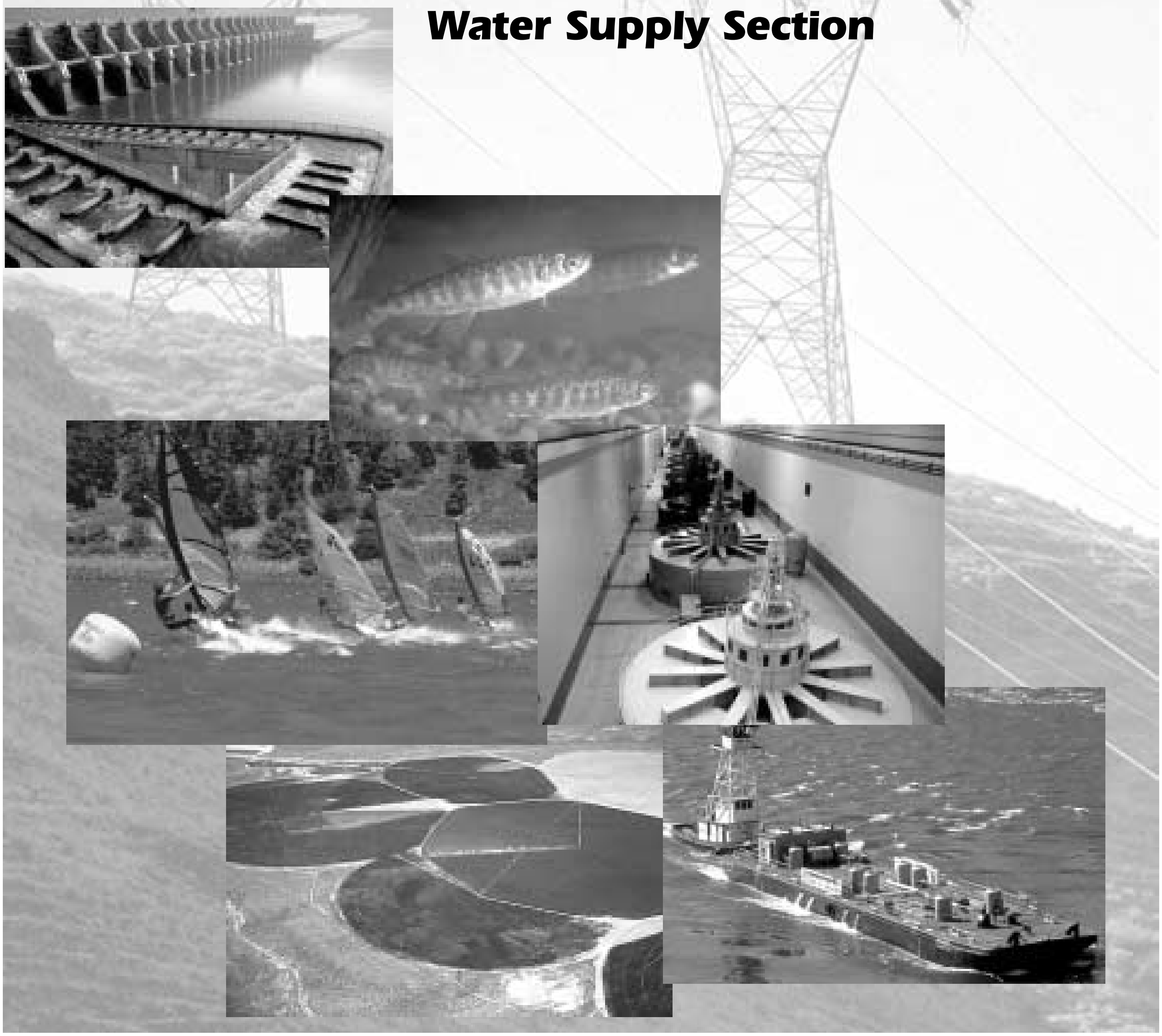
US Army Corps
of Engineers®
Portland District

Salmon Recovery through John Day Reservoir

John Day Drawdown
Phase I Study

Economic Analysis Technical Appendix
Water Supply Section



September 2000

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Section 1. Introduction

This technical appendix section documents the results of the water supply economics evaluation for the John Day Drawdown Phase I Study. This Phase I Study is a reconnaissance-level evaluation of the potential consequences and benefits of the proposed drawdown of the John Day Reservoir. This technical appendix section supplements the main report, which describes more fully the alternatives, purpose, scope, objectives, assumptions, and constraints of the study.

Section 2. Background of the Project

In 1991, the National Marine Fisheries Service (NMFS) proposed that Snake River wild sockeye, spring/summer chinook, and fall chinook salmon be granted “endangered” or “threatened” status under provisions of the Endangered Species Act. Natural resource agencies believe that the drawdown of the 76-mile John Day Reservoir may provide substantial improvements in migration and rearing conditions for juveniles by increasing river velocity, reducing water temperature and dissolved gas, and restoring riverine habitat. It is also speculated that drawdown may improve spawning conditions for adult fall chinook by restoring spawning habitat and the natural flow regimes needed for successful incubation and emergence.

As a result, the NMFS Reasonable and Prudent Alternative Action #5 of its’ Biological Opinion on Operation of the Federal Columbia River Power System (FCRPS), and subsequent reports recommended that USACE investigate the feasibility of lowering John Day Reservoir. In compliance with appropriation conditions, only two alternatives were to be evaluated: reduction of the current water surface elevation 265 to the level of the spillway crest that would vary between elevations 217 and 230, or reduction to natural river level elevation 165. Both alternatives were proposed by NMFS. These two alternatives were then expanded to consider each alternative with 500,000 acre-feet of flood storage and without such storage. Flood storage and hydropower are the current approved authorizations for the John Day project.

Section 3. Description of the Study Area

The Columbia River originates in Canada and flows for 300 miles through eastern Washington to Oregon and continues west to the Pacific Ocean, as shown in Figure 1. The adjoining region is mostly open country, with widely scattered population centers. The climate of the region is semiarid. Agriculture, open space, and large farms are prevalent. Lands adjacent to the reservoir are used to grow grains and other crops. 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 impounded by John Day Dam, Lake Umatilla, is referred to as the John Day Reservoir throughout this report. The John Day is the second longest reservoir on the Columbia River, extending 76 miles upstream to McNary Dam.

