

Lower Snake River Dam Navigation Study

September 30, 2015

**Rocky Mountain Econometrics
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Preface

Rocky Mountain Econometrics (RME) has been actively analyzing Northwest energy and Lower Snake River Dam (LSRD) issues since 1985. In the 1980s and 1990s, the author was the staff economist for the Idaho Public Utilities Commission.

In 1998 Governor Kempthorne, and later, Governor Batt, contracted with RME to monitor the Army Corp of Engineers' (ACOE) development of the *Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement* (FREIS)¹ and the potential breaching of the four Lower Snake River Dams in Washington State. In that capacity RME documented for Idaho's elected leaders the conclusions, errors and omissions in the ACOE's analysis.

In 2002 Northwest Resource Information Center and RME published, *"Idaho Economic Effects of Breaching/Not Breaching the Army Corps of Engineers' Snake River Dams in S.E. Washington."* That document details that much of the ACOE's findings in the FREIS were flawed and that the best economic alternative was to decommission the LSRD.

In early 2015 *Save Our wild Salmon* asked RME to once again bring its expertise to the subject and revisit the FREIS for the purpose of reviewing the status and future of navigation on the Snake River from Lewiston, Idaho, to the McNary pool in Washington State.

The following pages present the context in which the four Lower Snake River Dams in Washington State currently operate to maintain slack water for barge traffic from Pasco, Washington to Lewiston, Idaho. The following pages also detail the degree to which the federal government, via the ongoing actions of the United States Army Corps of Engineers' maintenance of the dams, together with the Bonneville Power Administration's spending on fish and wildlife mitigation, subsidize barge shipments far in excess of what it would cost to ship commodities via other modes of transportation.

¹ US Army Corps of Engineers, Walla Walla District, "Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement" (FREIS), 1999.

List of Acronyms

Bonneville Power Administration	BPA
Columbia River Basin, Fish and Wildlife Program	CRBFW
Lower Snake River	LSR
Lower Snake River Dams	LSRD
Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement	FREIS
Northern Santa Fe	BNSF
Port of Lewiston	POL
Port of Portland	POP
Rocky Mountain Econometrics	RME
The Northwest Power and Conservation Council	The Council
Union Pacific	UP
US Army Corps of Engineers	COE or ACOE
Washington State Department of Transportation	WSDOT

Executive Summary

Container-on-Barge shipping on the Columbia – Snake Rivers has ended. Petroleum shipments to Lewiston are less than 5 percent of their historic levels. Lumber, which now means wood chips, is at one-quarter of its historic level. Shipments of wheat and barley, then and now the major commodities shipped on the Lower Snake River, are running at two-thirds of their pre-2000 levels and may be headed lower.

The loss of containers can be blamed on the container ships abandoning the Port of Portland. A pipeline to Spokane made petroleum barges on the Snake all but obsolete. Lumber/wood products/wood chips was never a major player but it too has decreased by three-fourths of its historic level. Wheat and barley shipping is being lured away by a combination of renewed interest and competitive tariffs on the part of the rail lines. Unit trains are now the standard.

The loss of containers directly impacts the Port of Lewiston and indirectly affects the farmers shipping pulse. So too, the loss of petroleum shipments is primarily a loss to the Lewiston area. The remaining fertilizer traffic, for as long as it lasts, continues to go to primarily to Central Ferry. Wood chips traffic will continue to run out of the Lewiston area for as long as navigation remains.

Wheat and barley is more broadly distributed along the length of the river with about 40 percent accessing barges in the Lower Granite pool and another 40 percent beginning their journey in the Little Goose reservoir, the next reservoir downstream. Of the remaining 20 percent of wheat and barley about 6 percent accesses the navigation channel in the Lower Monumental pool with the remaining 17 percent accessing barges in the Ice Harbor pools. The reductions in the volume of shipped wheat and barley is similarly spread over the length of the Lower Snake River.

While barges once had a five-cent per ton-mile advantage over rail, the bonus, adjusted for inflation, has been cut by more than half. Factor in rail's flexibility to go to alternate destinations, along with the navigation channel's lack of reliability, and it is easy to see why grain shippers are increasingly opting to use rail instead of navigation.

Since the year 2000 the benefit of shipping by barge out of the lower Snake River basin has plummeted from about \$19.4 million per year to about \$7.6 million in 2014.

While the benefit of navigation has been waning, the cost of maintaining the dams and mitigating their impacts has been soaring. Total direct costs of keeping the LSRDs functioning are now about \$227 million per year and increasing about 4.5 percent annually. Maintaining the navigation portion alone now costs around \$18

million per year. The Benefit-to-Cost Ratio of navigation on the Snake is now at a shutdown level of .43:1, and that doesn't include the cost of mitigating the LSRD's adverse fish and wildlife impacts.

As navigation benefits continue to decline, the costs to maintain the channel, both in terms of direct costs and mitigation costs, continue to increase faster than inflation.

Navigation related costs of the LSRD are well in excess of navigation related benefits.

The \$7.6 million benefit of navigation is now dwarfed by the \$24+ million it costs to maintain and mitigate the channel.

Lower Snake River Navigation Review and Freight Forecasts

It is far from clear what constitutes the “right stuff” of economic development. Looking at leading cities around the country and nation would seem to suggest that a seaport is a prime ingredient. New York, San Francisco, Chicago, Seattle, Tokyo, Vancouver, BC., all thrive, at least in part, because of their ports. Intuitively, cheap energy also seems like a desirable ingredient, along with cheap land and labor.

Idaho in general and Lewiston in particular already had the cheap energy, land, and labor, so when the COE planned and built sufficient dams and locks to qualify Lewiston, Idaho, as a seaport, 465 river miles inland from the nearest ocean, hopes and expectations were high. Boom times, many thought, were sure to follow.

But that isn’t exactly how things played out.

It was the completion of Lower Granite Dam and Lock in 1975 that allowed barge traffic access to Lewiston. If said barge transportation were to be Lewiston’s hoped for economic springboard, it does not show up in the history of Lewiston’s population growth. In fact, all of Lewiston’s major growth spurts occurred prior to Lewiston’s achievement of port status.

Since the completion of Lower Granite Dam, the final project that allowed barge traffic to reach Lewiston, population growth has averaged less than one percent per year and has never exceeded ten percent over any ten-year period.

Table 1**Lewiston Population History**

Census	Pop.	%±
1880	739	—
1890	849	15%
1900	2,425	186%
1910	6,043	149%
1920	6,574	9%
1930	9,403	43%
1940	10,548	12%
1950	12,985	23%
1960	12,691	-2%
1970	26,068	105% ²
1980	27,986	7%
1990	28,082	0%
2000	30,904	10%
2010	31,894	3%

Lewiston is one of Idaho's major cities. It is the second-largest city in northern Idaho, behind Coeur d'Alene, and ninth largest in the state. While Lewiston continues to grow, RME considers this growth modest at best. While other Idaho cities have found some success courting high-tech and tourism, Lewiston and the surrounding area followed a track more consistent with agriculture, timber, and mining products.

Traditional industries are typically more stable, but they also tend to be slower growth. Since 1980 Idaho's population has grown by about two-thirds, from 944,000 to about 1.6 million in 2010. Over the same period, Lewiston's population only grew by about fourteen percent, from 27,986 to 31,894.

Table 2 – Population, Idaho and Lewiston

Year / Change	1980	2010	Increase
Idaho	943,935	1,567,582	(66%)
Lewiston	27,986	31,894	(14%)

² The bulk of the 105% growth from 1960 to 1970 was the result of Lewiston's annexation of neighboring Lewiston Orchards.

