Economics of Columbia River Initiative

Final Report to the Washington Department of Ecology and

CRI Economics Advisory Committee.

Study Team:

Daniel Huppert
School of Marine Affairs
University of Washington

Gareth Green
Albers School of Business
Seattle University

William Beyers
Department of Geography
University of Washington

Andrew Subkoviak
Department of Economics
University of Washington

Andrew Wenzl
Department of Geography
University of Washington

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EXECUTIVE SUMMARY

The purpose of this study is to review the economic effects of increased water use from the Columbia River in the context of Washington State's Columbia River Initiative (CRI). The CRI is designed to address the legal, scientific, and political issues related to water use from the mainstem of the Columbia River in Washington State. The economic analysis in this report is one of several kinds of information that will be used to inform the Department of Ecology's rule-making related to the Columbia River. In addition to this review, the State has contracted with the National Academy of Sciences to consider the relationship between water use and the health of salmon populations. This report focuses on the economic consequences of increased water diversions in the mainstem Columbia river in Washington State, including 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. In addition to gauging these effects, the report includes a summary of issues related to the increased use of market transactions in water rights.

The analysis is focused on a series of five "Management Scenarios" developed by the Department of Ecology in consultation with water users. Each "scenario" incorporates a policy for issuing new water rights, and each is conditional upon an assessment of risks to anadromous fish. Water rights for roughly 4.7 million acre-feet of water for diversions from the Columbia river (including groundwater rights within1 mile of the river) are currently held in the State, with 91% going to irrigated agriculture and 9% to municipal, industrial, domestic and other users. As shown in Table E-1, the first three Scenarios increase these water rights by 1 million acre-feet (MAF) and permit existing interruptible water rights (about 3.6% of the surface water rights) to be converted to non-interruptible rights. For each of these three Scenarios, the new water rights holders must meet water efficiency standards (called Best Management Practices, or BMPs) and begin metering their withdrawals. In Scenarios 2 and 3 fees are charged ($10 or $20 per acre-foot per year) for new and converted water rights, and 300 KAF of the 1 MAF is withheld until the majority of existing water users meet the BMPs. Scenario 4 envisions no overall increase in water diversions but it permits new users to obtain rights via transfer from existing users, thus mitigating for the new diversions in time and place. Scenario 5 is the "no change" or *status quo* option.

Table E-1. Five CRI Management Scenarios

Scenario	Quantity of New Water Rights	Fees	Contingencies	Other Requirements
1	1 MAF	none	none	Meet BMPs and meter withdrawals
2	1 MAF	$10/acre-foot annually	300 KAF depends upon 80% of existing rights complying with BMPs	Meet BMPs and meter withdrawals
3	1 MAF	$20/acre-foot annual	300 KAF depends upon 80% of existing rights complying with BMPs	Meet BMPs and meter withdrawals
4	None	$30/acre-foot for transfers & conversions	New withdrawals must be fully offset by transfers, conservation or new storage.	Meet BMPs and meter withdrawals
5	Status Quo	none	Issuance of new rights follows current procedure & depends upon opinion of fishery managers.	

To evaluate the economic effects of the second and third scenarios we developed lower bound, partial allocations of the water rights. These lower bounds reflect the possibility that either the BMP & metering requirements and/or the increased fees would discourage new water applicants and keep the total new water rights allocation below the maximum of 1 MAF. For Scenario 2, the lower level was set at 700 KAF and for Scenario 3 the lower level allocation is set at 572 KAF. In assessing the impacts of these scenarios, we assume that the new water rights include 220 KAF for the Columbia Basin Project (209 KAF for irrigation and 11 KAF for municipal and industrial use), and 80.7 KAF for existing applicants for municipal and industrial (M&I) water. The remainder goes for new irrigated agricultural use. We distribute the new agricultural water among river reaches and counties in a manner reflecting the locations of applications in the existing pool of water permit applications at Department of Ecology.