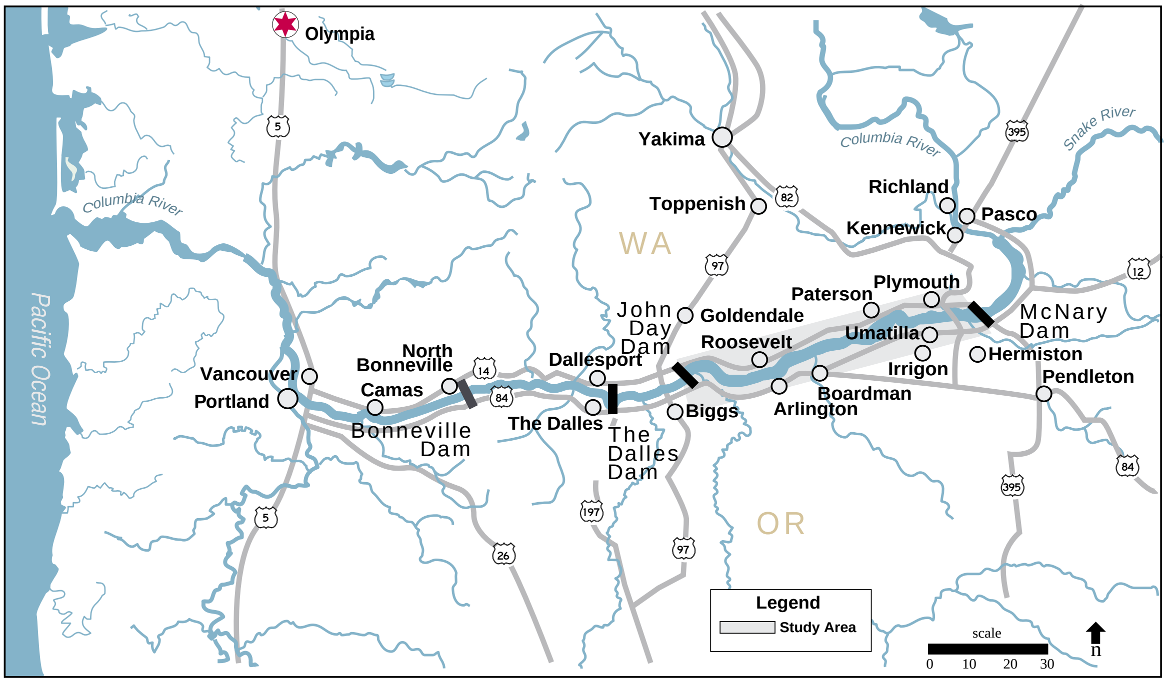

Figure 1. John Day Drawdown Phase 1 Study Area

John Day Dam and Reservoir are part of the Columbia-Snake Inland Waterway. This shallow-draft navigation channel extends 465 miles from the Pacific Ocean at the mouth of the Columbia River to Lewiston, Idaho. The entire channel 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 to The Dalles, Oregon. Although this section is authorized for dredging to a depth of 27 feet, it is currently maintained at 17 feet. The third section of the channel is authorized and maintained at a depth of 14 feet and extends from The Dalles to Lewiston. In addition to the main navigation channel, channels are dredged to numerous ports and harbors along the river.

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 the reservoir. Interstate 84 (I-84), a divided multilane highway, runs parallel on the south shore with the Columbia River from Portland, Oregon, to points east. 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, downstream from McNary Dam, is the only highway bridge linking Oregon and Washington across the Columbia River in the John Day Reservoir.

The study area includes lands directly adjacent to the reservoir as well as those directly and indirectly influenced by the hydrology of the reservoir (e.g., irrigated lands). It includes the reservoir behind the John Day Dam, and adjoining backwaters, embayments, pools, and rivers.

Section 4. Alternatives

The Phase 1 Study includes a preliminary evaluation of the impacts of the drawdown scenarios relative to the “without project condition,” which is defined as the condition that would prevail into the future in the absence of any new federal action at John Day. The four alternatives are summarized below. One of the most important constraints on the alternatives is the requirement to pass fish for river flows up to the 10-year flood flow of 515,000 cfs. Under the four alternatives, John Day Reservoir would be drawn down at a rate of one foot per day. For greater detail, please refer to the main report, *John Day Drawdown Phase 1 Study*, and *John Day Drawdown Phase 1 Study, Engineering Technical Appendix, Structural Alternatives Section*.

4.1. Spillway Drawdown without Flood Control (Alternative 1)

The first drawdown alternative is based on requirements for improved downstream fish passage conditions during both low and flood flow conditions on the Columbia River. The existing 20-bay spillway will be operated differently from current operations, but without any structural modifications. All project inflows will be directly passed through the dam spillway with the spillway gates fully opened in free overflow condition, resulting in a pool elevation that will vary from elevation 217 to 230. Impacts downstream from John Day Dam were not studied.

4.2. Spillway Drawdown with Flood Control (Alternative 2)

The second study alternative is based on requirements for improved downstream fish passage conditions during low flow periods, while maintaining authorized flood control for the John Day Project. The existing 20-bay spillway will be operated differently from current operations, but without any structural modifications. During low flow periods, project inflows will be directly passed through the dam spillway with the spillway gates set in fully open, free overflow condition. During a flood event, however, the spillway gates will be controlled to reduce downstream flood flows based on using 500,000 acre-feet of allocated project storage space. Ponding will occur upstream from the dam. Impacts downstream from John Day Dam were not studied.

4.3. Natural River Drawdown without Flood Control (Alternative 3)

The third study alternative is based on a natural river drawdown for fish passage "without flood control" condition. Natural river conditions pertain to an opening at the John Day Dam that permits acceptable upstream fish passage conditions. The size of the total dam opening must conform to two criteria based on an invert elevation at the dam of 135. The first criterion is that the opening must be sufficiently large to meet maximum allowable stream velocity criteria for sustained swim speed for the weakest salmon species, which is estimated to be 10 feet per second (fps). The second criterion is that fish passage for this opening must correspond to the 10-year annual flood peak (515,000 cfs). This alternative will require extensive modifications to John Day Dam even beyond modification of the 1,228-foot long spillway structure. Impacts downstream from John Day Dam were not studied.

4.4. Natural River Drawdown with Flood Control (Alternative 4)

This fourth study alternative is based on natural river conditions for fish passage and includes the "with flood control" condition. It requires natural fish passage conditions for both upstream and downstream directions at the dam and includes a requirement for full authorized flood control. The calculated width of the total dam opening will correspond to that previously calculated for natural river conditions without flood control (Alternative 3). Impacts downstream from John Day Dam were not studied.