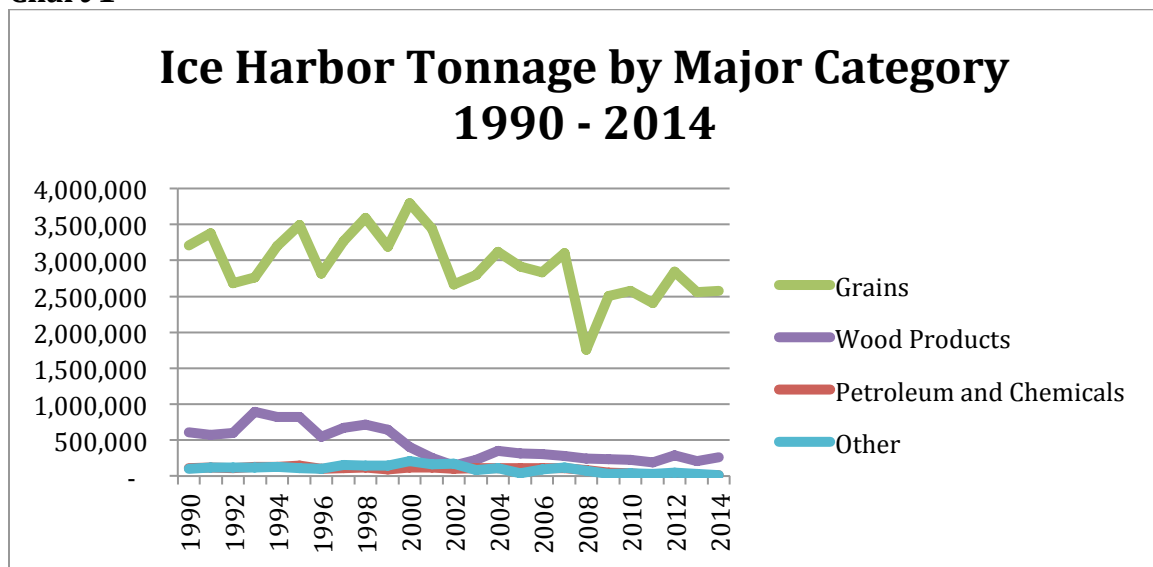
This is not to say that Lewiston companies did not try to take advantage of the navigation potential provided by the dams. They did.

Civic leaders, and the COE, expected the Lewiston area economy to get a major boost from low cost barge transportation in four general freight categories:

Lumber/Fiber/Chips
Barley-Wheat
Containers
Petroleum and Chemicals

Four following subsections look at how the Palouse area in general, Lewiston in particular, and shipping related to these four categories have progressed and will likely fare in the future.

Chart 1



Lumber / Fiber / Chips

One can't say Lumber / Fiber in Lewiston without saying Potlatch / Columbia Paper, one of northern Idaho's largest employers. Potlatch was an early and major proponent of navigation on the LSR. Potlatch also committed substantial resources consistent with including LSR navigation into its future operating plans.

Potlatch developed hybrid poplar plantations downstream near Hermiston, Oregon. The idea was to produce wood fiber in a manner that saved manpower by automating the tree harvesting process. The felled trees would then be transported by barge upriver to Potlatch's Lewiston plant where they would be processed into paper and pulp. The paper and or pulp would then be barged down river as finished products or for further processing by paper producers downstream.

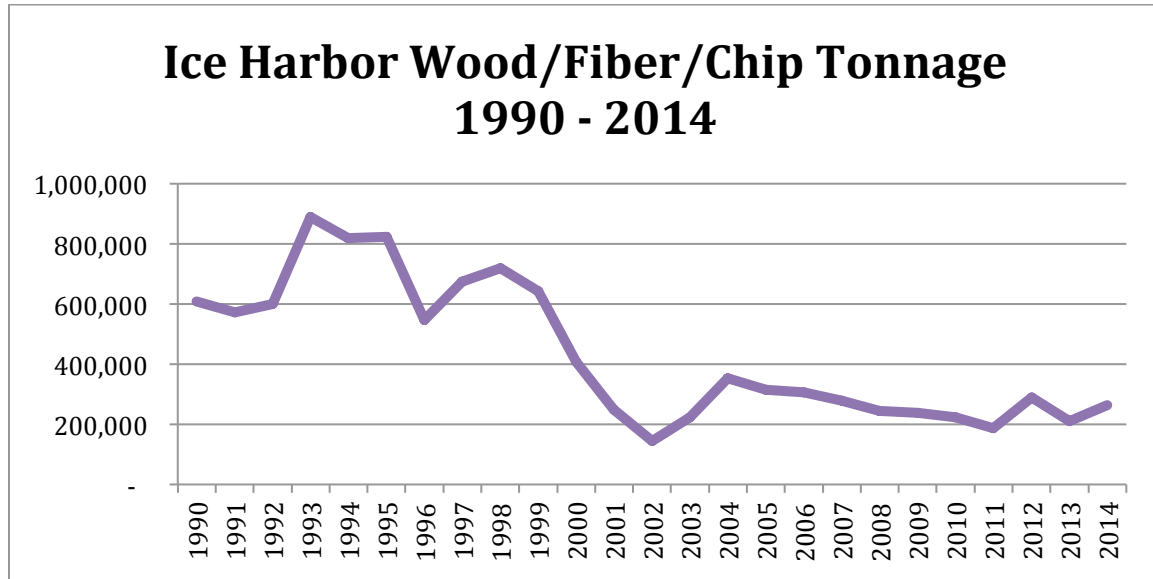
For reasons best known to the company, Potlatch terminated this process. They sold the plantations, and the timber grown there is now grown in a manner better suited to structural purposes. The upstream barge shipments of timber were eliminated.

Potlatch further distanced itself from barge transportation with the development of a packaging plant in Las Vegas, Nevada. The impossibility of shipping bulk paper from Lewiston to Las Vegas by barge put an end to a large portion of the container traffic originating in Lewiston.

Wood products continue to be shipped on the LSR, but this category of freight is now almost exclusively in the form of wood chips and the tonnage is a small shadow of its former value. The tonnage of wood products moving through the Ice Harbor lock peaked at 890,000 tons in 1993. Except for brief partial rebounds, volumes have been declining ever since. The low point occurred in 2002 with 144,000 tons, only 16 percent of the 1993 peak. Tonnage in 2015, now almost exclusively wood chips, was a little higher at 231,000 tons, 26 percent of the 1993 peak.

The average for the past five years was 236,000 tons. While that number looks reasonably firm for the future, there being no sign it will go away, there is also little or no sign the number will increase.

Chart 2



The trend for the past four years has been up slightly, but a major rebound seems unlikely. The ultimate volume is limited by the sustainable rate of harvest from a relatively fixed acreage of forest. Tree harvest may vary from year to year, but the long-term annual harvest potential is fairly constant. If anything, the long-term annual tree growth is likely to decline as climate change progresses. Also, as this is being written, fires are playing havoc in northern Idaho. When winter comes and stock is taken, it is possible that lumber harvest will see substantial reductions for decades to come.

Container Traffic

In 2002 the COE included in the DREW report a study commissioned by the State of Oregon and Port of Portland entitled “Breaching the Lower Snake Dams: Transportation Impacts in Oregon (HDR Engineering, Inc., 2000)”. One of the key findings of this study was:

- Four of the six ocean carriers currently calling in Portland might stop if containers could no longer be shipped on the lower Snake River. Two are considered “likely” to stop calling; two others are considered “vulnerable.”

There isn’t much loyalty in the business world. Subsequent to the DREW report Potlatch Corp., of its own volition, decreased its reliance on river navigation for both raw materials and finished products. It seems unlikely that Potlatch’s reduction in container shipments was the cause of the Port of Portland’s container ills, but it didn’t help.

Containers originating in Lewiston never exceeded ten percent of Portland’s container exports and in the most recent decade were more commonly 5% or less. Regardless, at the downstream end of the navigation channel four of the six ocean carriers serving Portland had stopped calling on the port by the beginning of 2015.