A major impact of the first three scenarios occurs in the irrigated agriculture sector, where new water rights allow the expansion of crop production, mainly in the Columbia Basin

Project area and in Benton County. Assuming that crop prices remain at current levels, and that the costs of production are reflected in available crop budget studies, the gross revenue (sales value) and net revenue (sales revenue minus farm costs) of new crops was estimated for each of the Scenarios. It is important to note the results are sensitive to the assumption of crop prices remaining at current levels, as is discussed in detail in Chapter 3. The main results, detailed in Table E-2, are that agricultural production will increase with the new water allocations to generate between $349.6 and $ 779 million in gross revenue and between $11.5 and $43.7 in net revenue to farms. The gross revenue increases from Scenario 1 to Scenario 3 because we assume shifts in cropping patterns induced by the increasing fees. Most of the new crop production occurs in Benton, Douglas, Grant, and Okanogan Counties. A 65% share of the new revenue is attributed to expansion in orchards, while 4.7% is in vegetables, and 18.4% in potatoes. Under Scenario 4, we would expect some increase in value of agricultural crops as water is transferred from lower-valued to higher-vales uses. We did not estimate the magnitude of that increase.

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

Scenario	Gross Revenue	Net Revenue
1	$733.1 mil.	$43.7 mil.
2	$465.4 – 757.2 mil.	$21.9 mil.- $38.3 mil.
3	$349.6 – 779.0 mil.	$11.5 mil - $32.6 mil.
4	unknown but likely >0	unknown but likely >0
5	none	none

As additional water is allocated to irrigated agriculture, we may be interested to know how much additional value is created per acre-foot of water diverted. Under the assumptions used in our analysis, the water allocated to the Columbia Basin Project generates about $11/AF in net revenues. For the non-Columbia Basin Project water, we have built in some shifts in cropping patterns, which we found to be a realistic depiction of the likely response to fees for new water rights. For the non-CBP water, the net revenue per acre-foot is in the $59 to $69 range. Overall, the average net revenue from new water diversions to irrigated agriculture ranges from $48.05 with 1 MAF of additional water under Scenario 1 to $46.05 with 700 KAF under

Scenario 2 to $43.86 with 572 KAF under Scenario 3. The net revenue estimates treat the $10/AF and $20/AF fees as an added costs to the farmers under Scenarios 2 & 3.

Because the Municipal and Industrial (M&I) use of water is a relatively small portion of the total withdrawals from the river, and because these uses tend to have relatively high values, we assume that these uses are high priority. M&I applications represent about 28.5% of existing M&I water rights, and most of those applications are from the McNary reservoir. The population of the Tri-City area, the main population center near McNary reservoir, grew by 32% in the past 10 years. Hence, we assume that M&I water use would need to increase by 30% over the period covered by the CRI process. This amounts to 80.7 KAF, which will go to high-value uses and will facilitate the expansion of towns and food processing companies in the area where agricultural production is expected to grow. Based upon records of water transactions reviewed in Chapter 4, municipal and industrial water is valued at between 0 and $452 per acre-foot.

Each new diversion will decrease the stream flow in the Columbia River downstream of the diversion point. This reduced flow will cause a reduction in hydroelectric power production at 6 Federal and 5 Public Utility District dams on the mainstem of the Columbia River. Using a simple monthly model of irrigation and M&I water withdrawal and return flow, and assuming hydropower production rates (megawatt-hours per unit of flow) remain as in the past, we estimate that the loss of hydropower associated with an increased water withdrawal of 1 MAF will amount to $18.4 million for typical water years. In dry years (such as 1976-1977) hydropower generation rates differ, and withdrawals would include interruptible rights that are converted to non-interruptible, raising the estimated hydropower loss to $20.0 million. These hydropower losses were valued using average prices forecasted for the years 2004 – 2024 by analysts at the Northwest Power and Conservation Council. Based upon these wholesale power prices, the value of diverted water for power generation ranges from a high of $38.53/AF at Grand Coulee in a dry year to a low of $5.64/AF at John Day dam in a dry year. During dry and warm climate conditions, the prices are likely to exceed these forecasts due to water shortages and high power demand.