Section 5. Overview of the Analysis

The objective of this economic analysis is to provide a preliminary assessment of potential impacts to national economic development on irrigators and M&I water users associated with the drawdown alternatives. The assessment includes development of a profile of irrigated agriculture and M&I water use in the study area. The analysis is based on existing information and data. However, in cases where obvious changes in the use of irrigation and M&I water have occurred, supplemental information was obtained from local area industry and community representatives. This information was used to describe existing conditions and analyze impacts. A list of information sources is included at the end of this appendix.

The basis for the evaluation of the alternatives is the current operation for the John Day project. The current operation is considered to be the baseline (or base condition) against which changes that would occur with the alternative operations were measured.

To establish the base condition, existing irrigation and M&I water uses were reviewed, as described in the following pages. To establish the relative significance of irrigation impacts, the description includes a brief overview of agriculture in Oregon and Washington. Finally, irrigated agriculture directly affected by drawdown is profiled. Also, major users of M&I water are described.

Section 6. Geographic Scope of the Analysis

The geographic scope of the analysis of irrigation and M&I water use impacts of drawdown alternatives is determined as a function of the John Day Reservoir as a source of water. Thus, the geographic scope includes (1) all lands irrigated, either directly or indirectly, with water drawn from the John Day Reservoir and, (2) communities, industries, and individuals that are served by water drawn, either directly or indirectly, from the John Day Reservoir. The John Day Reservoir as both a direct and an indirect source of water is used in defining the geographic scope of the study because of the significant effect that the John Day Reservoir has on the water Table of the ground water in areas near the pool.

The above criteria for the geographic scope of the analysis established the geographic scope as being lands in the states of Oregon and Washington that border the John Day Reservoir. The John Day Reservoir, a segment of the Columbia River, extends from John Day Lock and Dam, located at river-mile 215.6, to McNary Dam Lock and Dam, located at river-mile 291, a distance of 77 miles. Three counties in Oregon (Sherman, Gilliam, and Morrow) and two counties in Washington (Klickitat and Benton) border on the John Day Reservoir and are included in the study area. In addition to these counties that constitute the focal point of drawdown impacts, the economies of two other counties in Oregon (Sherman and Wasco) and two counties in Washington (Franklin and Walla Walla) would be affected because they include important trading centers. Nevertheless, these counties are excluded from the analysis because the focus of the analysis is on direct impacts of drawdown to John Day water users.

Section 7. Area Description and Land Use

The study area lies eastward of the Cascade Mountains, which block moisture from Pacific storms. As a result, the climate is semi-arid and there is little natural vegetation. The geography of the region is primarily rolling plains and low hills that are transected by the Columbia River. At the river, elevations range from about 100 to 300 feet above sea level. Agriculture and open space are the dominant land uses. Lands at higher elevations and more distant from the river are suitable for dry land grains and irrigated crops. Lands irrigated from the reservoir are bench lands adjacent to the reservoir. All of these lands that are used for growing crops are irrigated.

Section 8. Profile Of Agriculture and M&I Water Use

8.1. Agriculture

The history of irrigated agriculture on lands irrigated with water drawn from the John Day Reservoir differs significantly from the history of irrigated agriculture in the west in general. Irrigated agriculture in the west in general is the result of an intentional and well-organized public and private enterprise. This enterprise was formalized and substantially boosted by the passage of the Reclamation Act of 1902. The Reclamation Act established the federal interest in irrigation development in the west and led to federal financing, planning, engineering, and construction of major projects throughout the west through the actions of federal agencies, principally the U.S. Bureau of Reclamation. The Bureau is now the operator of more than 100 irrigation and multipurpose projects throughout the west.

In contrast, irrigation and associated M&I water use from the John Day Reservoir is a story of private initiative that took advantage of the federally funded development of the Columbia River for navigation, hydropower generation, and flood control. Prior to completion of construction of the John Day project in about 1968, there was little or no irrigation water drawn from the Columbia River along the reach of the current John Day Reservoir. However, with completion of the project, all of the elements for a highly successful irrigated agricultural economy came in to place: ideal climate and soils and, with the John Day project, a feasible and reliable source of water for irrigation.

The economic importance of agriculture is assessed in the context of the five counties in Washington and Oregon that would be directly affected by drawdown of the John Day Reservoir. Parameters used for the assessment are:

- Number of farms
- Acreage in farms
- Number of irrigated farms
- Acreage in irrigated farms
- Market value of agricultural products sold.

Data are presented for 1992 and 1997. In addition to the data for the five counties, data for each of the states is presented to establish relative importance. The percent of the study area in each state to its respective states is shown. Data for Oregon is shown in Table 1 and the data for Washington is shown in Table 2.

As shown in Table 1, while the study area in Oregon accounts for only about 6 percent of the number of farms, it accounts for about 19 percent of the land in farms; about 12 percent of the irrigated land; and about 14 percent of the market value of agricultural products sold. At the same time, the area accounts for only 2.4 percent of the state's population.

On the north side of the river in Washington, a similar situation exists, but it is less pronounced. There the study area accounts for about 5.5 percent of all farms; about 8.0 percent of the land in farms; about 10 percent of the irrigated land; and, about 7.0 percent of the value of agricultural products sold. These data suggest a significant concentration of irrigated agriculture in the study area. This is especially true in Gilliam County in Oregon where there were only 29 irrigated farms in 1997.

Table 1. Selected Agricultural Data for Oregon and John Day Reservoir Counties, 1992 and 1997							
Data Type	**Year**	**Oregon**	**Gilliam**	**Morrow**	**Umatilla**	**Combined Counties**	**Percent of State**
Number of Farms	1997	34,030	166	420	1,488	2,074	6.1%
(all farms)	1992	31,892	143	378	1,441	1,962	6.2%
Land in all Farms	1997	17,449,293	742,728	1,118,226	1,345,097	3,206,051	18.4%
(acres)	1992	17,609,497	766,373	1,119,004	1,466,580	3,351,957	19.0%
No. of Irrigated Farms	1997	15,348	29	223	940	1,192	7.8%
	1992	15,002	26	200	919	1,145	7.6%
Irrigated Land (acres)	1997	1,948,739	3,861	95,143	128,658	227,662	11.7%
	1992	1,622,235	4,014	101,506	116,001	221,521	13.7%
Market Value Product	1997	2,969,194	24,526	141,531	249,201	415,258	14.0%
(Total Sales ($1,000))	1992	2,292,973	17,036	94,132	186,690	297,858	13.0%