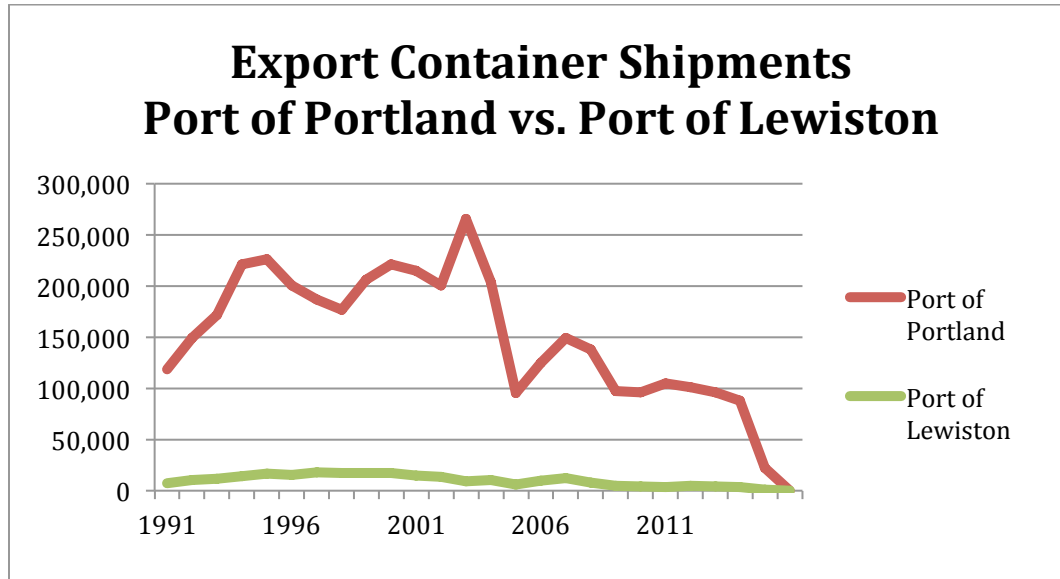
The two remaining major container carriers ended their Portland service in the spring of 2015. Hanjin Shipping Co., citing labor problems, pulled out of Portland in February, eliminating nearly 80 percent of the Port of Portland’s remaining export container business.³

The last container carrier of note, Hapag-Lloyd, notified its Pacific Northwest customers on April 7, 2015, that it had ended its service to Portland because of “schedule integrity” problems. Combined with the departure of Hanjin Shipping Co., Portland has lost 99 percent of its container business as of March 2015.⁴

³ http://www.oregonlive.com/business/index.ssf/2015/04/port_of_portland_container_ter_3.html

⁴ http://www.joc.com/port-news/us-ports/port-portland-ore/hapag-lloyd%E2%80%99s-portland-exit-decimates-port%E2%80%99s-container-business_20150408.html

Chart 3



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Shipping companies are doing plenty of finger pointing justifying their decisions. Hanjin cites labor problems. Hapag-Lloyd cites schedule integrity. Street rumors point to the danger of moving ever-bigger ships over the Columbia Bar and through the treacherous currents of the Columbia for 90+ miles up-stream to Portland as a major contributing factor.

The biggest factor may have been that container exports from the Port of Portland peaked in the year 2003, twelve years ago, and have been steadily declining ever since. Container traffic out of POP may have simply declined to the point where a major freight line could no longer break even on the costs of sending a state of the art ship that far up the Columbia for the dwindling amounts of cargo.

While containers had been on the decline for nearly two decades down the Snake to Portland, it was the loss of service by the two remaining major freighters, Hanjin and Hapag-Lloyd, that put the last nail in the coffin.

“The loss of service suspended all container on barge service on the Columbia-Snake River System”.⁷

Unless the Port of Portland is successful in finding a replacement freight company equal to or larger than Hanjin, and soon, it is reasonable to think that containers are

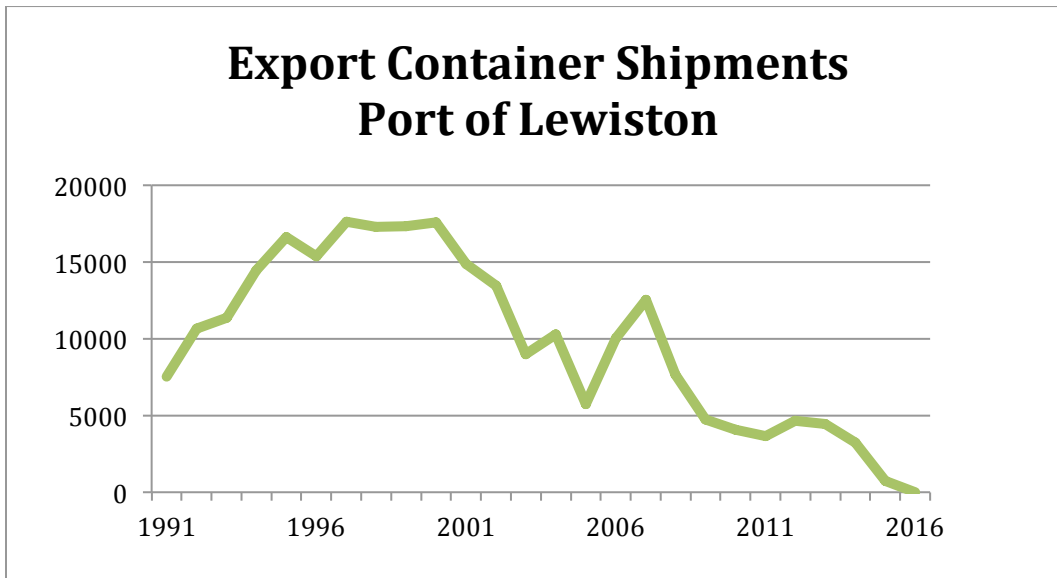
⁵ <http://portoflewiston.com/media-room/shipping-reports/>

⁶ http://www.portofportland.com/Notices/MAR_T6_Westwood_Visit_BLT.htm

⁷ <http://portoflewiston.com/media-room/shipping-reports/>

finished as a means of shipping commodities on the Columbia and Snake rivers for many years to come, perhaps forever.

Chart 4



The last containers in the Port of Lewiston inventory have already been shipped out, empty, by truck.

At the moment, the only forecast for container traffic on the LSR that makes sense is zero.

Petroleum and Chemicals

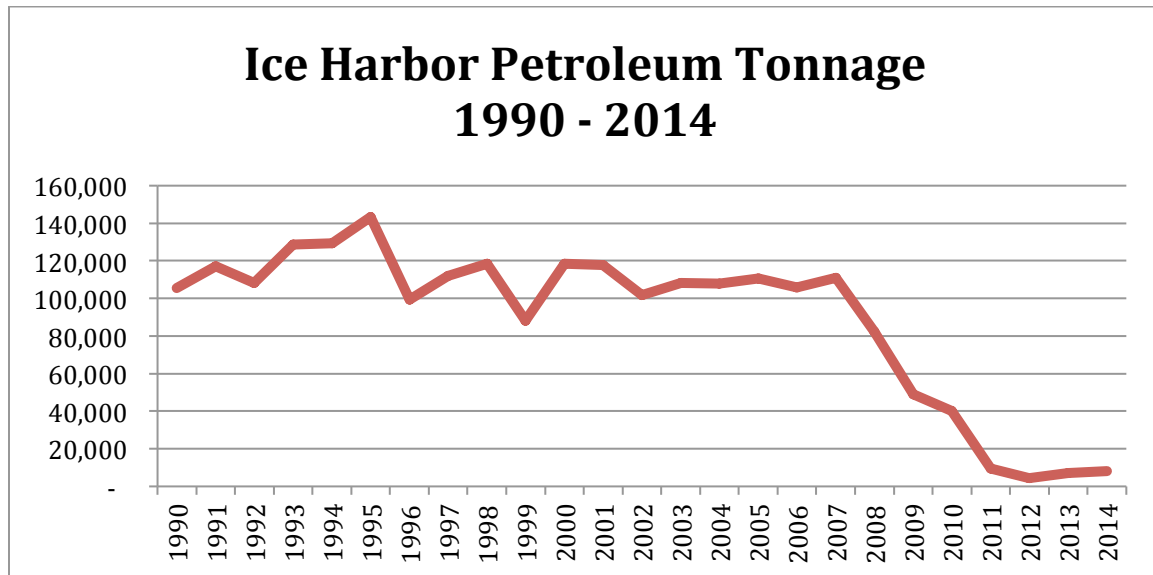
Petroleum shipments on the LSR share the same fate as containers; tonnage numbers at or near zero. The difference is that while the demise of containers came as a bit of a surprise, the end of petroleum was only a matter of time. It had long been known that as soon as demand got high enough or pipeline costs got low enough someone would put a pipeline into the Lewiston / Spokane area and the barging of petroleum would end.

