilled by the Avondale Irrigation District in lieu of pumping from Hayden Lake. Farming is on a part-time basis and subdividing continues since this is a popular resort area which also offers industrial employment.

The Boise Project

Boise Project furnishes a full irrigation water supply to about 224,000 acres and a supplemental supply to some 173,000 acres under special and Warren Act contracts. The irrigable lands are in southwestern Idaho and eastern Oregon.

Principal facilities include five storage dams (excluding Lucky Peak Dam constructed by the Corps of Engineers and Hubbard Dam a reregulatory facility) which form reservoirs with a total capacity of 1,793,600 acre-feet (active 1,663,200 acre-feet), two diversion dams, three powerplants with a combined capacity of 50,200 kilowatts, seven pumping plants, canals, laterals, and drains.

To facilitate organization of the administrative and operating procedures, the irrigable project lands are divided into the Arrowrock and Payette Divisions. Some of the features serve only one division; other features serve both divisions as well as other nearby projects.

The Dalton Gardens Project

Dalton Gardens is a privately developed project 2 miles north of Coeur d'Alene, Idaho, and 30 miles east of Spokane, Washington, on the eastern edge of the extensive Spokane Valley plain, known as Rathdrum Prairie. The project's irrigation works include a pumping plant, equalizing reservoir and main line, and a distribution system that has been reconstructed to supply approximately 980 acres of land with an adequate sprinkler irrigation water supply.

The Lewiston Orchards Project

Private interests originally constructed the Lewiston Orchards Project beginning in 1906. Most of the project features have been rehabilitated or rebuilt by the Bureau of Reclamation. The project facilities include four diversion structures (Webb Creek, Sweetwater, West Fork, and Captain John) feeder canals, three small storage reservoirs (Soldiers Meadow, Reservoir "A", and Lake Waha) a domestic water system including a water filtration plant that is no longer in use, and a system for distribution of irrigation water. The domestic water supply initially provided by surface water resources now comes entirely from groundwater resources developed by the Lewiston Orchards Irrigation District. A full irrigation water supply is delivered to project lands totaling over 3,900 acres, and a dependable domestic water system is now provided for some 16,000 residents.

The Little Wood River Project

Little Wood River Project includes lands within an area 2 miles wide and 12 miles long upstream and downstream from Carey, Idaho, in the south-central section of the State. The project provides a supplemental irrigation water supply for approximately 9,550 acres of land. The principal construction feature is the enlarged Little Wood River Dam and Reservoir that serve previously constructed diversion and distribution works. Flood control is provided by operation of the reservoir on a forecast basis.

The Mann Creek Project

The Mann Creek Project in west-central Idaho consists of approximately 5,100 irrigable acres utilizing an existing distribution system in the narrow valleys of Mann and Monroe Creeks, both tributaries of the Weiser River. The natural flow of Mann Creek historically has been near its lowest

point during the growing season when the demand for irrigation water is at its highest. Project development provides for storage of winter and spring flows of Mann Creek for use later in the irrigation season.

The Michaud Flats Project

The Michaud Flats Project provides irrigation for some 11,200 acres along the Snake River adjacent to the town of American Falls in southeastern Idaho. Surface flow of the Snake River, stored in space allotted to the project in American Falls (Minidoka Project) and Palisades (Palisades Project) Reservoirs, is pumped from below American Falls Reservoir into canals that serve 69 percent of the land. Return flow is used on as much of the land as it will serve, and ground water is pumped from wells to serve the remainder. The project area is part of 65 square miles of flat rolling land south of the Snake River between Pocatello and Eagle Rock known as the Michaud Flats. Irrigable land on the flats is divided by the western boundary of the Fort Hall Indian Reservation into a Michaud Flats extension of the Fort Hall Indian Project and the Michaud Flats Project.