Flood control and river navigation are important purposes served by the Federal dams in the lower Columbia and Snake rivers. The new CRI water diversions are not expected to have any perceptible effects on flood control activities, because the diversions will occur mostly during May – August, while flood control is a major factor in river operations only during the

late winter and early spring high run-off period. Shallow draft river navigation (barging) occurs in the reservoir system from Bonneville dam to the Tri-cities area, and up the Snake River as far as Lewiston, Idaho. Barging is not expected to be significantly affected because reservoir levels are maintained to exceed levels necessary for lockage at dams even in dry years. Deep-draft navigation in the lower Columbia River below Bonneville dam is not expected to be affected by the new diversions, because the minimum flow needed to maintain the shipping channel depth (70 kcfs) will not be jeopardized by the small decreases in flow caused by a 1 MAF diversion.

Commercial and recreational fishing may be harmed by the increased diversions if the salmon and steelhead runs in the Columbia and Snake rivers are negatively affected. This would occur if mortality during downstream migration of juvenile fish, or upstream migration of adult fish, increases as flows decline. Lacking a scientific consensus on flow-mortality relationships, and considering that the National Research Council committee is evaluating the risks to salmon and steelhead, we did not attempt to quantify the possible economic loss. Instead, the report summarizes existing information about the economic values of fish caught in the commercial and recreational fisheries for Columbia River fish. Those values can be used at some point in the future to assign values to estimated changes in anadromous fish runs.

The economic impact assessment notes that when the agriculture sector expands, all related economic sectors (e.g. suppliers and food processors) will expand in unison. Further, the increased incomes by wage-earners in the expanding sectors will spur increased sales of a wide variety of consumer goods, and this will cause yet additional economic expansion in the regional economy. To assess the regional economic impacts, we first estimate the "direct impacts" which encompass the increased sales of raw and processed agricultural products. Next, we assess the full effects, considering the expanding related sectors and income-driven economic expansion of the whole economy. These economic impacts are reported in three categories: Total Output, Employment, and Value-Added. The Output impact measures the change in sales of all products, including raw materials, wholesale products, plus a retail sales "margin". This measure does not correspond to any of the standard economic indicators (e.g. a State-level equivalent to national product or national income) and is probably the least useful measure of economic impact. Employment impact is calculated from the Output impact by dividing the sales in each of 62 sectors in the State economy by a standard ratio of full-time employees per $1 million in sales. Finally, the value-added (sales minus purchases of inputs) in each sector is summed up to yield a

measure that is similar to regional income. Table E-3 displays the direct and total employment impacts and value-added impacts for each level of water diversion. To put these numbers in perspective, these impacts are relatively modest in comparison to statewide totals of $222 billion in Gross State Product in 2001 and the 3.1 million in the State workforce in 2002. Still, the impact of a 1MAF increase in water represents roughly a 20% expansion in the State's agricultural economy. These impact assessments are likely a bit on the high side because they do not incorporate the probable price-depressing effects of increased agricultural production.

Table E-3 Summary of Statewide Economic Impacts of Agricultural Expansion ($ millions)

	Employment		Value-Added	
	Direct	Total Impact	Direct	Total Impact
1 MAF	18,420	44,841	$841.2	$2,032.2
700 KAF	11,658	28,343	$531.9	$1,284.1
572 KAF	8,733	21,205	$398.2	$960.3

Beyond the market-based values of agriculture and fishing, passive use values are held by the public for all manner of economic goods, services, and conditions. Sometimes called "existence values", these represent the amount people would be willing to pay for something even if they don't plan to consume or use it. Passive use values are thought to be particularly significant for public goods that are unique and scarce. Salmon and steelhead populations in the Columbia River qualify as objects having passive use values. We reviewed economic studies that estimated values for salmon in the range of $66.28 to $268.08 per fish. The wide range of estimates reflects both variability due to the vagaries of research methods in common use and variability associated with different descriptions of the "good" to be valued (e.g. a single endangered fish run, or a basin-wide complex of species).