1997 Census of Agriculture -- Highlights of Agriculture: 1997 and 1992.
www.nass.usda.gov/research/

Table 2. Selected Agricultural Data for Washington and John Day Reservoir Counties, 1992 and 1997.						
Data Type	**Year**	**Washington**	**Benton**	**Klickitat**	**Combined Counties**	**Percent of State**
Number of Farms	1997	29,011	1,078	530	1,608	5.5%
(all farms)	1992	30,264	1,128	508	1,636	5.4%
Land in all Farms	1997	15,179,710	611,903	588,732	1,200,635	7.9%
(acres)	1992	15,726,007	640,370	689,639	1,330,009	8.5%
No. of Irrigated Farms	1997	13,131	901	176	1,077	8.2%
	1992	14,068	914	164	1,078	7.7%
Irrigated Land (acres)	1997	1,705,025	153,254	20,239	173,493	10.2%
	1992	1,641,437	134,698	29,739	164,437	10.0%
Market Value Product	1997	4,767,727	300,530	33,231	333,761	7.0%
(Total Sales ($1,000))	1992	3,821,222	213,877	34,000	247,877	6.5%

1997 Census of Agriculture -- Highlights of Agriculture: 1997 and 1992.
www.nass.usda.gov/research/

8.2. Agricultural Production

8.2.1. Irrigator Survey

During 1995, the Corps conducted a telephone survey of irrigation water users on the John Day Reservoir. The purpose of the survey was to obtain data on the total irrigated acreage; irrigated acreage by crop; crop yield; water use; employment; and the potential response of the irrigator to drawdown of the John Day Reservoir to its minimum operating level (elevation 257), just 5 feet below the normal operating pool. The survey questionnaire is included as Attachment A. In all, 27 irrigators were identified, including the Oregon Department of Transportation rest stop at Boardman (15 in Oregon and 12 in Washington). Surveys were completed for 25 of the irrigators (13 in Oregon and 12 in Washington). Data obtained through the survey and estimated on the basis of the survey are shown in Tables 3 and 4 for Oregon and Washington, respectively. However, these data were updated to include new land brought into production since 1994. Data shown are crop type, acres of production by crop, yield per acre[1], production by crop, price[2] and total value by crop.

8.2.2. Agricultural Production

As explained above, the basis for estimated agricultural production for the study area is the survey conducted by the Corps in 1995, supplemented by additional information from follow-up conversation with representatives of two of the farms in Oregon, a representative of Potlatch Corporation, a representative of a local engineering firm and a representative of the Columbia/Snake River and Eastern Oregon Irrigation Associations. As shown in Table 3 and Table 4, in 1994 there were a combined total of about 182,000 acres in production (Oregon 89,700 acres and Washington 92,300 acres). The combined value of production, based on estimated acreage and production for 2000 and average prices for 1998 amounts to a total of about $324.6 million (Oregon $111.3 million and Washington $213.3 million).

As shown in Table 3, the order of importance of crops grown in the study area in Oregon in terms of acres of production is alfalfa, potatoes, all wheat, and field and sweet corn. These four crops account for over 80 percent of the total acreage and value of production. The total value of production, based on estimated acreage and production for 2000 and average 1998 prices, amounts to about $111.3 million. Although the total value includes the value of poplars (harvested for wood chips for pulp), harvest has not yet occurred. The value shown for poplars is based on estimates of yield and the average expected long-term price (estimated range is $50 to $100 per bone-dry ton).[3] In the case of poplars, acreage was not updated to 2000. Poplars are being planted on existing farms and, for this analysis, crop acreages reported for 1994 have been used, except in cases where new land has been put into production.

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1 Estimates of yield are from the average of reported yields for potatoes, wheat, corn, alfalfa and onions. Estimates of yields for other crops, except poplars, is from the Umatilla & Morrow County Crop Report—1998, Oregon Agricultural Extension Service, 1999. The estimate of yield for poplars is from estimates obtained from Potlatch Corporation, August 1999.

2 Prices are from the Umatilla & Morrow County Crop Report—1998, except for poplars. The price estimate for poplars is from information obtained from Potlatch Corporation, August 1999.

3 Based on information obtained from Potlatch Corporation, August 1999.

As shown in Table 4, the order of importance of crops grown in the study area in Washington in terms of acres of production is field and sweet corn (27 percent), potatoes (24 percent), alfalfa (9 percent) and all wheat (6 percent). These four crops account for about 66 percent of the total acreage and 40 percent of the value of production. The total value of production, based on acreage estimated for 2000 and average prices in 1998, amounts to about $213.3 million. As is the case with Oregon, although the total value includes the value of poplars (harvested for wood chips for pulp), harvest has not yet occurred. The value shown is based on estimates of yield and the average expected long-term price (estimated range is $50 to $100 per bone-dry ton).[4]

[4] Based on information obtained from Potlatch Corporation, August 1999.

Table 3.
Irrigated Acres, Crops, Estimated Annual Production and Market Value of Production Impacted by John Day Reservoir Drawdown in Oregon.

Crop Type	Acres	Yield/Acre	Production	Unit Value 1/	Total Value ($)
Potatoes (tons)	18,741	26.6	498,784	104.00	51,873,500
All Wheat (bushels)	10,737	118.1	1,268,063	2.78	3,525,216
Field Corn (bushels)	11,600	178.8	2,073,411	2.53	5,245,729
Sweet Corn (tons)	6,177	9.6	58,990	148.40	8,754,168
Alfalfa (tons)	27,848	7.1	196,791	100.00	19,679,112
Alfalfa Seed (tons)	485	0.5	243	2,799.20	678,806
Grass Seed (lbs)	-	0	-	0.62	-
Hay & Pasture (aum)	6,010	6	36,060	14.00	504,840
Beans (tons)	1,759	18	31,662	144.90	4,587,824
Peas (tons)	1,259	21	26,439	216.52	5,724,572
Popcorn (tons)	779	3.1	2,415	104.99	253,539
Onions (tons)	1,240	15.9	19,654	250.00	4,913,500
Carrots (tons)	125	25.7	3,208	70.02	224,589
Milo (bu)	125	200	25,000	3.15	78,750
Canola (tons)	401	0.6	241	180.00	43,308
Poplars (tons)	64	8.2	524	75.00	39,273
Vineyards (tons)	-	2.94	-	774.37	-
Orchard (tons)	-			1,171.00	
Apples (tons)	580	13.1	7,598	632.00	4,801,936
Apricots (tons)	-		-	800.00	-
Cherries (tons)	-		-	1,710.00	-
Asparagus (tons)	-		-	1,020.00	-
Mint (lbs)	-	78	-	11.10	-
Sugar Beets (tons)	-		-	40.70	-
Landscape	11		-		-
Other Grass (hay) (tons)	1,800	2.3	4,140	82.50	341,550
Total	**89,741**				**111,270,212**

Notes: 1/Source: Umatilla & Morrow County Crop Report--1998, Oregon Agricultural Extension Service.
2/ Acres=reported by growers in COE 1995 survey & IRZ Engineering, August 1999.
3/ Yield=average of yield reported by growers or Crop Report—1998.