The Minidoka Project

Minidoka Project lands extend discontinuously from the town of Ashton, in eastern Idaho along the Snake River, about 300 miles downstream to the town of Bliss in south-central Idaho. The project furnishes irrigation water from five reservoirs that have a combined active storage capacity of more than 3 million acre-feet.

The project works consist of Minidoka Dam and Powerplant and Lake Walcott, Jackson Lake Dam and Jackson Lake, American Falls Dam and Reservoir, Island Park Dam and Reservoir, Grassy Lake Dam and Grassy Lake, two diversion dams, canals, laterals, drains, and some 177 water supply wells.

The Owyhee Project

The Owyhee Project lies west of the Snake River in Malheur County, Oregon, and Owyhee County, Idaho. The project furnishes a full irrigation water supply to over 105,000 acres of land lying along the west side of the Snake River in eastern Oregon and southwestern Idaho. An additional 13,000 acres are furnished supplemental water. About 72 percent of the lands are in Oregon, and 28 percent in Idaho. Irrigable lands are divided into the Mitchell Butte, Dead Ox Flat, and Succor Creek Divisions. The key feature of the project is Owyhee Dam, on the Owyhee River about 11 miles southwest of Adrian, Oregon, which acts as both a storage and diversion structure. Project works also include canals, pipelines, tunnels, 9 pumping plants, laterals and drains.

The Palisades Project

The principal features of the project are Palisades Dam Reservoir, and Powerplant. Palisades Dam is on the South Fork of the Snake River at Calamity Point in eastern Idaho about 11 miles west of the Idaho-Wyoming boundary. The project provides a supplemental water supply to about 650,000

acres of irrigated land in the Minidoka and Michaud Flats Projects. The 176,600 kilowatt hydroelectric powerplant furnishes energy needed in the upper valley to serve irrigation pumping units, municipalities, rural cooperatives, and other power users. The principal features of the project are Palisades Dam, Reservoir, and Powerplant.

The Preston Bench Project

The Preston Bench Project, located in southeastern Idaho near the town of Preston, includes Mink Creek Canal which supplies irrigation water for 5,000 acres of highly developed land in the vicinity of Preston.

The Rathdrum Prairie Project

The Rathdrum Prairie Project area extends about 12 miles north and 13 miles west of Coeur d'Alene in the panhandle of Idaho. The initial project consisted of the Post Falls, Hayden Lake, and East Greenacres Units, totaling about 10,200 acres of irrigable land. However, in 1991, the landowners within the Post Falls Unit petitioned for dissolution of the operating entity, the Post Falls Irrigation District. By 1995, with approval of the Bureau of Reclamation, dissolution activities were completed. Currently there are about 7,000 irrigable acres in the Rathdrum Prairie Project.

Major facilities of the Post Falls Unit consisted of a pumping plant, 3,000 feet of discharge pipe, 9 miles of canal, and 20 miles of laterals.

Hayden Lake facilities consisted of a pumping plant, 2 miles of 27-inch-diameter discharge pipe, a 10,026-cubic foot storage tank, and a pipe distribution system. However, the Hayden Lake Irrigation District has since converted to a groundwater supply.

Primary facilities of the East Greenacres Unit include 14 wells in 3 well complexes, a 43,446 cubic-foot regulating reservoir, and a pipe distribution system.

The Ririe Project

The Ririe Project was constructed to impound and control the waters of Willow Creek, a Snake River tributary in eastern Idaho, for flood control, irrigation, and recreation. Significant fish and wildlife protection measures also are included. Major features include Ririe Dam and Lake, and a floodway bypass outlet channel.

The Spokane Valley Project

The Spokane Valley Project provides an irrigation and domestic water supply for lands lying east of the city of Spokane, extending eastward to the Washington-Idaho boundary and on into Idaho for a short distance. The diversion dam on the Spokane River and the canal system previously used

were abandoned in 1967 favor of a pumping system from wells into a pressure pipeline system that now provides sprinkler irrigation and serves domestic, municipal, and industrial requirements.

