

NATIONAL TRANSPORTATION IMPACTS & REGIONAL ECONOMIC IMPACTS CAUSED BY BREACHING LOWER SNAKE RIVER DAMS

I.A. INTRODUCTION

Pacific Northwest Waterways Association contracted with FCS GROUP to provide an independent evaluation of the transportation and infrastructure related impacts that would be caused by Lower Snake River (LSR) dam breaching and closure of four LSR locks. Study findings help define logical (likely) outcomes of LSR dam breaching from local (employment and sales), regional (transportation/freight impact) and national (transportation and infrastructure cost, air quality, safety, tax revenue) perspectives. **The methodology used in this analysis is consistent with the benefit-cost analysis guidelines prescribed by the U.S. Department of Transportation.**

Using U.S. Dept. of Transportation benefit-cost analysis guidelines, the national cost impacts may exceed \$4 billion over 30 years. This equates to a net present value of \$1.9 billion (30-year analysis at standard 7.0% annual discount rate).

This analysis indicates that \$1.1 billion in infrastructure capital investments will be required to address transportation, railroad, grain storage and local infrastructure changes that result from LSR dam breaching.

FCS GROUP senior staff conducted 14 interviews with regional farm operations, shippers, port managers and agricultural trade groups. Each interview lasted approximately 1 to 1.5 hours. In addition to these interviews, FCS also held discussions with and obtained data from Washington and Idaho state agency representatives.

List of Participating Interviews and Organizations

- Washington Association of Wheat Growers: Michelle Hennings
- Shaver Transportation: Rob Rich
- Idaho Wheat Commission: Blaine Jacobson, Jason Dumont
- Idaho Grain Producers Association: Stacey Katseanes Satterlee
- Port of Whitman County: Joe Poire, Tom Kammerzell, John E. Love, Brenda Stav
- Tidewater Transportation & Terminals: Dave Konz
- Highline Grain Growers: Paul Katovich
- Port of Clarkston: Wanda Keefer
- Port of Lewiston: Dave Doeringsfeld
- Lewis / Clark Terminal: Scott Zuger
- Lewiston / Clarkston Visitors Bureau: Michelle Peters
- Port of Pasco: Randy Hayden and Gary Ballew
- Port of Umatilla: Kim Puzey, Jason Middleton

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- Washington Grain Commission: Glen Squires, Joe Bippert

Interviewees were asked to be prepared to describe any expected impacts (qualitatively and when available with facts and figures) of LSR dam breaching in the following areas of interest:

- CRSO Study limits (direct and indirect areas)
- River navigation impacts (barging, cruise related industries, etc)
- River maintenance and operations including dredging
- Highway / roads (truck) impacts
- Rail transportation impacts
- Agricultural industry impacts
- Port impacts (staff, revenue, etc)
- Community impacts (indirect jobs, etc)
- Energy impacts
- Fishery impacts
- Biological impacts
- Impacts to water supply and river water quality regulatory compliance
- Relevant background studies
- Other impact areas or considerations

In general, interviewees expressed issues and concerns about the direct impacts of LSR dam breaching and lock closure. To the extent possible, input from the interviews has been documented and analyzed by this study.

Interviewees identified problematic issues regarding the CRSO EIS Navigation TOM map that depicts the “existing” grain elevator and rail network assumptions provided by the EIS project to date, which include thousands of miles of short-line rail track that have been abandoned and grain elevators that do not have rail loading capabilities.¹

¹ It is unclear about the amount of miles of rail inaccurately depicted on the referenced map. Glen Squires identified that over 2,000 miles of short haul rail used prior to the construction of the dams no longer existed (abandoned). In interviews that followed, others corroborated that and identified that the rail lines and elevators represented on the map were grossly inaccurate.

Section II. TRANSPORTATION-RELATED IMPACTS

The methodology used in this analysis is intended to be consistent with the benefit-cost analysis guidelines prescribed by the U.S. Department of Transportation, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, December 2018; and the *Benefit-Cost Analysis Guidance for Rail Projects*, June 2016. **Exhibit 1** describes the types of benefits included in the analysis.

Exhibit 1: Analysis Overview

Topic	Description
Current Status, Baseline Condition	Current LSR dams (4) and locks remain operational. Analysis assumes LSR commodity freight movements by barge continue at 2017 levels.
Changes to Baseline Conditions & Alternatives Analysis	Lower Snake River Dams (4) breaching alternative with closure of four locks. LSR freight flows shift primarily to rail with increases in trucking/drayage mileage. It should be noted that the amount of total public investment in dam breaching and related mitigation costs have not been determined at this time but will be included in the CRSO EIS.
Types of Impacts	Permanent impacts as measured by National freight mobility costs include changes in Economic Competitiveness expressed in terms of: truck and rail miles of travel, transportation and infrastructure facility costs, fuel costs, accident costs, and increased farm subsidies (direct federal payments). Safety and air quality impacts also evaluated.
Population Affected: Positive Impacts	Short term construction benefits to contractors from transportation and infrastructure investments required to keep commerce moving (\$1.1 B). Note, short term economic benefits are not included in this analysis as they tend to be temporary and not permanent. Unlike the costs quantified in this paper, economic benefits are expected to be re-distributional as some ports, railroads and trucking companies see trade increases at the expense of barge/tug companies, shippers (farmers), LSR ports and the federal government.
Population Affected: Negative Impacts	The following parties will be negatively impacted: regional farmers/wheat suppliers; regional residents/employees, industrial businesses; barge/tug companies; Port of Lewiston, and Port of Clarkston. Municipalities and industrial businesses that depend on Snake River wastewater effluent discharge permits, such as the cities of Lewiston (ID), Clarkston (WA) and Asotin (WA) and Clearwater Paper company (ID).
Economic Methodology	Findings are monetized in terms of: increased capital facility investments, transportation maintenance costs; truck accident costs; fuel costs, environmental air quality costs, and federal direct payments in terms of farm subsidy costs. If farm subsidies are not increased, there could be devastating economic impacts as over 1,100 farms may risk bankruptcies.