Table 4.
Irrigated Acres, Crops, Estimated Annual Production and Market Value of Production Impacted by John Day Reservoir Drawdown in Washington

Crop Type	Acres	Yield/Acre	Production	Unit Value 1/	Total Value
Potatoes (tons)	22,095	26.6	588,043	102.00	59,980,350
All Wheat (bushels)	5,477	118.1	646,834	2.78	1,798,198
Field Corn (bushels)	18,558	178.8	3,317,243	2.53	8,392,624
Sweet Corn (tons)	6,648	9.6	63,488	148.40	9,421,679
Alfalfa (tons)	7,908	7.1	55,883	100.00	5,588,320
Alfalfa Seed (lbs)	-	1,050.0	-	1.40	-
Grass Seed (lbs)	2,610	1,953.00	5,097,330	0.62	3,181,244
Hay & Pasture (aum)	108	2	216	14.00	3,024
Beans (tons)	2,000	18	36,000	144.90	5,216,400
Peas (tons)	2,020	21	42,420	216.52	9,184,778
Popcorn (tons)	-	3.1	-	104.99	-
Onions (tons)	5,148	15.9	81,596	250.00	20,398,950
Carrots (tons)	4,142	25.7	106,284	70.02	7,441,986
Milo	-	200	-	2.53	-
Canola (tons)	200	0.6	120	180.00	21,600
Poplars	2,700	8.2	22,091	75.00	1,656,818
Vineyards (tons)	3,331	2.94	9,793	774.37	7,583,514
Orchard (tons)	250	2.94	735	774.37	
Apples (tons)	4,540	13.1	59,474	1,171.00	69,644,054
Apricots (tons)	40	13.1	524	632.00	331,168
Cherries (tons)	60	1.5	90	1,710.00	153,900
Asparagus (tons)	20	1.9	38	1,020.00	38,760
Mint (lbs)	500	78	39,000	11.10	432,900
Sugar Beets (tons)	3,262	20	65,240	40.70	2,655,268
Landscape	-		-		-
Other Grass (hay) (tons)	745	2.3	1,714	82.50	141,364
Total	**92,362**				**213,266,897**

1/ Source: Umatilla & Morrow County Crop Report--1998, Oregon Agricultural Extension Service
Acres = reported by growers in COE 1995 survey with corrections & additions from IRZ Engineering and D. Olsen, Aug. 1999.
Yield = average of yield reported by growers or Umatilla and Morrow County Crop Report--1998.

8.2.3. Net Income

A detailed analysis of net income was not prepared for this study. However, based on information obtained from several of the irrigators and from engineering and economic consultants in the study area who work for irrigators in both Oregon and Washington, net income to farming is estimated to be in the range of from $250 per acre to $350 per acre. This estimate is representative of the average for the study area and would not be valid for any one crop. Crops with the highest net income at present are potatoes and vineyards. A number of the crops that are used in rotation with potatoes, such as field corn and wheat, currently have negative net incomes.

8.2.4. Value of Land and Investments in Perennial Crops

The value of irrigated land and investments in perennial crops was determined to establish a basis for determination of the significance of the cost of alternative water supply options. Estimates of these values were developed in consultations with representatives of the irrigators and financial institutions that serve farmers in the study area. Based on this information, a range of values from a low of about $921 million to a high of $1.2 billion was developed and is shown in Table 5.

Table 5.
Estimated Value of Land and Investment in Perennial Crops on Farms Irrigated from the John Day Reservoir.

		Unit Value/Cost		Total Value/Cost	
Cost Item	**Acres**	**Low**	**High**	**Low**	**High**
Value of Land					
Oregon	89,741	3,500	4,500	314,092,450	403,833,150
Washington	92,362	3,500	4,500	323,267,000	415,629,000
Total	182,103			637,359,450	819,462,150
Investment in Perennial Crops					
Oregon	29,580	7,000	10,000	207,060,000	295,800,000
Washington	10,921	7,000	10,000	76,447,000	109,210,000
Total	40,501			283,507,000	405,010,000
Total Value of Land & Perennials					
Oregon				521,152,450	699,633,150
Washington				399,714,000	524,839,000
Total				920,866,450	1,224,472,150

8.2.5. Changes in Land Use and Crop Production Since 1994

Since 1994, approximately 27,000 acres of cropland, about 24,000 acres in Oregon and about 3,000 acres in Washington, has been or is in the process of being converted from cultivation of traditional farm crops to the cultivation of hybrid poplars as a source of wood chips for pulp. Two entities, Potlatch Corporation and Boise Cascade Corporation, have poplar plantations. Potlatch currently operates on the Oregon side of the river and has 17,000 acres planted and has plans to plant an additional 5,000 acres for a total of 22,000 acres. Potlatch expects to harvest the trees on a 7-year rotation and achieve a sustained annual yield of about 180,000 bone-dry tons (about 8.2 bone-dry ton per acre, based on total acreage). Water for the Potlatch plantations is provided from the pump station formerly owned by Eastern Oregon Farm Corporation (about 11,000 acres) and by the Columbia Improvement District (about 11,000 acres). Boise Cascade Corporation has plantations of approximately 7,000 acres in Oregon (Columbia Irrigation District) and about 3,000 acres in Washington (Sandpiper Farms).[5]

The combined total acreage of the hybrid plantations amounts to about 32,000 acres, rounded (Potlatch, 22,000 acres; Boise Cascade, 9,700 acres). On the basis of the annual sustained production estimate provided by Potlatch of 8.2 bone-dry tons per acre and the expected range of prices for woodchips of from $50 to $100 per bone-dry ton, the range of the gross annual value of production of woodchips is from $13 million to $26 million.