E 2.3 Oregon

The Arnold Project

The Arnold Project, a private development southeast of Bend, Oregon, diverts water from the Deschutes River a short distance above Lava Island Falls for approximately 4,300 acres of irrigable land. Project features include Arnold Diversion Dam, Arnold Flume and Canal, and laterals.

The Baker Project

The Baker Project in east-central Oregon consists of two divisions, the Lower and the Upper. The Lower Division provides a supplemental water supply for about 7,300 acres along the Powder River about 10 miles northeast of Baker, Oregon. The Upper Division provides supplemental water for 19,000 acres, including some contiguous areas previously dry-farmed near the city of Baker.

The Burnt River Project

The Burnt River Project in east-central Oregon consists of a storage dam and reservoir that provides water for supplemental irrigation of some 15,600 acres which formerly depended entirely on the natural flow of the Burnt River.

The Crescent Lake Dam Project

The Crescent Lake Dam Project is composed of lands of the Tumalo Irrigation District on the west side of the Deschutes River near Bend, Oregon. The principal feature of the project is Crescent Lake Dam, located at the outlet of Crescent Lake. The lake is a large natural body of water formed in a glacial deposit high on the eastern slopes of the Cascade Range. Canals, pipelines, and distribution laterals in the project furnish a full irrigation water supply to over 8,000 acres of land. Developed by private interests, various project facilities have been rehabilitated by or through the assistance of the Bureau of Reclamation.

The Crooked River Project

The main body of the Crooked River Project lies north and west of Prineville, Oregon. The water resources of Ochoco Creek and Crooked River are used to furnish irrigation water for approximately 20,000 acres. Project features include Arthur R. Bowman Dam on the Crooked River, Ochoco Dam on Ochoco Creek, a diversion canal and headworks on the Crooked River, Lytle Creek Diversion Dam and Wasteway, two major pumping plants, nine small pumping plants, and Ochoco Main and distribution canals.

The Dalles Project

The Dalles Project, Western Division is located about 80 miles east of Portland, adjacent to the city of The Dalles, Oregon, on the south side of the Columbia River. Principal features are the Mill Creek Pumping Plant, a booster pumping plant, seven relift pumping plants, three concrete-lined reservoirs, one elevated steel storage tank, five steel regulating tanks, and 46 miles of buried pressure pipe. The division provides water for nearly 6,000 irrigable acres of land.

The Deschutes Project

The Deschutes Project lands are in the vicinity of Madras, Oregon. Principal features include Wickiup Dam and Reservoir, Crane Prairie Dam and Reservoir, Haystack Dam and Reservoir, North Unit Main Canal and lateral system, and the Crooked River Pumping Plant. The project furnishes a full supply of irrigation water for about 50,000 acres of land within the North Unit Irrigation District, and a supplemental supply for more than 48,000 acres in the Central Oregon Irrigation District and Crook County Improvement District No. 1.

The Grants Pass Project

The Grants Pass Project lies within the Rogue River Basin in southwestern Oregon. The project was constructed by private interests beginning in the 1920's and partially rehabilitated by the Bureau of Reclamation in 1949-1955. The project furnishes irrigation water to over 10,000 acres of land surrounding the town of Grants Pass, Oregon. Principal project features are the Savage Rapids Diversion Dam on the Rogue River, and the associated pipelines, pumping plants, canals, and laterals.

The Klamath Project
(Note that the re-assessment of critical habitat is not occurring within the area of this project.)

The irrigable lands of the Klamath Project are in south-central Oregon (62 percent) and north-central California (38 percent). The Project provides full service water to approximately 240,000 acres of cropland. Two main sources supply water for the project: Upper Klamath Lake and the Klamath River; and Clear Lake Reservoir, Gerber Reservoir, and Lost River, which are located in a closed basin. The total drainage area, including the Lost River and the Klamath River watershed above Keno, Oregon, is approximately 5,700 square miles.