The items quantified by this analysis are described below in **Exhibit 2**.

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Exhibit 2: National and Regional Economic Development Criteria

BCA Criteria	Category	Description	Monetized in National Impact Analysis
State of Good Repair	Transportation and Infrastructure Capital Facility Costs	Project will require \$1.1 billion in investments to roadways, bridges, rail lines, grain elevators to maintain current freight movements.	Yes
State of Good Repair	Maintenance Costs	Project will increase truck and rail miles of travel and related road/rail facility and grain elevator maintenance costs.	Yes
Economic Competitiveness	Value of Travel Time	Net transportation cost impact with increased truck and rail shipments and miles of travel and decreased barge shipments and miles of travel.	Yes
	Freight Mobility and Reliability: National	Increased long-distance truck and rail operations results in fuel cost increases, energy dependence and higher truck/rail vehicle maintenance costs.	Yes
	Farm Impacts	Increased transportation and storage costs will result in need for federal direct farm payments to maintain neutral revenue. If farm subsidies are not increased, there could be devastating economic impacts as over 1,100 farms may risk bankruptcies.	Yes
	Regional Economic Development Impact	Changes in Snake River water levels will negatively impact several municipalities and industrial employers and cruise businesses.	No*
	Freight Mobility and Reliability: Local	Change in terminal usage at Ports on Snake River and Columbia River will result in redistribution of operating revenues at Ports; and change in asset values.	No
Environmental Sustainability	Air Quality Impacts: All Modes	Project will increase rail and truck vehicle emissions and reduce barge emissions.	Yes
	Emission Cost: All Models	emissions cost and reduce barge emissions cost.	Yes
Safety	Roadway Accident Cost	Project will increase truck miles of travel and result in additional accidents and related costs.	Yes
	Waterway Accident Cost	Project will result in increased sediment flows, and may reduce channel depths; thereby decreasing the likelihood tugs pushing tank barges could service the energy terminals in Pasco, WA for safety reasons.	No
	Railway Accident Cost	Project will result in additional trains through cities and sensitive areas (Columbia River Gorge National Scenic Area), thereby increasing chance for rail accidents.	No

* Regional economic development impacts have been quantified but not included in the national impact analysis findings.

II.A. STATE OF GOOD REPAIR: TRANSPORTATION

II.A.1. Existing Conditions

The Columbia/Snake River system is the largest wheat export gateway in the U.S. According to interview results, almost half of the wheat exports from west coast ports arrive by barges moving through the Columbia / Snake River system. Almost 60% of wheat exports originate from the Midwest. The rest is barged via the Columbia / Snake River system.

Taking the Snake River barging portion out of that mix will imbalance the economics and lead to higher rail rates. In 2017, over 3.5 million metric tons of commodities moved through the lower Snake River locks in the nine months when the locks were operational. As shown in **Exhibit 3**, 2,623,000 tons of outbound (mostly grain) products and 874,000 tons of inbound shipments moved through the LSR locks in 2017.

This analysis assumes that the future level of commodity shipments remains at 2017 levels. Interviews with shippers and port managers helped to ascertain the current and future expected distribution of commodity flows that move through the LSR locks to national and foreign markets.

Commodities moving through the Columbia/Snake River system currently remain on barges until they reach deep draft export ports on the west coast. The findings indicate that the current distribution of agricultural commodities moving out of the 10-county bi-state region are generally transported to deep draft export ports as follows: 90% barge and 10% rail.

Exhibit 3: LSR Freight Movements, 2017

Freight Movement Through Snake River Dams	Outbound (vessels)	Inbound (vessels)	
Tow Vessels	161	162	
Barges	773	735	
Cruise Ships/Other Vessels	223	274	
Freight Movement Through Snake River Dams	Outbound (short tons)	Inbound (short tons)	Outbound (bushels)
Grain Shipped Per Year	2,402,000	63,000	94,542,720
Other Commodities Shipped Per Year	221,000	811,000	
Total Commodity Movements	2,623,000	874,000	

* Source: U.S. Army Corps of Engineers, 2017, based on freight movement through lower Snake River locks. Bushel conversion by FCS GROUP.

II.A.2. LSR Dam Breaching Alt.: Removal of 4 Locks

With removal of the four LSR locks, there will be a shift of commodity flows as the share of goods transported by barge decreases and goods transported by truck and rail increase. **Based on interviews with shippers and port managers, this analysis assumes that the future redistribution of regional freight movements would shift to 60% rail, 30% barge and 10% truck as long as new highway, rail and grain storage facilities are constructed to handle this shift in demand.**

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These assumptions would result in increased trucking activity as drayage from shippers and grain elevators (located throughout eastern WA and northern ID) primarily to new BNSF rail terminals located in the Tri-Cities, or to new port/barge terminals that would need to be built at Columbia River ports in Oregon and Washington, such as the Port of Umatilla and Port of Morrow where new intermodal facilities would need to be added.