In addition to the recent cultivation of hybrid poplars for wood chips for pulp, since 1994 an estimated 20,950 acres of new land has been placed under cultivation for growing traditional crops on the Washington side of the river. Primary crops being grown on this new land include potatoes, row crops (such as onions and carrots), apples, and vineyards. Because this is new land that was not farmed during 1994 when the farm survey was conducted, the estimated crop acreage, production and value for this land has been added to summary of farm production and value for Washington (Table 4). The crop mix used in the analysis was that reported by representatives of the irrigators.

8.3. Municipal And Industrial Water Use

8.3.1. Profile of M&I Water Users

M&I water users in the study area include local communities, fish hatcheries, a school district, and an aluminum mill. In addition, there are a number of relatively small publicly owned and privately owned wells that draw from the unconfined aquifer that may be supplied by the Columbia River/John Day Reservoir. A summary listing of the major well owners/operators is shown in Table 6. In this Table, the major users are considered to be the entities that actually draw water either directly or indirectly (well in the unconfined aquifer) from the John Day Reservoir. As shown in Table 6, the largest M&I water users in Oregon are the City of Boardman, the Port of Morrow and the Irrigon and Umatilla fish hatcheries. In addition to those listed, another major M&I water user in Oregon is the Boardman coal-fired electrical power plant, located about 12 miles southwest of Boardman. The plant obtains its water directly from the John Day Reservoir through the pump station owned and operated by the Taggares (RD Offutt) farm. In Washington, the major M&I water user is the Columbia/Goldendale aluminum plant which pumps water directly from the river. Major water uses are discussed in the next section.

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[5] Ibid. Land that Potlatch has planted to poplars was farmed by Eastern Oregon Farm Corporation and by Pacific Northwest Farms (Columbia Improvement District) during the survey conducted by the Corps in 1995.

Table 6.
Summary Listing of Major Well Owners and M&I Water Users.

User	Source of Water	Number in Use	Water Uses	Yield
				(gpm)
Oregon				
City of Arlington	Wells	2	M&I	755
City of Boardman	Rainey wells	2	M&I	13,500
Port of Morrow 3/	Wells 1/	6	M&I	6,620
Port of Morrow--farm wells 3/	Sump wells	5	farming	8,457
Irrigon Fish Hatchery 4/	Rainey well	1	fish culture	21,000
Umatilla Fish Hatchery 4/	Rainey well	1	fish culture	9,000
City of Irrigon	Wells	2	M&I	1,542
City of Umatilla	Wells	3	M&I	4,545
Umatilla School District	Wells	2	M&I	350
Other Publicly Owned Wells	Wells	11	M&I	5,282
Privately Owned Wells	Wells	unknown		
Washington				
Columbia/Goldendale Aluminum	John Day Reservoir	1	cooling	21,000
Patterson	Wells	1		
Other Publicly Owned Wells 2/	Wells	8	Misc.	1,305
Privately Owned Wells	Wells	unknown	unknown	unknown

Sources:

Public Wells--CH2MHill, June 1995. John Day Reservoir Drawdown/Water Supply Mitigation Study, Publicly Owned Wells (30 percent review memorandum).

1/ Excludes farm wells.

2/ Yield is for just four wells. Yield of the others is unknown.

3/ Yield data are from the Corps of Engineers, JohnDayWells Qty.xls file, August 1999.

4/ Yield data are from Bovay Northwest, Inc., 1995. Study of Water Supplies for Irrigon and Umatilla Fish Hatcheries During John Day Reservoir Minimum Operating Pool.

8.3.2. Description of Major M&I Water Uses

Major M&I water uses in the study area are consistent with economic sector employment data presented earlier. That is, in addition to the usual residential and commercial uses typical of the communities the size of those in the study area, the major uses are for food processing and for providing cooling for electrical power generation and industrial processes. Essentially all of the water intensive food processing plants are located in the Boardman area and are supplied by the Port of Morrow. The Port uses recycled wastewater from the plants to irrigate farmland that it owns and leases to local area farmers. For irrigation use, the wastewater is diluted with water pumped from sump-wells at the rate of about two-thirds wastewater and one-third fresh water. A frequently overlooked M&I water user on the south side of the river in Oregon is the PGE coal-fired electrical generation plant that is located near Boardman.

The plant requires water for cooling purposes. Water is supplied to the plant by the RD Offutt Company that owns (since 1998) the Taggares farm and operates that farm and the Boeing farm. Water for the power plant is delivered to a 1,500 acre-foot reservoir adjacent to the plant. The power plant pumps water from the reservoir for steam cooling and the farm pumps from the reservoir for irrigation.

The only M&I water user on the north side of the river in Washington is Columbia (or Goldendale) Aluminum. The company pumps water directly from the John Day Reservoir from a station located near the John Day Dam to cool rectifiers in the aluminum ingot casting plant. As with the Coyote Springs and Boardman power plants, the plant cannot operate without cooling water.[6] A summary listing of water suppliers, and the type of water use for each supplier is shown by state in Table 7.

Table 7.
Major M&I Water Suppliers, Users and Uses on the John Pool in Oregon and Washington by State.

State/Supplier	Source of Water	Type of Water Use
Oregon		
City of Boardman	Ranney collectors	Commercial and Residential
City of Irrigon	Deep basalt wells	Commercial and Residential
Western Alfalfa Inc.	City of Irrigon	Prepared livestock feed
City of Umatilla	Deep basalt wells	Commercial and Residential
Boise Cascade	City of Umatilla	Manufacture of wood chips
Sectric	City of Umatilla	Motor & Industrial Controls
JM Manufacturing	City of Umatilla	Manufacture of PVC pipe
Port of Morrow--farm	Sump wells	Irrigation 1/
Port of Morrow--fresh	Deep alluvial wells	Industrial
PGE--Coyote Springs Co-Gen Plant	Port of Morrow--farm	System cooling (electrical power generation)
Lamb-Weston	Port of Morrow--fresh	Food processing--potato products
Oregon Potato	Port of Morrow--fresh	Food processing--potato products
Boardman Foods	Port of Morrow--fresh	Food processing--fresh pack onions
Logan International	Port of Morrow--fresh	Food processing--potato products
RD Offutt Company 2/	John Day Reservoir	Industrial
PGE Boardman Coal-Fired Plant	RD Offutt Company	System cooling (electrical power generation)
Washington		
Columbia/Goldendale Aluminum	John Day Reservoir	System cooling (aluminum reduction)

Sources: Oregon Department of Economic Development, August 1999 and Port of Morrow, August 1999.