Petroleum shipments were never a major source of tonnage on the LSR. From its inception to 2007 the volume ranged from about 90,000 tons to a high of 140,000 tons.

After 1995, petroleum tonnages were essentially flat. They weren't growing, but they weren't declining either. For the first eight years of this century the tonnage was consistently near 110,000 tons.

That all changed in 2008 when a pipeline connecting refineries in Salt Lake City, Utah started displacing barged petroleum products on the LSR. By 2012 petroleum tonnage on the LSR was a scant 3.6 percent of its volume four years earlier.

Chart 5



Since 2011 petroleum and chemical tonnage on the LSR has not exceeded 10,000 tons. This is primarily fertilizer destined for Central Ferry in the Little Goose reservoir. To the extent that the demand for fertilizer is directly tied to cultivated acreage, it is reasonable to think that tonnage of this product will be relatively constant.

There is no prospect that the combined tonnages of petroleum plus chemicals / fertilizer will ever return to previous century levels.

While it is probably fair to think that demand in the 10,000 ton per year range as far as Central Ferry, roughly one barge load every four months, will continue indefinitely, it is also reasonable to speculate as to whether the barge companies and terminals can operate profitably at such low levels. If not, the final end for barging of petroleum and chemicals on the LSR may end much like the end of containers on the Columbia and Snake. The carrier will simply call it day.

The current barge tonnage could be replaced by as few as 10 truckloads per week.

For the purposes of this report RME will use a forecast for petroleum and chemical shipments on the LSR of 10,000 tons per year.

Wheat and Barley Barge Traffic

Wheat and barley has always accounted for the most tonnage shipped on the LSR. It is no surprise that grain is still shipped in large volumes even as other categories have ceased. What is a surprise is that grain shipments have also declined steadily and substantially for the last quarter century.

Agricultural land served by the LSR is finite and completely developed. For all intents and purposes, every acre that can be planted for crops is already planted. This has been true for at least 50 years. There can be no substantive increase in barge traffic due to increased grain production as a result of planting more acres of the crop.

Acres of wheat and barley planted each year vary as part of crop rotation programs and speculation by farmers as to the future value of wheat and barley relative to other commodities. That, too, has been the practice for decades and will not result in more than periodic spikes in grain production.

Wheat and barley yields per acre have been increasing since the beginning of time. However, the rate at which yields per acre increases is incremental. Long-term yield increases are rarely more than a few tenths of a percent per year.

Offsetting increases in bushels per acre is the trend to ever-larger farm machinery. The larger machines allow for reductions in manpower per acre and per bushel, thus saving manpower costs and increasing profits. The tradeoff is that the larger machines often have trouble operating on steep slopes and getting into corners. The

increased profits to the farmer come at the expense of a slight reduction in acres harvested and thus a slight reduction in bushels harvested. This factor runs counter to that of increasing yields per acre.

Finally, farmers, like any business entity, are perpetually looking for more profitable line extensions. In other words, barley and wheat may be the staple of the Palouse but farmers have little or no price leverage with wheat and barley crops. They have to take whatever price is being offered on any given sale day. This is especially true if they limit their sales option to a single export destination.

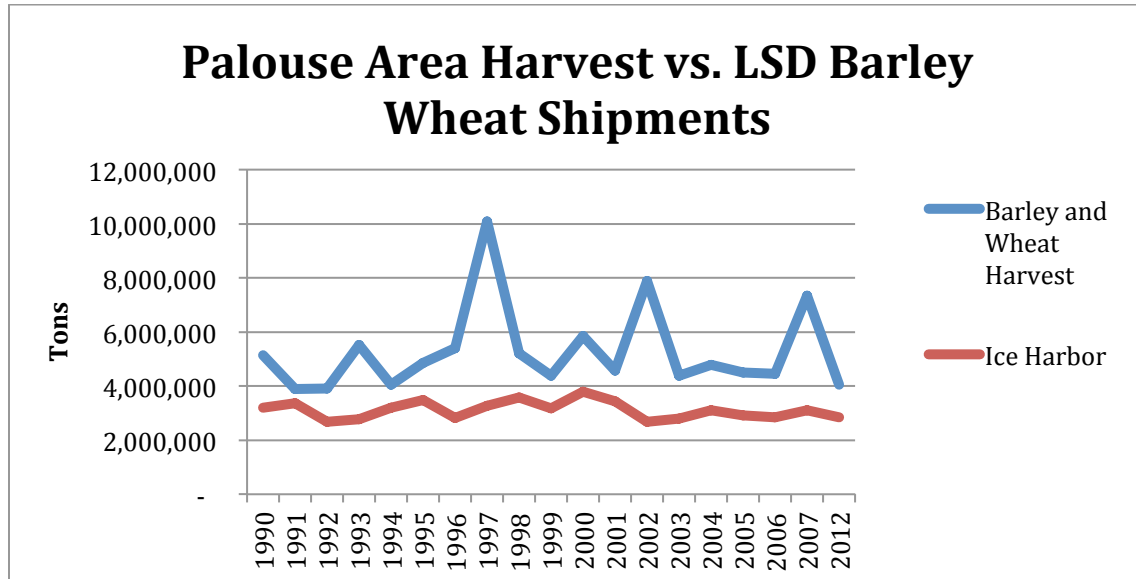
The workaround for many farmers is to experiment with other higher profit crops such as rapeseed (canola) and chickpeas (garbanzo beans). That is good for the farmer, but the alternative crops do not fit well with non-containerized barge transportation and provide one more factor pointing toward lower tonnage moved on the LSR.

Each of the individual effects described above may be small, but cumulatively they are resulting in a leveling, or even a slight lowering, of wheat and barley harvests in the area served by barge traffic on the Lower Snake.

As shown on Chart 6 below, barley and wheat harvested in the lower snake river area was on a slight incline leading up to a major peak of about 10 million tons in 1997. Since that time both the 5-year spikes and the lower base line harvests have been declining. The barley and wheat harvest in 2012, at 4.1 million tons, was the lowest in sixteen years. This year's harvest is expected to be even lower, perhaps as low as 2 million tons, as a result of drought in eastern Washington and northern Idaho.

Chart 6 also shows the tonnage of wheat and barley barged on the Lower Snake relative to the barley/wheat harvest in the Palouse. Barley and wheat traffic increased slowly from the inception of navigation on the river until the end of the last century. Barley and wheat tonnage on the LSR peaked at 3.8 million tons in the year 2000. Since then the trend has been downward. Barley and wheat shipments through the Ice Harbor lock in 2012 were 2.8 million tons, only 74 percent of the peak 12 years earlier.

Chart 6



Some of the credit/blame for reduced shipments of grain on the LSR must go to the Washington Grain Train. "In the early 1990s, a national shortage of rail hopper cars made it difficult and expensive for Washington state farmers to get grain to market. To help alleviate this shortage of grain cars the Washington State Energy Office and the Washington State Department of Transportation (WSDOT) used federal funds to purchase 29 used grain cars to carry wheat and barley from loading facilities in eastern Washington to export facilities in western Washington and Oregon."⁸ In subsequent years WSDOT has continued to add to the rolling stock.