As shown in **Exhibit 4, the LSR dam breaching alternative is expected to require at least 201 additional unit trains and 23.8 million miles in additional trucking activity annually.**

Exhibit 4: Expected Change in Freight Movements: Outbound and Inbound

Total Combined Freight Movement Assumptions				
Economic Competitiveness Impacts				
Particulars	Existing Conditions	EIS Alt.: Removal of 4 LSR Locks	Change	Units
Freight Volume Moved (tons per year)	3,497,000	3,497,000	-	short tons
Rail volume to ocean ports	-	2,010,800	2,010,800	short tons
Barge volume to ocean ports	3,497,000	1,136,500	(2,360,500)	short tons
Truck volume (long haul)	-	349,700	349,700	short tons
Railcar Deliveries (# of train car hoppers per year)	-	20,123	20,123	train cars
Unit Train Deliveries (# of 1-way train trips per year)	-	201	201	unit trains
Barge Deliveries (# of 1-way barge trips per year)	500	162	(337)	4-barge tows
Truck Deliveries (dray trips per year to LSR terminals)	111,206	-	(111,206)	1-way trips
Truck Deliveries (dray trips per year to long haul destinations)	-	14,826	14,826	1-way trips
Truck Deliveries (dray trips per year to Tri-Cities area RR terminals)	-	85,251	85,251	1-way trips
Truck Deliveries (dray trips per year to Boardman/Umatilla ports)	-	48,184	48,184	1-way trips
Truck Miles of Travel Per Year	11,120,622	34,930,217	23,809,595	miles

II.A.2.a. Transportation and Grain Storage Capital Cost Impacts

Addressing the change in commodity movements in a safe and effective manner is expected to require up to \$1.1 billion in public and private transportation and infrastructure investments.

The loss of barge shipping on the LSR will require a shift in the movement of commodities in eastern Washington and Idaho from barge to truck or rail. A comprehensive study, *Lower Snake River Drawdown Study, Summary of Transportation Impacts*, was commissioned by the Washington State Legislative Transportation Committee and conducted by Lund Consulting, Inc. and HDR Engineering, Inc. in 1999 to evaluate the impacts created by the potential loss of LSR locks. The regional transportation impacts and mitigation costs identified in the Lund/HDR study are relevant today, since there has been no substantial highway or rail infrastructure investments made in the region since that time. The listed capital facility investments and costs (in adjusted 2019 dollars) are summarized in **Exhibit 5**.

The capital cost findings used in this study were based on our interpretation of the 1999 Washington State Legislature transportation impact study and stakeholder interview input. The transportation cost assumptions in this analysis have been adjusted to be consistent with the assumptions used in the

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Washington State Transportation Legislative Committee study; and estimates for local infrastructure costs along with a standard 20% contingency have been included.

As listed below, the existing road, bridge, rail and grain elevator systems are not sized to safely handle the required change in freight modes required without a substantial capital investment ranging from \$669,000 to \$1.1 billion (midpoint estimate \$872 million). New facilities would be required primarily along the BNSF rail network system.

No funding for these improvements has been identified at this time, and all of these improvements are considered to be national costs that would not otherwise be required if the LSR locks remain operational.

Exhibit 5 Transportation-Related Mitigation Costs

Transportation & Infrastructure Improvements Required with LSR Dam Removal (millions)							
	Low Estimate (1999 \$)	High Estimate (1999 \$)	Source Year of Figure	Escalation Factor***	Low Estimate (2019 \$)	High Estimate (2019 \$)	Midpoint Estimate (2019 \$)
Major Roads							
Bridge and Road Repair*	\$48	\$192	1999	1.6473	\$79	\$316	\$197.7
State Road Improvements*	\$84	\$101	1999	1.6473	\$138	\$166	\$152.4
Rail and local Infrastructure improvements							
Rail Facility Improvements*	\$182	\$214	1999	1.6473	\$300	\$353	\$326.2
Other Local transportation and infrastructure facility improvements**					\$40	\$60	\$50.0
Subtotal					\$557	\$895	\$726.2
Standard contingency (@20%)					\$111	\$179	\$145.2
Total Capital Cost					\$669	\$1,074	\$871.5

Notes

*Lund Consulting and HDR Engineering, 1999 study for Washington State Legislative Committee.

** Allowance based on stakeholder interviews to account for other local infrastructure (roads, water, storm, sewer, riverbanks, etc.).

***Escalation rate based on McGraw Hill Seattle ENR Construction Cost Index, 1998-2018 time frame.

The LSR dam breaching alternative is expected to require an upfront transportation and infrastructure investment of up to \$1.1 billion to keep freight moving efficiently and safely in the Pacific Northwest.

The added cost associated with dam breaching and related mitigation and dredging have not been determined at this time but will be included in the draft CRSO Environmental Impact Statement.

II.A.3. Economic Competitiveness Analysis

As discussed above, increased reliance on truck-to-rail or truck-to-barge terminal shipping is expected to result in an increase of 23.8 million miles of travel per year on county, state and federal highways.² This would increase the total truck transit times by at least 408,262 hours per year, which would require nearly 200 additional full-time truck drivers. **It should be noted that there is currently a severe shortage of truck drivers in Washington at this time (there were over 3,000 unfilled truck driving positions as of September 2019 in WA State according to the Washington Dept. of Employment Security). Hence, the ability to fill additional truck driver positions that result from LSR dam breaching is unlikely.**

The increased trucking activity will increase fuel costs, highway maintenance costs, terminal facility maintenance cost, driver time, and vehicle maintenance costs. In comparison to existing conditions, the combined increase in these costs is estimated at \$63.6 million per year, as shown in **Exhibit 6**.