Notes:
1/ Water is used to dilute recycled waste water from food processing plants (2/3 waste with 1/3 well) which is then used for irrigation.
2/ RD Offutt Company owns the Taggares farm and operates the Taggarres and Boeing farms.

[6] Information on Columbia Aluminum smelter is from Kevin O'Sullivan of the BPA, March 1995.

Section 9. Impacts of Drawdown on Water Users

9.1. Agriculture

9.1.1. General

Irrigators face two sources of impacts from drawdown. First, they face the potential for interruption in water availability during construction of new pump stations at the new level of the river following drawdown. Interruption of water availability would occur with implementation of the option to relocate pump stations to the new level of the river following drawdown. Potential costs to irrigators associated with this option are discussed in following paragraphs. The second source of impacts that irrigators would face with drawdown is the cost of the new irrigation delivery systems.

9.1.2. Irrigation Water Supply Alternatives

Two alternatives are being considered for providing water for irrigation with drawdown. From an engineering standpoint the least cost alternative is to relocate the existing pumps to the new level of the river. Where necessary, new pumps would be installed to achieve the same capacity as the stations now provide. The more expensive alternative, again from an engineering standpoint, is the construction of canals from the McNary Dam to the study area. A canal would be constructed on both the Oregon and Washington sides of the river. The canals would extend far enough downriver to provide water to all of the existing farms. This alternative includes relocation of existing pump stations to the canal to provide water service to existing farms.

9.1.3. Total First Cost of Water Supply Alternatives

The construction cost of the pump relocation plan for the spillway crest drawdown alternative is currently estimated by the Corps to be $237 million and the cost for the natural river drawdown alternative is currently estimated by the Corps to be $239 million. The construction cost of the canal alternative is currently estimated by the Corps to be $373 million, including the cost of relocating existing pumps to the canals. Estimated costs for the pump relocation and canal construction alternatives include all of the costs related directly to implementation of each of the alternatives. Increasing operating costs are not included. Details of the cost estimates are explained in detail in another report. On the basis of construction costs alone, the pump relocation option appears to be the least costly alternative. However, this is without consideration of impacts on irrigators and costs that they would incur. These costs must be added to the construction cost to obtain an estimate of the total cost of each alternative.

The canal alternative could be constructed prior to drawdown so that there would be no interruption of water service. Therefore, this alternative has no additional costs due to impacts on irrigators. This is not the case, however, with the pump relocation plan. The pump relocation alternative cannot be constructed until the pool has been drawn down. In the case of the spillway crest alternative, plans are to complete drawdown from November through February. Following drawdown, cofferdams would be constructed and dewatered to allow for relocation of the pump stations. With construction beginning in March, at the earliest, it would not be possible to complete the modifications prior to the start of the growing season. Therefore, irrigators would lose crop production for at least one season and irrigators with perennial crops would probably suffer a total loss of all perennial crops. These costs must be added to the cost of the pump relocation plan. Adding the NED costs that would be incurred by irrigators increases the first cost of pump relocation plan from $237 million to a range of from a low of $611.6 million to a high of $769.5 million for spillway crest drawdown. For natural river drawdown, adding the NED cost to irrigators to the cost of pump relocation increases the total cost from $239 million to a range of from a low of $613.6 million to a high of $771.5 million—the only difference between the total cost of the spillway crest drawdown and natural river drawdown alternatives is the difference in the actual implementation cost, amounting to $2 million. Ranges of costs are shown because of uncertainties about the actual losses associated with net income from farming and the investment in perennial crops. Assumptions used to develop the ranges of costs and the derivation of the ranges of costs are shown below in Table 8.

Table 8.
Summary of Assumptions and Derivation of Total Costs of Irrigation Water Supply Options

Item Description & Assumptions		Inputs Low	Inputs High	Totals Low	Totals High
Canal Construction Option					
Construction Cost ($)				**373,000,000**	**373,000,000**
Pump Relocation Option (Spillway Crest)					
Construction Cost ($)				237,000,000	237,000,000
Other Irrigator NED Costs					
Oregon--Irrigator Costs					
Loss of Net Farm Income	Acres of lost production, Oregon	89,741	89,741		
	Net Income per acre (2 years)	500	700		
	Total ($)	44,870,350	62,818,490		
Loss of Perennial Crops	Acres of lost crops	29,580	29,580		
	Lost Investment per acre ($)	7,000	10,000		
	Total ($)	207,060,000	295,800,000		
Total Cost--Oregon		**251,930,350**	**358,618,490**		
Washington--Irrigator Costs					
Loss of Net Farm Income	Acres of lost production, Oregon	92,362	92,362		
	Net Income per acre (2 years)	500	700		
	Total ($)	46,181,000	64,653,400		
Loss of Perennial Crops	Acres of lost crops	10,921	10,921		
	Lost Investment per acre ($)	7,000	10,000		
	Total ($)	76,447,000	109,210,000		
Total Cost--Washington		**122,628,000**	**173,863,400**		
Total Cost to Irrigators				374,558,350	532,481,890
Total Cost of Pump Relocation Alternative				**611,558,350**	**769,481,890**
Increase in Pump Costs Over Canal Costs				**238,558,350**	**396,481,890**

9.1.4. Summary of First Costs and Annual Capital and O&M Costs of Irrigation Water Supply Alternatives

To determine if it would be theoretically possible for farmers to bear the costs of the irrigation water supply alternatives, the first costs of the alternatives (including construction costs and costs to irrigators) were converted to annual costs. Since farmers would be required to pay the costs, annual costs were computed using terms currently available to farmers in addition the increase in pumping costs associated with the higher lift with drawdown was included, as follows:

- Interest rate—7 percent
- Loan repayment period—30 years
- Increase in pumping costs with spillway crest drawdown (30-foot increase in lift)
  - Low--$4.00 per acre
  - High--$5.00 per acre
- Increase in pumping costs with natural river drawdown (60-foot increase in lift)
  - Low--$8.00 per acre
  - High--$10.00 per acre

Operation and maintenance costs could increase slightly with drawdown, especially if there were a significant increase in turbidity. This could cause excessive wear of pump impellors, etc. However, insufficient information was developed for this reconnaissance study to determine if O&M costs would actually increase. Therefore, O&M costs are assumed to remain at approximately the levels associated with the existing pump-stations.