A different approach to assigning a value to passive use of salmon is to estimate the value the public places on various, realistic changes in the size of the anadromous fish runs, as was done by Layton, Brown, and Plummer (1999) for the Department of Ecology. While this valuation process incorporates both use and passive use values, the majority of the value estimated in the study is undoubtedly passive use value. The result is a value function, which

assigns a public value to changes in the overall fish population from the status quo level. For example, a 1/2% reduction in Columbia River anadromous fish run is estimated to cause a loss in passive use value of $7.15 million. (averaging $715 per fish). The evidence presented by that study clearly shows that passive use value held by State residents vastly exceeds the estimated commercial and recreational values of the fish, at least at recent population levels and for moderate changes in population size.

Finally, we reviewed the prospects for water markets, which are an increasingly attractive alternative to regulatory or other non-market mechanisms for resolving disputes over water use and for improving the efficiency of water use. Water markets (sometimes called water exchanges or water banks) permit willing sellers and willing buyers to transfer water, which generally shifts water from lower valued to higher valued uses. Three types of transactions can accomplish this result. Outright purchases of permanent water rights, temporary leases of diversionary water rights, and transfers of ownership of stored water (typically in a storage reservoir) all facilitate the increase in value of water use. While numerous water transfers of all types have occurred in Washington State, the expansion of water markets is slowed by three obstacles:

1. Third party effects of water transfer, due to shifts in return flows, have to be taken into consideration, possibly involving compensation or mitigation.
2. Partly due to third party impacts, the water right that can be transferred needs to be defined in terms of consumptive use, not diversionary right, and this requires documentation and measurement that may not be immediately available.
3. There is often resistance to transfer of water from a traditional use (e.g. agriculture) to another use because of impacts on local communities and cultural attachments to traditional uses.

None of these is a fatal complication, but all three issues highlight the care required in development of a water transfer institution. Washington State has made the legal changes necessary to permit water transfers. Current law requires that such transfers be submitted to the DOE for review and approval. The ability to retain water rights while temporarily transferring water use to instream flow has also been achieved in Washington. The Washington Water Trust has purchased and leased water for enhancement of instream flows in such places as Salmon Creek, a tributary of the Okanogan river. And the DOE has a water acquisition program designed to shift water from out-of-stream use to instream flow in chosen locations. All these examples

illustrate the principle that increasing transferability of water rights can, given adequate attention to the three issues listed above, work to improve economic efficiency of water use and to improve stream flows.

CONCLUSION

The Columbia River Initiative promises to encompass a number of important developments in the economy and environment of Washington's portion of the Columbia river. While considering increased diversions of water of up to 1 million acre feet, the CRI "management scenarios" also incorporate improved water efficiency and metering requirements, and they propose levying fees for new water users of $10 to $30 per acre-foot per year, with the fee level depending upon the level of threat to salmon runs. Funds from the fees would be used to mitigate the effects of water diversion on the habitat and flow conditions affecting the fish populations. The economic review shows that these increased diversions are (a) unlikely to have significant impacts on flood control or river navigation, (b) will have moderately large negative impacts on hydropower production, (c) will have very large positive impacts on the agricultural economy and on the State's regional economy, and (d) might have some negative effects on fisheries and passive use values tied to salmon and steelhead runs. To some degree, the fees proposed under the second and third management scenarios will permit the State to mitigate the effects of increased water diversion on the fish and wildlife resources. Finally, improving and facilitating the exchange of water rights among users through water markets should improve the efficiency of water use and provide opportunities to acquire water for use by fish and wildlife.

This report is limited in scope to the five Management Scenarios provided by the Department of Ecology, and it does not consider a wider range of mainstem water policies suggested by some interest groups. In addition, the scope of this research is limited to summarizing and extrapolating from existing studies. No new field data collection is incorporated in the study. The report is also limited in considering only those future changes in the economy which can reasonably be inferred from recent past information. In particular, we have not built into the analysis recent forecasts of climate trends for the Pacific Northwest. Without closer examination, it is unclear how the various economic sectors will need to adjust to predicted increases in average temperatures and earlier snow melt. Further, this report does not consider wider regional repercussions of increased water diversions in Washington State. For

example, reactions by the States of Idaho and Oregon, or by Treaty Tribes and Federal courts concerning water and fish allocations, have not been incorporated. Finally, the report is narrowly focused on a set of economic effects of the CRI program, and does not consider other potentially important social and legal ramifications of increased water use from the mainstem Columbia River.