Today there are 118 hopper cars in the Grain Train fleet dedicated to moving barley and wheat to market. Roughly half of the Grain Train cars travel all the way to export terminals on rail. Sixty-two of the cars ship grain to barge terminals. The bad news for the LSR is that these 62 rail cars deliver their cargo to the Port of Wallula on the Columbia. None of the Grain Train shipments end up on LSR barges.

A bigger piece of the credit/blame for reduced shipments of grain on the LSR goes to the railroads. Beginning around 1990 the two main rail carriers in the northwest, Burlington Northern Santa Fe (BNSF) and Union Pacific (UP), took a new look at operating techniques and began reinvesting in assets. Unit trains of 100+ cars began running from eastern Washington, bringing per ton-mile rates down closer to barge rates. Consistent with that, rail terminals capable of quickly loading unit trains continue to be developed across central and eastern Washington. With added numbers of unit train rail terminals at more convenient locations, farmers can cut

⁸ <http://www.wsdot.wa.gov/Freight/Rail/GrainTrain.htm>

shipping costs by reducing the miles that their product travels via high priced truck transportation.

Shipping by rail also gives farmers pricing and sales flexibility not possible with barge shipping. For instance, shipping by barge means selling to dealers in the Portland area. Shipping by rail gives farmers other options, such as selling to dealers in Puget Sound ports, or even going east to sell to Atlantic rim exporters. The difference in price may be small but in commodity marketing every little edge helps.

Shipping by rail also lets farmers avoid the recurring closures of the LSR navigation system. The need to perform maintenance on the locks is understandable, but in the 21st century the recurring need to shut down an entire transportation system is, at best, quaint. Farmers, Co-Ops, etc., routinely utilize futures markets and other sales options that require the ability to deliver product in real-time. That means something other than barge.

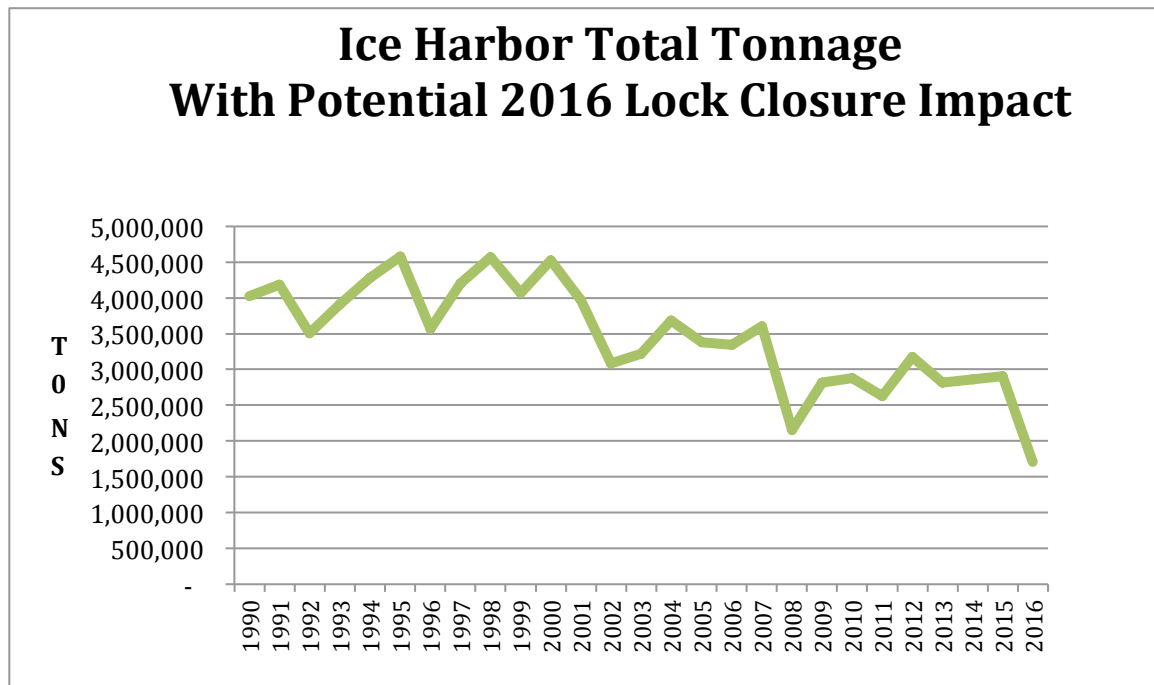
In summary, farmers now have many more, and often better, alternatives to simply growing the same old barley and wheat crops, and putting them on the same old barges, year after year after year.

Summary – Total LSR Shipping

Looking at Chart 7 below, it is clear that total tonnage clearing the Ice Harbor lock, at about 3 million tons per year, is only about two-thirds of its volume at its peak prior to the year 2000.

As discussed earlier, competition from the railroads and revised production processes from various manufacturers have had a major impact. As this is being written it is hard to see any of those changes being reversed in the near, or even the distant future. The rail lines, and companies aligned with the rail lines, have made, and continue to make, significant investments for the purpose of moving wheat and barley by rail. Those tons will not be back for a very long time, if ever.

Chart 7



Looking at the total tonnage moved through Ice Harbor for the last 6 years, it is tempting to say that volumes shipped by barge are trending upward, at least slightly. While technically true, one should hesitate to put too much stock in the tonnage growth or its long term potential. Part of the reason the upward trend looks as strong as it does is the statistical equivalent of an optical illusion. The growth, such as it is, comes on the heels of a major dip in tonnage associated with the last extended lock closure.

If one looks at Ice Harbor tonnages for the future and superimpose the same percentage decrease in tonnage resulting from the proposed 2016 lock closure as occurred after the last extended lock closure, the future looks a good deal less bright for future tonnages shipped on the Lower Snake River.

As this is being written the Palouse is suffering one of its worst droughts on record. Wheat and barley yields are predicted to be as low as 50 percent of normal. Combine the drought effects with the coming lock closure effects and it is possible that tonnage will drop as low as one million tons for the year, roughly 25 percent of previous century levels.

The high side and the low side future for tonnage shipped on the lower Snake River have narrowed considerably.

There is nothing on the horizon that suggests a substantial, or even a marginal, long-term shift away from rail and a return to barge transportation. Similarly, nothing on the horizon suggests an influx of businesses that will rely on barge transportation.

The recent announcement by Columbia Pulp that they would build a plant on the banks of the Snake to produce pulp from straw looked, at first blush, like a natural for barge transportation. However, Columbia Pulp makes it clear that they value the river more for the water than for transportation. They chose the site for its central location relative to raw materials and for access to rail lines and highways to move both raw and finished product.

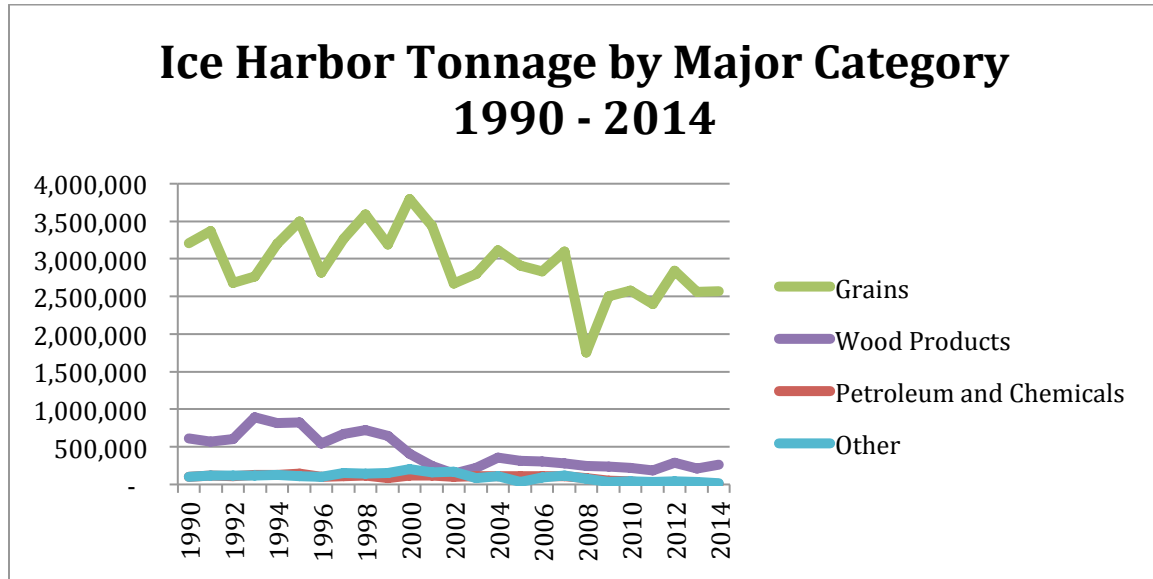
On a similar vein, and a further sign of how times and business perceptions have changed since the LSRD were planned and constructed, of the 21 largest employers in the Lewiston area, only one ships product by barge at all, and then only on a very minimal and sporadic basis.⁹