Exhibit 6 Trucking Impacts

Truck Freight Assumptions	EIS Alt.:		Change
	Existing Conditions	Removal of 4 LSR Locks	
Freight Volume Moved (tons per year)	3,497,000	3,497,000	-
Truck Deliveries (# of trucks per year)	100,885	134,500	33,615
Avg. Distance of Travel (1-way miles)	-	250	250
Miles of Travel Per Year	11,120,622	34,930,217	23,809,595
Avg. Truck Speed on roadways (mph)	35	40	5
Truck Travel Time Per Year (hours)	432,363	840,625	408,262
Fuel Cost per Year	\$ 5,380,946	\$ 16,901,718	\$11,520,772
Roadway Maintenance Cost Per Year	\$ 5,096,581	\$ 16,008,519	\$10,911,938
Rail/Barge Grain Terminal Facility Access Maintenance Cost	\$ 2,000,000	\$ 10,893,359	\$8,893,359
Annual Cost of Truck Driver Travel Time	\$ 11,457,610	\$ 22,276,563	\$10,818,953
Annual Maintenance Cost of Trucks (excludes fuel & driver	\$ 10,008,560	\$ 31,437,196	\$21,428,636
Total Cost (2017 \$)	\$ 33,943,697	\$ 97,517,353	\$63,573,656

The overall impact of LSR dam breaching on economic competitiveness also includes changes in economic activity that result from increased rail freight movements and decreased barge freight activity. These two modes counterbalance each other to some extent, as ton miles shift from barge to

² Truck, rail and barge miles and labor hours are conservatively calculated as 1-way trips (shipper to receiver/terminal) and conservatively exclude return trip miles and labor time during trans-loading.

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rail. As shown in **Exhibit 7**, the shift in ton-miles from barge to rail and truck will increase fuel consumption by 4.67 million gallons per year; thereby reducing our nation’s ability to achieve energy independence.

Exhibit 7 Combined Freight Impacts

Total Combined Freight Movement Assumptions Economic Competitiveness Impacts				
Particulars	Existing Conditions	EIS Alt.: Removal of 4 LSR Locks	Change	Units
Freight Volume Moved (tons per year)	3,497,000	3,497,000	-	short tons
Truck Ton Miles Per Year	262,300,000	823,892,400	561,592,400	ton miles
Rail Ton Miles Per Year	-	522,808,000	522,808,000	ton miles
Barge Ton Miles Per Year	1,286,896,000	272,760,000	(1,014,136,000)	ton miles
Truck Fuel Used Per Year (gallons)	1,793,649	5,633,906	3,840,257	gallons
Barge Fuel (gallons)	558,549	118,385	(440,163)	gallons
Rail Fuel Used Per Year (gallons)	-	1,265,879	1,265,879	gallons
Total Fuel Used All Modes (gallons)	2,352,197	7,018,170	4,665,973	gallons

The shift in freight movements from barge to truck and rail will require additional trucking costs, as well as the transportation and infrastructure facility investments discussed above. **Interview feedback with wheat producers and farm operation managers indicate that with LSR dam breaching, the transportation/storage expense, which accounts for over 10% of total cost per bushel of wheat, will likely increase 50 to 100%. Given the current “break even” cost per bushel of \$5.00, the transportation/storage cost is now approximately \$0.40 per bushel. These costs could increase to \$0.60 to \$0.80 per bushel with LSR dam breaching.**

As shown in **Exhibit 8**, if we assume the current transportation/storage costs increase by 50% to 100%, that increase would likely result in a decline in farm net cash income by \$18.9 to \$38.8 million per year.

It is important to remember that dam breaching is expected to bring a significant rise in commodity shipping costs. Freight movement patterns would be disrupted, and efficient Snake River barge operations would be supplanted by distant trucking, rail and Columbia River barge options. To account for this, this study calculates a decline in farm net cash income of \$18.9 to \$38.8 million per year. Since current wheat prices are already near breakeven, farmers are not expected to adjust to lower levels of income without some form of subsidy.

Hence, **the federal government would likely need to increase the amount of federal direct payments by \$18.9 to \$38.8 million (\$28.4 million at midpoint) to keep farm operations at the current level of net cash income.**

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If farm subsidies are not increased, devastating economic impacts could result as over 1,100 farms may risk bankruptcies.³

It should be noted that these figures are conservative, according to input received by the Port of Whitman County, which indicated that current transportation/storage costs are now approximately \$0.55 per bushel and they could double to \$1.10 if barging was no longer an option.

Exhibit 8 Federal Direct Payments to Farmers

Annual Farmer Impacts from Lower Snake River Locks/Dams Breaching		
	Amount	Unit
Annual Farm Shipments via LSR Locks, 2017 ¹	94,542,720	bushels
Current Breakeven Grain Price ²	\$5.00	per bushel
Current Transport/Storage Cost ²	\$0.40	8.0%
Expected Transport/Storage Cost		
Sensitivity Analysis		
@50% cost increase	\$0.20	per bushel
@75% cost increase	\$0.30	per bushel
@100% cost increase	\$0.40	per bushel
Required Change in Federal Direct Payments: Neutral Impact		
@50% cost increase	\$18,908,544	annual
@75% cost increase	\$28,362,816	annual
@100% cost increase	\$37,817,088	annual
Notes		
¹ Derived from U.S. Army Corps.of Engineers, Freight Movement statistics, 2017.		
² Estimates based on interviews with regional wheat producers/shippers.		

II.A.4. Safety Impacts

Replacing safe and most efficient barge trips with truck and train trips will increase accidents and related safety costs.

³ According to the U.S. Census of Agriculture, the average net farm cash income for regional farm operations was only \$42,823 in 2017. Wheat farm net cash income is even lower than this amount today, and shifting to higher value crops is not viewed as a viable option by interviewees.

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As previously mentioned, the LSR dam breaching alternative is expected to result in an increase of 23.8 million miles of truck travel annually as drayage distances increase between shippers and receivers. This will in turn increase the number of traffic accidents and related safety costs. Using accident frequency and injury/fatality probability statistics from the National Highway Traffic Safety Administration (NHTSA⁴), LSR dam breaching will result in an increase in the number of truck accidents involving injuries, and as well as the number of fatalities.