The Owyhee Project

The Owyhee Project lies west of the Snake River in Malheur County, Oregon, and Owyhee County, Idaho. The project furnishes a full irrigation water supply to over 105,000 acres of land lying along the west side of the Snake River in eastern Oregon and southwestern Idaho. An additional 13,000 acres are furnished supplemental water. About 72 percent of the lands are in Oregon, and 28 percent in Idaho. Irrigable lands are divided into the Mitchell Butte, Dead Ox Flat, and Succor Creek

Divisions. The key feature of the project is Owyhee Dam, on the Owyhee River about 11 miles southwest of Adrian, Oregon, which acts as both a storage and diversion structure. Project works also include canals, pipelines, tunnels, 9 pumping plants, laterals and drains.

The Rogue River Basin Project

The Talent Division of the Rogue River Basin Project is in the northeastern part of the Rogue River Basin in southwestern Oregon. Work on the division consisted of construction, rehabilitation, and improvement of the irrigation facilities of three irrigation districts in the vicinity of Medford, Oregon, and the provision for full and supplemental water for these lands. The work on the Medford and Rogue River Valley Irrigation Districts included rehabilitation and betterment of Fourmile Lake Dam, Fish Lake Dam, and the numerous structures which are a part of the Main and Medford Canals. An extensive collection, diversion, storage, and conveyance system was constructed to carry excess waters of the Rogue River and Klamath River Basins to the irrigated lands.

The Talent Irrigation District consists of approximately 15,500 irrigable acres. Medford Irrigation District has a water supply for 11,500 acres, and Rogue River Valley Irrigation District has a water supply for 8,300 acres. Additionally, the Talent Division provides electric power from a 16,000-kilowatt hydroelectric Green Springs Powerplant.

Principal features of the Talent Division include Howard Prairie Dam, Howard Prairie Delivery Canal, Keene Creek Dam, Green Springs Powerplant, the enlarged Emigrant Dam and Lake, and Agate Dam and Reservoir.

The Tualatin Project

The Tualatin Project area lies primarily in Washington County in the northwest part of the Willamette Basin, west of and adjacent to the city of Portland, Oregon. Some 17,000 acres of land are furnished irrigation water. Several communities and an industrial corporation are furnished untreated water for municipal and industrial use, and for quality control purposes. Fish and wildlife enhancement, recreation, and flood control are also important project functions.

Principal features include Scoggins Dam, Henry Hagg Lake, Patton Valley Pumping Plant, Spring Hill Pumping Plant, booster pumping plants, and piped lateral distribution systems.

The Umatilla Project

The original Umatilla Project furnishes a full supply of irrigation water to over 17,000 acres and a supplemental supply to approximately 13,000 acres. These lands, located in north-central Oregon, are divided into three divisions. The East Division is the Hermiston Irrigation District, the West Division is the West Extension Irrigation District, and the South Division includes the Stanfield and Westland Irrigation Districts. In addition, there are approximately 3,800 acres not included in an

irrigation district that are provided either a full or supplemental water supply from McKay Reservoir under individual storage contracts.

Project features of the East Division are Cold Springs Dam and Reservoir, Feed Canal Diversion Dam and Canal, and Maxwell Diversion Dam and Canal. Three Mile Falls Diversion Dam on the Umatilla River and the 27-mile West Extension Main Canal are the principal features of the West Division. McKay Dam and Reservoir are the only features in the South Division.

Activities were initiated in the mid-1980´s under the Umatilla Basin Project to restore instream flows for anadromous fish and allow established irrigation to continue. These activities resulted in Umatilla River channel modifications, construction of fish ladders, fish traps and fish screens, and the construction of water exchange facilities (Phase I and Phase II) to deliver irrigation replacement water from the Columbia River.