The long term high forecast for tonnage on the Lower Snake River looks to be about 2.7 million tons.

The low side forecast is similar.

⁹ <http://www.lewis-clarkvalley.org/area-profile/major-employers/>

Chart 8



A core number of farmers will use the barge system as long as it exists. For farmers close to the river, farmers who do not have to maintain fleets of 18-wheeler trucks to get their produce to the river, the roughly \$0.039 per ton mile barge rate, approximately 2 – 2.5 cents less than rail, will be sufficient incentive for them to continue shipping by barge. That means the current level of 2.5 million tons is probably a reasonably firm bottom number for wheat and barley.

The only other remaining category of any substance is wood products. It has been steady at about 250,000 tons for a decade. There is no reason to believe it will go away. The combination of the two categories suggests that low side forecast for total tonnage on the Snake will be about 2.8 million tons per year for at least the next decade.

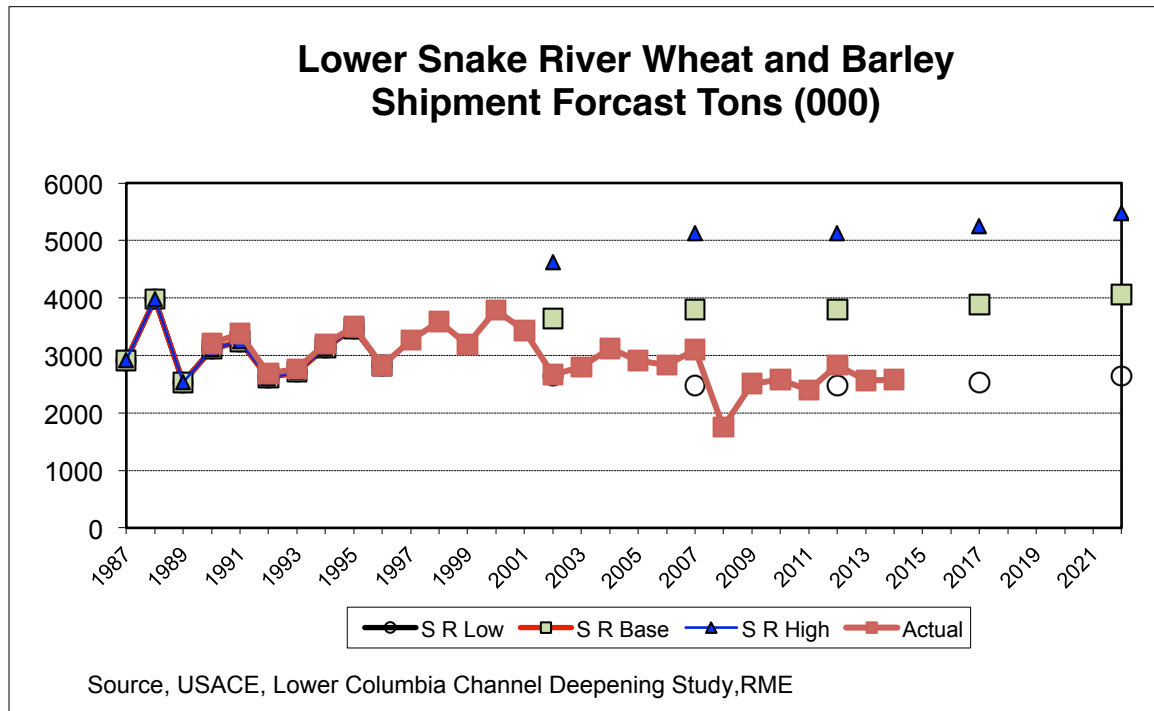
The best forecasts are based on correlations of one or more independent events driving a dependent event. In the case of barge traffic on the lower Snake, the main independent variable is grain acreage within trucking distance of a Snake River port. The second and smaller independent variable is forest acreage within trucking distance of a Snake River port. Those are the sources of the only two general commodity groups for which barge shipping has been, or will be, a prime candidate in the future. Since those acreages are essentially fixed, the only movement of the independent variable is year-to-year variations in harvest and periodic swings in shipments to the Pacific Rim rather than the other direction to Europe and the Atlantic rim.

In other words, in the absence of growth in the independent variables, the dependent variable, tonnage shipped via barge, will not grow either. For any reasonable look

into the future, tonnage moved through on the LSR will be in the vicinity of 2.6 – 2.7 million tons.

For historical purposes it is worth a glance at the LSRD freight forecast used by the COE in the DMMP, presented in Chart 9. The three rows of dots show the COE's forecasts. The blue triangles show the high forecast. The greenish squares show the COE's best guess. The white circles show the COE's worst case forecast. The red line shows actual freight movement on the LSR since 1990. It also shows actual shipments on the LSR are following the COE's worst-case scenario.

Chart 9



Shipping Costs

The following Table 3 lists the cost of shipping barley and wheat from the Palouse to the Port of Portland. These are the rates that farmers and co-ops see when they contract to move grain to port.

Truck rates, at fourteen cents per ton-mile, are the highest of the lot and explain why so little grain arrives in Portland by that mode.

Rail is less than one half the cost of trucking, at about 6.3 cents per ton-mile. Barge, as has always been the case in this region, is the low cost shipper at 3.9 cents per ton-mile.

Table 3

**Shipping Cost Charged to Farmers
Per Ton Mile**

Mode	\$ / Ton Mile		% Change
	1998	2015	
Truck ¹⁰	\$ 0.1000	\$ 0.1400	40%
Rail ¹¹	\$ 0.0500	\$ 0.0633	26.6%
Barge ¹²	\$ 0.0100	\$ 0.0393	293.0%

When RME first looked at navigation on the LSR in 1998, the order was the same but the relative splits were different. Barge rates were at 1 cent per ton-mile and rail rates were at 5 cents per ton-mile. With rail costing five times as much as barge it was easy to see why shippers preferred the barge option even if it meant a considerable haul by truck to get to a river port.

In the intervening 17 years the difference between rail and barge rates has narrowed considerably. Barge rates have nearly tripled while rail rates have only increased by about one-quarter. In 1998 a shipper paid a four-cent penalty to move grain by rail. Now the penalty is only 2.4 cents. Adjusting for inflation, the 2.4-cent difference is equivalent to a 1.5-cent difference in 1998 dollars.

The narrowing of rail and barge tariffs is important for two reasons.

¹⁰ Est. based on DOE published rate of \$0.1654 per ton-mile for less than full load truck cost. Fully loaded grain haulers would be cheaper.
http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_03_21.html

¹¹ Based on UP rate for covered hopper 110-car unit train. Tariff no. UP 4052-A.