As shown in **Exhibit 9**, this would result in a national annual average cost impact of **\$5.9 million**, including \$3.3 million for injuries and \$2.6 million for fatalities, as seen in **Exhibit 9**.

Based on the increase in truck miles of travel, these findings indicate that closure of the LSR locks would result in about 1 additional traffic fatality every 3 years.

While increased movement of freight trains of an additional 1 to 2 unit trains per day (primarily along the BNSF line in Washington) will enhance the probability of train related incidents and fatalities, the cost of train safety incidents has not been included in this study.

Exhibit 9

Truck Freight Movement Analysis (2017 \$)*

Truck Safety Impacts

Assumptions	Existing Conditions	EIS Alt.: Removal of 4 LSR Locks	Change
Truck Miles of Travel Per Year	11,120,622	34,930,217	23,809,595
Truck Accidents resulting in injuries per year	8.8	27.6	18.81
Truck Accidents resulting in fatalities per year	0.1	0.4	0.27
Truck Accident Costs: Injuries	\$1,537,088	\$4,828,041	\$3,290,953
Truck Accident Costs: Fatalities	\$1,206,365	\$3,789,230	\$2,582,865
Total Accident Costs	\$2,743,453	\$8,617,271	\$5,873,818

II.A.5. Environmental Sustainability Impacts

Environmental emission factors for trucking, barging and rail freight activity are from the U.S. Environmental Protection Agency, U.S. Maritime Administration, and the Texas Transportation Institute. The emission types quantified include carbon dioxide (CO₂) as well as volatile organic compounds (VOCs), nitrogen oxide (NO_x), and particulate matter (PM). Grams per ton-mile are then converted into short tons (907,185 grams per short ton). The emissions are monetized using damage costs for pollutants from Table A-6 of the U.S. Department of Transportation, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*.

⁴ Accident rate from National Highway Traffic Safety Administration, "Traffic Safety Facts, Large Trucks, 2012 Data.

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Exhibit 10 indicates that **shifting commodity flows from barge to truck and rail will result in annual increases emissions, as follows:**

CO ₂ , +860,000 tons	NO _x , +306.5 tons	PM, +7.5 tons
CO, +69.7 tons	VOC, +7 tons	

This annual CO₂ increase is equivalent to the environmental impact of:

- **Adding 90,365 standard size homes**
- **Adding 181,889 passenger cars**
- **Removing 6,927 acres through deforestation**
- **The cumulative emissions of the Boardman coal-fired power plant every 5-6 years**
(according to Environment Oregon, the Boardman plant generates 4.6 million tons of CO₂ annually)

The economic and social cost of the overall increase in emissions is expected to have a national cost that exceeds \$7.1 million per year.

It should also be noted that these costs conservatively exclude the temporary traffic, safety and air quality impacts generated by construction trips that would be required to deliver labor and materials for facility improvements.

Exhibit 10 Environmental Cost Impact

**Total Combined Freight Movement Assumptions
Environmental Impacts**

Assumptions	Existing Conditions	EIS Alt.: Removal of 4 LSR Locks	Change
Truck Ton Miles	262,300,000	823,892,400	561,592,400
Rail Ton Miles	-	522,808,000	522,808,000
Barge Ton Miles	1,286,896,000	272,760,000	(1,014,136,000)
Net Total Emissions			
Annual Emissions (short tons)			
Carbon Dioxide (CO ₂)	507,858	1,363,302	855,445
Carbon Monoxide (CO)	105	175	69.7
Volatile Organic Compounds (VOCs)	30	37	6.9
Nitrogen Oxide (NO _x)	877	1,183	305.8
Particulate Matter (PM)	22	29	7.5
Economic Value of Emissions			
Carbon Dioxide (CO ₂)	1,015,716	2,726,605	\$1,710,889
Carbon Monoxide (CO)			
Volatile Organic Compounds (VOCs)	60,846	74,700	\$13,854
Nitrogen Oxide (NO _x)	7,279,527	9,817,707	\$2,538,180
Particulate Matter (PM)	8,204,488	11,027,556	\$2,823,068
Total	\$16,560,577	\$23,646,568	\$7,085,991

II.B. SUMMARY OF NATIONAL IMPACTS

As summarized in **Exhibit 11**, based on the draft findings and assumptions contained in this paper, the national costs associated with the LSR dams breaching alternative is expected to be on the order of nearly \$155 million per year (30-year analysis). These costs reflect the assumptions generated during this research and are presented in non-discounted dollars.

Using federal guidelines, after accounting for the remaining residual life (value) of transportation capital investments in year 30, the net present value of these national costs at a standard 7% discount rate equates to \$1.9 billion, and the non-discounted cost would exceed \$4 billion.

These findings are intended to represent a conservative estimate based on year 2017 freight movements. This excludes additional costs associated with the following:

- Construction cost of dam breaching and related access changes;
- Truck and rail costs associated with return trips and layover times;
- Increased river dredging costs;
- Rail safety/accident costs;
- Replacement of hydropower capacity and transmission facilities;
- Water supply and wastewater discharge facility costs that are incurred with river drawdown. Specifically, municipal and industrial mitigation costs to cities of Clarkston, Lewiston, Asotin, and Clearwater Paper).
- Irrigation water impacts;
- Loss of revenues at the ports of Lewiston and Clarkston
- Regional (non- agricultural) economic development dislocation costs

Please refer to Section II for a discussion of regional economic impacts.

It is recommended that additional sensitivity analyses be conducted once more detailed cost assumptions are available.