The Vale Project

The Vale Project lands are located along the Malheur River and Willow Creek in east-central Oregon, surrounding the town of Vale. The project furnishes irrigation water to 35,000 acres of land. Features include Agency Valley Dam and Beulah Reservoir, Bully Creek Dam and Reservoir, Harper Diversion Dam, Vale Main Canal, and a distribution and drainage system. To supplement project needs, the Federal Government purchased one-half of the storage rights in the Warm Springs Reservoir built by the Warmsprings Irrigation District.

The Wapinita Project

The Wapinitia Project, Juniper Division, is on Juniper Flat in north-central Oregon. Juniper Flat is a plateau, 3 to 6 miles wide and approximately 17 miles long, between the Deschutes and White Rivers. Some 2,100 acres over a scattered area receive supplemental irrigation service from the project. The principal construction feature is Wasco Dam on Clear Creek, 0.5 mile below the outlet of Clear Lake, a natural lake in a mountain valley.

E 2.4 Washington

The Chief Joseph Project

The Chief Joseph Dam is on the Columbia River in north-central Washington and is a key structure in the comprehensive development of the Columbia River Basin. Storage water from the reservoir, and power revenues to assist in paying for irrigation features, are necessary for present and future irrigation development of the area.

The Columbia Basin Project

The Columbia Basin Project is a multipurpose development utilizing a portion of the resources of the Columbia River in the central part of the State of Washington. The key structure, Grand Coulee Dam, is on the main stem of the Columbia River about 90 miles west of Spokane, Washington. The extensive irrigation works extend southward on the Columbia Plateau 125 miles to the vicinity of Pasco, Washington, where the Snake and Columbia Rivers join.

Principal project features include Grand Coulee Dam, Franklin D. Roosevelt Lake, Grand Coulee Powerplant Complex, switchyards, and a pump-generating plant. Primary irrigation facilities are the Feeder Canal, Banks Lake, the Main, West, East High, and East Low Canals, O'Sullivan Dam, Potholes Reservoir, and Potholes Canal. There is over 300 miles of main canals, about 2,000 miles of laterals, and 3,500 miles of drains and wasteways on the project.

The project irrigation facilities were planned to deliver a full water supply to about 1.1 million acres of land previously used only for dry farming or grazing. About 671,000 acres are currently irrigated and further development is not anticipated. Power production facilities at Grand Coulee Dam are among the largest in the world; the total name plate generating capacity is rated at 6,809 megawatts.

The Okanogan Project

Project facilities include Conconully Dam and Reservoir, Salmon Lake Dam and Conconully Lake, Salmon Creek Diversion Dam, and canals and laterals to serve some 5,000 acres of irrigable lands along the Okanogan River in the vicinity of Okanogan, Washington.

The Spokane Valley Project

The Spokane Valley Project provides an irrigation and domestic water supply for lands lying east of the city of Spokane, extending eastward to the Washington-Idaho boundary and on into Idaho for a short distance. The diversion dam on the Spokane River and the canal system previously used were abandoned in 1967 favor of a pumping system from wells into a pressure pipeline system that now provides sprinkler irrigation and serves domestic, municipal, and industrial requirements.

The Yakima Project

The Yakima Project provides irrigation water for a comparatively narrow strip of fertile land that extends for 175 miles on both sides of the Yakima River in south-central Washington. The irrigable lands presently being served total approximately 464,000 acres.

There are seven divisions in the project: Storage, Kittitas, Tieton, Sunnyside, Roza, Kennewick, and Wapato. The Wapato Division is operated by the Bureau of Indian Affairs, but receives most of its water supply from the Yakima Project for irrigation of 136,000 acres of land. Over 45,000 acres not included in the seven divisions are irrigated by private interests under water supply contracts with

the Bureau of Reclamation. Storage dams and reservoirs on the project are Bumping Lake, Clear Creek, Tieton, Cle Elum, Kachess, and Keechelus. Other project features are 5 diversion dams, canals, laterals, pumping plants, drains, 2 powerplants, and transmission lines.