¹² SHAVER TRANSPORTATION, TARIFF NO. S-96

First, academically, economic theory holds that as prices of two competing products or services get closer to each other, demand will shift, to some degree, from the cheaper service to the more expensive service. In other words, the shift we are seeing of farmers shipping ever more grain by rail instead of by barge is consistent with theory. It is not just a passing fancy.

As long as the prices of rail continue to be this close or closer to barge rates, the inroads rail has made in attracting volume away from barge will hold and perhaps expand even further.

Second, the difference between rail and barge shipping costs is a critical part of the numerator in the COE's Benefit-Cost Ratio (BCR) determination. In the COE's analysis performed to determine the value of dredging the navigation channel, the COE decided that the benefit of dredging was the avoidance of the higher cost of rail transportation multiplied by the amount of freight that moved by barge. The Benefit / Cost math is presented below.

$$\text{Benefit / Cost Ratio} = \frac{\text{Barge Tonnage X } (\$ \text{ Rail Rate} - \$ \text{ Barge Rate})}{\$ \text{ Dredging Cost}}$$

- As detailed in previous sections, the tonnage moved by barge is now only about 2/3 what it was as recently as 2000.
- The difference between the rail rate and the barge rate is now smaller at 2.4 cents as opposed to the previous 4 cents.

The combination of these two effects is substantial. In 1998 the ton miles moved on the LSR was 503 million. At a price differential of 4 cents, the benefit to barge shippers was \$20.1 million per year. In 2014 the ton-miles of freight moving by barge on the LSR was only 315.6 million. With the price differential between rail and barge down to only 2.4 cents, the benefit to barge shippers has dropped to only \$7.6 million.

The following section looks at the denominator, the cost portion of the equation.

Cost to Maintain Navigation

COE Based Costs

This section deals with the amount of money the COE spends on maintaining navigation on the LSR. The problems associated with getting a clear and concise cost accounting starts with the fact that the four dams are “multi-purpose” dams. Their primary functions are for power and navigation. The COE also claims benefits for irrigation, flood control¹³, etc. To that end, money spent to operate and maintain the dams is dedicated to the various aspects of the dams, and comes from a variety of sources.

Most funding for the dams comes from two agencies of the federal government. The COE is one funding source. The Bonneville Power Administration (BPA) is the other funding source. The money gets mingled in a myriad of ways, both in the direct operation and maintenance of the dams as well as money spent peripherally to the dams such as dredging and wildlife mitigation. Money spent for navigation by the COE may benefit power production and money spent by BPA often has navigation related effects. Money spent on the dams also gets mingled in the financial reporting. One example is mitigation spending that may get reported by BPA, The Northwest Power and Conservation Council (The Council), and the COE.

While the navigation portion of the dams—the locks and associated mechanics—is no better at passing fish than is the power portion of the dams, it is BPA that picks up the bulk of the costs associated with wildlife issues.

The mingling of the monetary sources and the cross purposes of dam related spending makes it difficult, perhaps impossible, to put a definitive cost on navigation spending on the LSR.

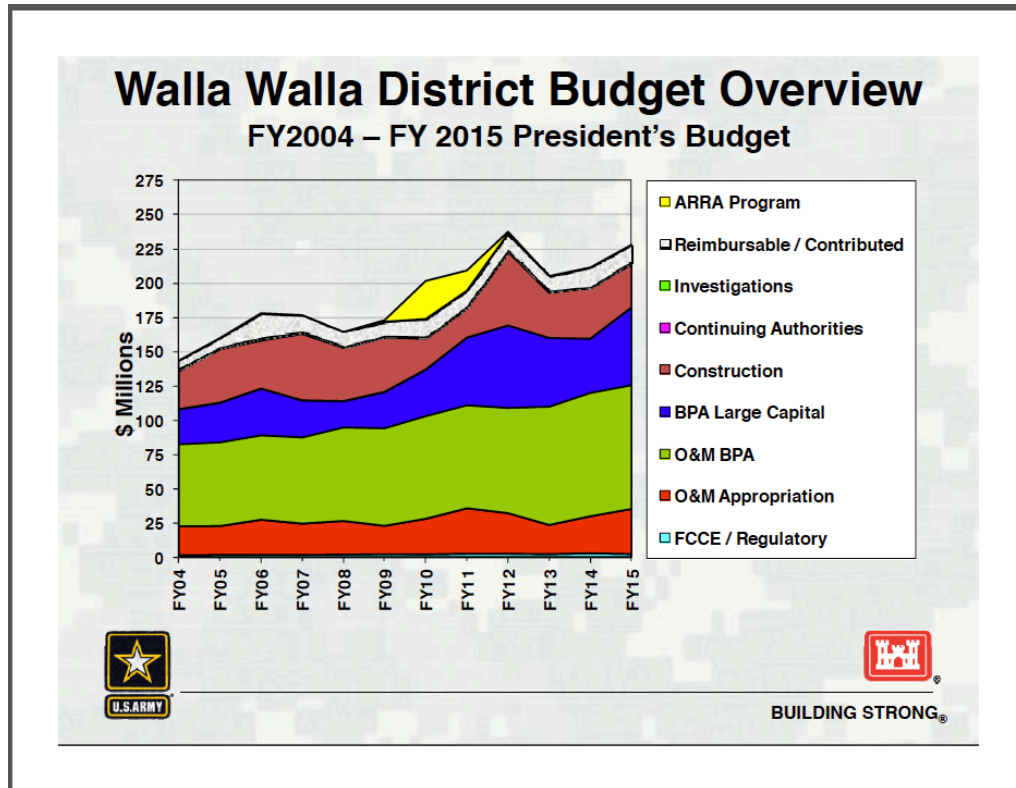
The solution, such as it is, is to allocate portions of the total spent on the dams to the various “purposes” of the dams. The COE has historically concluded that the

¹³ The COE has a tortured history regarding dams and flood control. Early in the COE’s history they argued against the Bureau of Reclamation that it was improper to include flood control as a benefit for building dams on the grounds that a dam could, at best, only control minor flooding events. Dams, the COE claimed, could never control the largest flood events. (Further, for a dam to contain a flood the reservoir has to be at least partially empty. Reservoirs that are perpetually full to the brim, such as the LSRD reservoirs, are more of a flood risk than a device for flood protection.) Later, in an effort to justify marginal projects the COE began including flood protection as a benefit of its proposed dams. Fast-forward to about 1998, some dams, such as Lower Granite Dam, are tagged as a cause of floods as water backs up in an effort to get over the sediment deposited where the river meets the reservoir. Finally, all of that ignores the fact that all reservoirs when full of water are flood risks to downstream populations. Google St. Francis, Teton, Fontenelle, or Jamestown for details.

navigation portion of the dams ranges from 9% to as much as 13% of total spending^{14,15}. For this analysis RME will use 10% as navigation's percentage of spending on the LSRD.

Chart 10 and Table 4 below detail the Walla Walla District's spending. Total budgeted spending in 2015 is shown as being about \$227 million and growing at a 4.54% compound growth rate over eleven years.

Chart 10



Source: Walla Walla District - Industry Day, 30-Oct-14, Dana M. Knudtson, P.E.

¹⁴ FINAL, February 2002, Lower Snake River Juvenile, Salmon Migration Feasibility Report/Environmental Impact Statement, APPENDIX I, Economics, pp. I3-214,

¹⁵ 10.3%, 3.1. ECONOMIC ANALYSIS –NED, 3.10, AVOIDED COST ANALYSIS, FREIS pp 7

Table 4

	2004		2015	
Reimbursable / Contributed	\$5.5	3.8%	\$11.0	4.8%
Continuing Authorities & Investigations	\$0.5	0.3%	\$1.0	0.4%
Construction	\$27.0	18.9%	\$33.0	14.5%
BPA Large Capital	\$25.0	17.5%	\$57.0	25.1%
O&M BPA	\$62.0	43.4%	\$90.0	39.6%
O&M Appropriation	\$22.5	15.7%	\$34.0	15.0%
FCCE / Regulatory	\$0.5	0.3%	\$1.0	0.4%
Total	\$143.0		\$227.0	

Walla Walla District - Industry Day, 30-Oct-14

Dana M. Knudtson, P.E.