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Exhibit 11 Summary of National Transportation-Related Impacts

	Amount	Source Note
Outbound Commodity Freight through LSR locks, 2017 (short tons)	2,623,000	1
Inbound Commodity Freight through LSR locks, 2017 (short tons)	874,000	1
Economic Competitiveness, Change of Freight Movements		
Annual Change over No Build (no discount rate)		
Change in Barge Miles	(144,877)	2
Change in Rail Miles	52,319	2
Change in Truck Miles	23,809,595	2
Change in Barge Ton-Miles	(1,014,136,000)	2
Change in Rail Ton-Miles	522,808,000	2
Change in Truck Ton-Miles	561,592,400	2
Net Change in Fuel Required (gallons)	4,665,973	2
Capital & Maintenance Investment (annual average)		
Annualized Capital Cost of Transportation	(\$31,491,706)	3
Annualized Capital Cost of Rail/Barge Terminals	(\$23,000,768)	3
Annualized Capital Cost of Local Infrastructure	(\$3,914,736)	3
Net Annual Change in Fuel Costs (@\$3 per gallon)	(\$13,997,919)	2
Net Annual Barge/Rail Terminal Maint. & Replacement Reserve	(\$8,893,359)	2
Net Annual Truck Maintenance Cost	(\$21,428,636)	2
Net Annual Highway Maintenance Cost & Replacement Reserve	(\$10,911,938)	2
Safety Impacts (annual average)		
Change in Truck Accident costs (injuries)	(\$3,290,953)	2
Change in Truck Accidents costs (fatalities)	(\$2,582,865)	2
Net Environmental Impacts, Annual Emissions (tons)		
Carbon Dioxide (CO ₂)	855,445	2
Carbon Monoxide (CO)	70	2
Volatile Organic Compounds (VOC)	7	2
Nitrogen Oxide (NOx)	306	2
Particulate Matter (PM)	7	2
Net Environmental Impacts, Annual Cost of Emissions		
Carbon Dioxide (CO ₂)	(\$1,710,889)	2
Volatile Organic Compounds (VOC)	(\$13,854)	2
Nitrogen Oxide (NOx)	(\$2,538,180)	2
Particulate Matter (PM)	(\$2,823,068)	2
Net Change in Federal Direct Payments to farmers		
Annual direct payment to farmers (to achieve neutral profit condition)	(\$28,362,816)	5
Summary of Cost Impacts, Annual Cost		
Transportation & Infrastructure Capital Cost	(\$58,407,211)	4
Transportation & Infrastructure Maintenance Cost	(\$19,805,296)	
Transportation Fuel Cost	(\$13,997,919)	
Truck Maintenance Cost	(\$21,428,636)	
Truck Safety Impact Cost	(\$5,873,818)	
Environmental Air Quality Cost	(\$7,085,991)	
Net Change in Annual Farm Impacts (Federal Direct Payments)	(\$28,362,816)	5
Summary of Annual Impacts (Costs)	(\$154,961,686)	
Residual Value of Transportation & Infrastructure Investments in Year 30	\$519,114,034	6
NPV of 30-year Impacts (no discount rate)	(\$4,100,000,000)	rounded
NPV of 30-year Impacts (w/ @7% annual discount rate)	(\$1,900,000,000)	rounded

Notes to table

- 1) Reflects 2017 freight volume through Lower Snake River locks, U.S. Army Corps. of Engineers.
- 2) Based on assumptions consistent with U.S. Dept. of Transportation, Benefit Cost Analysis Guidance for Discretionary Grant Projects, Office of the Secretary, Dec. 2018, and U.S. Dept. of Transportation, Benefit-Cost Analysis Guidance for Rail Projects, June 2016.
- 3) Based on capital improvement cost estimates for transportation, bridges, rail and local roads/infrastructure.
- 4) Upper end estimates included in table; excludes unknown net costs associated with breaching four LSR dams, power supply/transmission impacts, and any related regional economic development/dislocation costs.
- 5) Assumes midpoint of expected increase in shipping/transportation cost to farmers in 10-county region.
- 6) Assumes 60-year life cycle for major transportation/rail investments and 40-year life cycle for local infrastructure investments.

Section III. REGIONAL ECONOMIC IMPACTS

III.A. REGIONAL MARKET ANALYSIS

For the purposes of this work, the primary regional market area that would be directly impacted by the LSR breaching alternative is defined as ten counties that are generally within a two-hour drive of the ports of Lewiston and Clarkston, five of which are in Washington, and five in Idaho. These counties are primarily rural agricultural areas that depend heavily upon the LSR locks and barge transportation systems for the movement of wheat, fuel and other bulk products. They include:

Idaho:

- Latah County
- Clearwater County
- Nez Perce County
- Lewis County
- Idaho County

Washington:

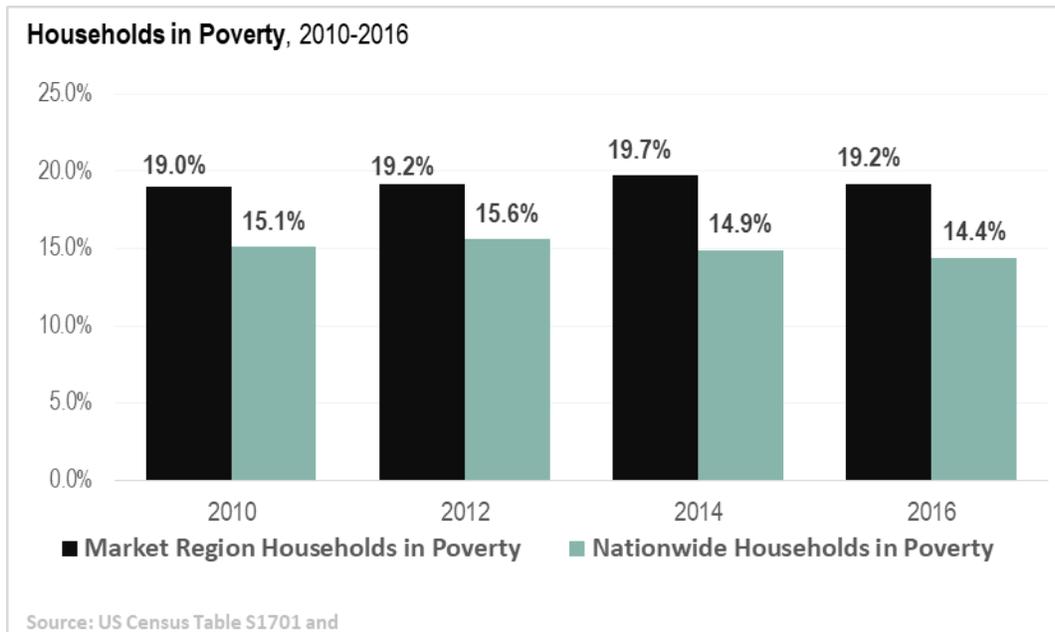
- Adams County
- Asotin County
- Garfield County
- Columbia County
- Whitman County

III.A.1. Social Justice Considerations

Since 2010, the regional market area has experienced slower population growth than the statewide averages in Idaho and Washington. **The market region population increased by an average annual rate of 0.2% since 2010 to 202,852 people** in 2017. Comparatively, the state of Idaho grew at 0.8% annually and Washington grew by 0.9% annually.

Nearly 1 in 5 people in the market region are at or below the federal poverty level. As reflected in **Exhibit 12**, between 2010 and 2016, the number of households meeting Federal Poverty Level (FPL) thresholds remained above 19% within the Regional Market Area in comparison to 14.4% nationally (as of 2016).

Exhibit 12



III.A.2. Major Economic Sectors

Measures of employment, average wage and location quotient (LQ)⁵ shown in **Exhibit 13** indicate that the economy of the market area is centered on agriculture, government and manufacturing employment and earnings. Tourism is reported to be an emerging sector in the region, which has been buoyed by the cruise ship and recreational activity on the Snake River.

Average wages in the region were \$40,211 or about 25% below the national average in 2017.

The LSR dam breaching alternative could have a negative regional economic impact on agriculture (if federal direct payments do not increase as described in the prior section) and potential negative impacts on manufacturing, transportation, warehousing and visitation businesses that are physically or functionally related to LSR freight movements and river access.

⁵ Location quotients (LQ) reflect the Regional employment for each cluster/sector divided by the share of National employment in the same cluster/sector. For example, an LQ of 7.0 for agriculture indicates that the share of Regional employment in agriculture is seven times the national average.

Exhibit 13 Employment Characteristics, Regional Market Area, 2017

Cluster	Employment	Average Wage	LQ
Agriculture	9,580	\$22,437	7.0
Government	26,776	\$61,708	2.2
Manufacturing	10,717	\$67,823	1.2
Retail Trade	10,324	\$26,388	1.2
Accommodation & Food Services	8,032	\$18,335	1.1
Health & Social Services	10,812	\$43,101	1.0
Other Services	4,561	\$20,291	0.8
Transportation & Warehousing	3,851	\$36,143	0.8
Wholesale Trade	2,657	\$54,902	0.7
Professional Business Services	16,162	\$26,632	0.5
Arts, Entertainment & Recreation	1,904	\$8,974	0.5
Educational Services	873	\$13,217	0.2
Total	111,947	\$40,211	1.0

Source: FCS GROUP IMPLAN Modeling Analysis

III.A.3. Wheat Exports

The Regional Market Area includes 1,139 farm operations with nearly 4.6 million acres, according to the U.S. Census of Agriculture, 2017. **After expenses, the net cash income for farms reporting receipts averaged only \$42,823 per farm operation in 2017.**

Agricultural exports (primarily wheat) shipped from the Snake River to ocean ports accounted for \$472.7 million in sales and 1,346 direct jobs in 2017. Indirect and induced impacts (supply chain and spending benefits which stem from the direct sales and jobs) accounted for 2,635 secondary jobs and generated a combined \$205.8 million in annual gross domestic product (GDP).⁶

The total economic output attributed to value of wheat exports moving through the Snake River generate nearly for \$29.3 million in federal tax revenues annually from direct and secondary businesses.

Interview input noted that this level of economic activity in agriculture is at risk of bankruptcies and severe reductions, especially if federal direct payments are not increased to enable farms to achieve revenue neutrality.

⁶ The term GDP and value added are used interchangeable in this paper. They both include the aggregate level of payroll wages, tax payments, proprietor income, and business profits attributed to existing worker establishments.

Exhibit 14 At-Risk Agriculture-related Economic Activity, Regional Market Area, 2017

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	1,346	\$61,847,732	\$34,321,204	\$472,713,599
Indirect Effect	1,975	\$87,179,273	\$124,404,579	\$212,080,613
Induced Effect	660	\$24,308,959	\$47,042,549	\$84,818,528
Total Effect	3,981	\$173,335,965	\$205,768,332	\$769,612,740

Source: FCS GROUP IMPLAN model analysis for LSR Region.

III.A.4. Affected Businesses

Interview feedback indicated that the LSR dam breaching alternative would result in significant reductions to river levels which will have a negative impact on specific business establishments, especially industrial employers and cruise ship operations in the Lewiston/Clarkston area. Concerns range from the inability to ship finished products from manufacturing firms through existing port terminals, to mitigation cost of wastewater outfalls; and new investments in water intakes, filtration and pumping/transmission systems.