Total first costs (excludes interest during construction) and annual costs are shown in Table 8. Annual costs for the pump relocation alternative were computed with and without implementation impacts to irrigators for both drawdown scenarios. Annual costs are shown in Table 9. As shown in Table 9, if implementation of pump relocations results in a loss of production for two years as currently estimated, annual costs generally exceed estimates of net income ($250 to $350 per acre) for both drawdown scenarios. However, if pumps could be relocated without direct impacts to farming operations, costs of this alternative, for both drawdown scenarios would be significantly less than net income. The annual cost of the canal alternative, although somewhat higher than the cost of pump relocation without implementation impacts to irrigators, would be less than estimates of net income.

Table 9.
Summary of Implementation and Annual Costs of Alternative Irrigation Water Delivery Systems, With and Without Implementation Impacts to Irrigators.

	Low ($)	High ($)
Pump Relocation Alternative (with implementation impacts to farmers)		
Spillway Crest Drawdown		
Construction Cost	237,000,000	237,000,000
Cost to Irrigators	374,600,000	532,500,000
Total First Cost	611,600,000	769,500,000
Annual Cost of Construction	49,286,644	62,011,238
Annual Increased Cost of Pumping	728,412	910,515
Total Annual Cost	50,015,056	62,921,753
Annual Cost per Acre	275	346
Natural River Drawdown		
Construction Cost	239,000,000	239,000,000
Cost to Irrigators	374,600,000	532,500,000
Total First Cost	613,600,000	771,500,000
Annual Cost of Construction	49,447,817	62,172,410
Annual Increased Cost of Pumping	1,456,824	1,821,030
Total Annual Cost	50,904,641	63,993,440
Annual Cost per Acre	280	351
Pump Relocation Alternative (without implementation impacts to farmers)		
Spillway Crest Drawdown		
Construction Cost	237,000,000	237,000,000
Annual Cost of Construction	19,098,978	19,098,978
Annual Increased Cost of Pumping	728,412	910,515
Total Annual Cost	19,827,390	20,009,493
Annual Cost per Acre	109	110
Natural River Drawdown		
Construction Cost	239,000,000	239,000,000
Annual Cost of Construction	19,260,150	19,260,150
Annual Increased Cost of Pumping	1,456,824	1,821,030
Total Annual Cost	20,716,974	21,081,180
Annual Cost per Acre	114	116

Table 9 (cont.). Summary of Implementation and Annual Costs of Alternative Irrigation Water Delivery Systems, With and Without Implementation Impacts to Irrigators.		
	Low ($)	**High ($)**
Canal Alternative 1/		
Construction Cost	373,000,000	373,000,000
Cost to Irrigators	0	0
Total First Cost	373,000,000	373,000,000
Total Annual Cost	30,058,729	30,058,729
Annual Cost per Acre	165	165
1/ There may be a savings in pumping costs if the canal feed pump stations are located in the McNary Pool, as is assumed in the current cost estimate for the canal. These savings, however, were not estimated because of the uncertainty about possible removal of the McNary dam.		
2/ O&M costs are assumed to remain the same as for the existing pump stations.		

The potential range of impacts is quite wide. Due to the scope of this study, it is inappropriate to assume that all engineering concerns related to the pump modification plan will be overcome. While the canal option also has implementation issues, it is still a likely a reasonable mid-point estimate of the range of potential impacts, resulting in an average annual NED impact of $26,600,000, based on a first cost of $373,000,000 annualized over 50 years at an interest rate of 6.875.

9.1.5. Uncertainty and Need for Additional Research and Information

There are a number of areas of uncertainty in the analysis and additional information would be needed to confirm the preliminary analysis prior to a final decision of implementation of drawdown and alternative irrigation water delivery systems. Basic areas of uncertainty and research and information needs are summarized below.[7]

- First, it would be necessary to conduct a study of farm production costs and income to determine with certainty if farming is actually economically viable over the long-term and if it would continue to be economically viable in the future with drawdown and the associated increase in fixed costs.
- Second, it would be necessary to verify the current market value of land by conducting actual appraisals of a representative sample of the properties.
- Third, it would be necessary to determine appropriate terms for financing construction of the canals as the basis for determining annual costs to irrigators. The longest financing term currently available is for 30 years. However, an analysis based on a longer term that incorporates an assumption of rollover (refinancing) at the end of the initial term might be appropriate. Also, the appropriate rate of interest would need to be determined.
- Fourth, an essential condition to long-term financing of the canals would almost certainly require a contractual agreement with the government that the McNary pool would not be

[7] This listing, however, is not intended to encompass all of the research and information that might be needed.

drawn down in the future. If the government could not enter into such a contract, it would be necessary to relocate the canal pump station to the John Day Reservoir.

- And, fifth, since construction and operation of the canals would require cooperation and participation by virtually all of the irrigators, institutional arrangements that would enable the irrigators to join together to construct and operate the canals. Such institutional arrangements would have to assure irrigators that rights-of-way could be obtained. In addition, consideration should be given to providing bonding authority to facilitate financing.

9.2. Municipal and Industrial Water Users

9.2.1. Cost to Modify Municipal and Industrial Water Supply Systems

As with the irrigators who pump water directly or indirectly from the John Day Reservoir, M&I water users face two potential sources of impacts of drawdown: interruption of water supply at the quantity and quality that is currently provided by existing systems and the cost of modifications to existing system or construction of new systems. Ranney well systems appear to be most vulnerable to drawdown. For example, the Ranney well system of the City of Boardman actually draws water from the aquifer that underlies the John Day Reservoir and the Columbia River. The alluvium that contains the aquifer naturally filters water that is drawn from the system. Drawdown would certainly decrease the yield of the existing system and could cause degradation in water quality.[8] To avoid potential reductions in the supply of water, it would be necessary to modify existing systems or construct new systems prior to drawdown. There is no way of knowing, however, if the modifications would adequately address impacts of drawdown until drawdown is actually implemented. This creates a degree of risk and uncertainty that must be addressed prior to drawdown to insure adequate water supplies to water dependent industries, especially food processing.

Estimated costs of proposed modifications and new systems for natural-river and spillway crest drawdown are summarized in the following table. Costs are identical for both the spillway crest alternatives and the natural river alternatives. Cost detail is available in the Economic Analysis Technical Appendix Implementation Cost Estimate Section.

Table 10. Municipal and Industrial Water Supply Impacts	
First Cost	$110,000,000
Annualized First Cost	$8,750,000
Additional Annual O&M	$8,800,000
Total Average Annual Costs	**$17,550,000**

[8] City of Boardman, 1994. Letter to the Columbia River System Operation Review Interagency Team.