Input provided by the Port of Clarkston identifies six potential businesses and cruise ship operations which directly employ a combined 3,042 workers. These businesses would be adversely impacted by LSR dam breaching, and include paper manufacturing, munition manufacturing, water transportation, lumber mill, wholesale trade and cruise operations.

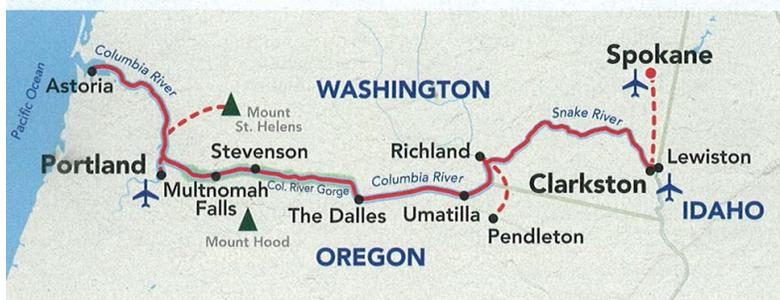
These directly affected businesses support 6,811 total jobs and generate \$625.7 million in combined annual GDP. A subset of GDP includes \$65.5 million in state and local & state tax payments and \$86.6 million in annual Federal tax payments (**Exhibit 15**).

Exhibit 15 Directly Affected Business Related Economic Activity, Regional Market Area, 2017

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	3,042	\$211,384,737	\$336,705,019	\$1,528,170,411
Indirect Effect	2,338	\$113,063,161	\$187,077,163	\$383,481,102
Induced Effect	1,431	\$52,829,021	\$101,963,848	\$184,019,640
Total Effect	6,811	\$377,276,919	\$625,746,029	\$2,095,671,153
State and Local Taxes				\$65,495,135
Federal Taxes				\$86,595,482

Source: Port of Clarkston input regarding direct impacts; IMPLAN model for Regional Market Area, 2017.

The cruise ship industry is now an important component of the local economy. Over \$3 million in annual GDP spending and 70+ jobs would be lost if LSR dams are breached. According to the Port of Lewiston, cruise companies are building new ships to come up the Columbia/Snake river system; with 4 new boats built over the past few years. The industry is growing rapidly and currently serves around 17,000 passengers annually, with the majority being aging baby boomers, senior citizens and their friends and families (**Exhibit 16**).



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The full extent of potential business impacts from LSR dam breaching is unknown. Hence, this analysis is intended to represent a subset of existing businesses and their associated economic benefits to the community. This analysis does not contain a full list of businesses that may be impacted within Washington and Idaho.

III.A.5. Affected Communities

At least three cities (Clarkston, Lewiston and Asotin), regional counties and major industrial businesses (such as Clearwater Paper) have permits for treatment and discharge of wastewater into the river. As observed in the 1992 drawdown experiment (**Exhibit 17**), existing wastewater infrastructure is likely to be damaged or rendered useless if the river level drops. This will require significant infrastructure investments that are unknown at this time. Analysis of the economic contributions of three cities was performed for the Regional Market Area.

- **City of Clarkston:** Clarkston, a city with a population of 7,344 would be impacted by increases in wastewater effluent discharge mitigation costs and reduction in port-related industrial and tourism activity. The economy of Clarkston includes 4,490 workers, and is attributed with generating nearly \$250 million in annual GDP.
- **City of Lewiston:** Lewiston, by far the largest potentially impacted city, has a population of 32,482. Lewiston's economic base includes 18,594 jobs with the largest industries including health care and manufacturing. Those jobs generate over \$1.2 billion in gross domestic product.
- **City of Asotin:** Asotin, a city with a population of 1,226 is also at risk of significant infrastructure damage and mitigation costs in the event of a drawdown. Asotin's economy includes 420 jobs and generates nearly \$25 million in annual GDP.

The business activity supported within these three affected cities accounted for nearly \$1.5 billion in annual GDP in 2017. Note, this analysis is conservative since many other communities and counties in WA and Idaho will also be impacted.

III.B. OTHER IMPACTS

Several interviewees indicated that the impact of the river drawdown would have impacts on other local infrastructure such as roadways, public docks, outfalls, stormwater infrastructure and various public and private capital investments, as well as land values. These local costs would have significant economic impacts to local and state governments and the nation.

While other communities and agricultural operations will likely be impacted by lower Snake River levels and lower water tables, these additional costs are unknown at this time and have been conservatively excluded from this study.

Exhibit 17 Photographs from 1992 Snake River Drawdown (credit: Port of Lewiston)



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- Washington Department of Employment Security, statistics on occupational job openings.

List of Participating Interviews and Organizations

- Washington Association of Wheat Growers: Michelle Hennings
- Shaver Transportation: Rob Rich
- Idaho Wheat Commission: Blaine Jacobsen, Jason Dumont
- Idaho Grain Producers Association: Stacey Katseanes Satterlee
- Port of Whitman County: Joe Poire, Tom Kammerzell, John E. Love, Brenda Stav
- Tidewater Transportation & Terminals: Dave Konz
- Highline Grain Growers: Paul Katovich
- Port of Clarkston: Wanda Keefer
- Port of Lewiston: Dave Doeringsfeld
- Lewis / Clark Terminal: Scott Zuger
- Lewiston / Clarkston Visitors Bureau: Michelle Peters
- Port of Pasco: Randy Hayden and Garg Ballew
- Port of Umatilla: Kim Puzey, Jason Middleton
- Washington Grain Commission: Glen Squires, Joe Bippert
- Idaho Department of Environmental Quality

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