It is tempting to try and parse these numbers to get to a definitive number for just the navigation portion of the four LSRD. For instance, O&M BPA doesn't sound like it should be included in navigation, but does that mean all of the "O&M Appropriation" category should be included in navigation? That doesn't sound quite right either.

Somewhere in the numbers there should be a number for dredging the navigation channel. That is an ongoing event and 90% plus should be allocated to navigation, but which category is it in? There are no answers to these questions from the COE and thus no end to this line of deliberation. And, to be fair, the answer may be unknowable.

For the purpose of this analysis RME will take two broad strokes.

First, there are five large dams in the Walla Walla District, McNary, and the four LSRD. McNary is much bigger than the four LSRD, but seems to be less trouble. It doesn't seem to suffer ills related to fish passage to the same degree as the LSRD. This dam also doesn't appear to face the same need for dredging. There seems to be much more activity on the part of the COE, BPA, The Council, etc., regarding the four LSRD than there does on all the rest of the main stream Columbia river dams farther downstream combined. Giving each of the Walla Walla District's 5 main dams a 20% stake of the total, RME nevertheless conservatively assigns 80% of the total as being the LSRD portion of total spending.

Next, RME took 10% of the remainder as being spending dedicated to navigation on the LSR.

Applying this process to the Walla Walla District ACOE spending chart, RME estimates spending on navigation in 2015 to be about \$18 million.

Waddell Estimated Costs

For an accuracy check, RME went to Jim Waddell, a recently retired engineer for the Walla Walla District. Mr. Waddell has compiled cost estimates limited to the four LSRD.

Waddell uses different categories than did the COE in the earlier chart. His totals are also a little lower for the first few years than shown by the COE. However, Mr. Waddell also shows some system improvements beginning in 2026 that are not shown by the COE. Mr. Waddell also breaks out Dredging into its own column.

In the end, the problem for RME vis a vis Waddell's numbers is similar to the problem RME had with the COE's numbers.

It is tempting to exclude Turbine Rehabilitation and Power Services from a navigation accounting. However, the turbines are one of the paths fish are presumed to take heading downstream, so it would be proper to include a portion of the cost of making the turbines more fish friendly in the navigation component.

In the dredging category the logic goes the opposite way. There is a portion of the dredging activities that is presumed to be for flood minimization. However, if one looks at the dredging schematics for 2015 it is clear that all of the dredging was done for the benefit of navigation. To that end including only 10 percent of dredging would be a mistake when the evidence suggests 90 percent plus is more accurate.

In the end, RME took two paths.

Table 5

Waddell LSRD Cost Estimate

Annual Costs of Keeping the Lower Snake River Dams (in 1,000s)

Year	Total Annual Costs to keep Dams	Total annual cost if escalated 2% faster	1. System Improve ments	2. O&M	3. Turbine Rehab	4.Comp Plan (Hatcher ies)	5. Power Services	6. Dredging
2018	\$170,937	\$170,937		\$43,100	\$42,700	\$34,596	\$37,930	\$12,611
2019	\$159,220	\$162,404		\$44,400	\$26,500	\$36,326	\$39,068	\$12,926
2020	\$163,831	\$170,450		\$45,700	\$26,500	\$38,142	\$40,240	\$13,249
2021	\$197,177	\$209,245		\$47,100	\$55,000	\$40,049	\$41,447	\$13,581
2022	\$176,162	\$190,683		\$48,500	\$29,000	\$42,052	\$42,690	\$13,920
2023	\$181,393	\$200,273		\$50,000	\$29,000	\$44,154	\$43,971	\$14,268
2024	\$218,377	\$245,928		\$51,500	\$60,600	\$46,362	\$45,290	\$14,625
2025	\$194,919	\$223,901		\$53,000	\$31,600	\$48,680	\$46,649	\$14,991
2026	\$248,470	\$291,123	\$47,743	\$54,600	\$31,600	\$51,114	\$48,048	\$15,365
2027	\$290,584	\$347,274	\$49,175	\$56,300	\$66,200	\$53,670	\$49,490	\$15,749
2028	\$266,621	\$325,009	\$50,650	\$57,900	\$34,600	\$56,353	\$50,974	\$16,143
2029	\$274,691	\$341,544	\$52,170	\$59,700	\$34,600	\$59,171	\$52,504	\$16,547
2030	\$320,803	\$406,856	\$53,735	\$61,500	\$72,400	\$62,129	\$54,079	\$16,960
2031	\$294,768	\$381,314	\$55,347	\$63,300	\$37,800	\$65,236	\$55,701	\$17,384
2032	\$303,697	\$400,721	\$57,008	\$65,200	\$37,800	\$68,498	\$57,372	\$17,819
2033	\$354,198	\$476,704	\$58,718	\$67,200	\$79,000	\$71,923	\$59,093	\$18,264
2034	\$325,985	\$447,507	\$60,479	\$69,200	\$41,200	\$75,519	\$60,866	\$18,721
2035	\$335,869	\$470,297	\$62,293	\$71,200	\$41,200	\$79,295	\$62,692	\$19,189
2036	\$327,201	\$467,324		\$73,400	\$86,300	\$83,259	\$64,573	\$19,669
2037	\$294,793	\$429,457		\$75,600	\$45,100	\$87,422	\$66,510	\$20,161
2038	\$301,963	\$448,701		\$75,900	\$45,100	\$91,793	\$68,505	\$20,665
2039	\$313,425	\$475,047		\$80,200	\$45,100	\$96,383	\$70,560	\$21,181
Average '20-'39								
	\$269,246	\$347,468						

First, RME looked at Waddell's 2020 – 2039 average of \$269 million. Next, RME deflated this average back to 2015 at 3% per year. This resulted in an average annual expenditure on the four LSRD of \$178 million. Taking a blanket 10% of the total, RME arrives at \$17.8 million per year as the portion relating to navigation.

For a second look, RME went to the midpoint (2029) row in Waddell's chart. For this option, RME took 10% of the sum of System Improvements, O&M, and Comp Plan,

and 90% of the dredging number. Next, RME again deflated the result back to 2015 at 3% per year. The resulting number is \$21.2 million.

The latter approach has the most intuitive appeal of the three. It includes a number that could be a shadow price for periodic lock maintenance that the others lack. It also includes a portion of the O&M, and Comp. Plan. That seems reasonable, as does including 90% of the dredging costs. Finally, it omits the Power Services and Turbine Rehab columns that seem to be most specific to the power portions of the dams.

The three approaches provide navigation cost estimates ranging from \$17.8 to \$21.2 million per year, a spread of \$3.4 million from low to high. For a working number RME will be conservative and use the lowest number, \$17.8 million per year. This is a judgment call on the part of RME. The purpose is to be as cautious as reasonably possible. At the same time, it is worth noting that the \$17.8 million chosen by RME is very close to the \$18 million number produced via the COE's numbers.

Direct Cost - Benefit to Cost Ratio

Referring back to the previous section, RME determined, using the COE's methodology from the DMMP, that the benefit to navigation in 2015 is \$7.6 million. Applying the \$17.8 million cost to maintain navigation, the BCR for 2015 is .427:1.

In English, this means that for every dollar spent on the dams to maintain the possibility of navigation on the LSR, farmers and businesses in the region only see a benefit of 43 cents.

Put another way, if rather than pouring the same amount of money into the dams, the COE would pay the entire extra cost for the various farmers and businesses to ship by rail instead of barge, the COE would have \$10.2 million left over to refund to American taxpayers.

Put still another way, if a banker looked at a proposal for a new business with a BCR of .43:1, that banker would not fund it. Alternately, if this were a private business whose BCR had declined to .43 the business owner would shut it down.

And that, in a sense, is the good news.

Mitigation Spending

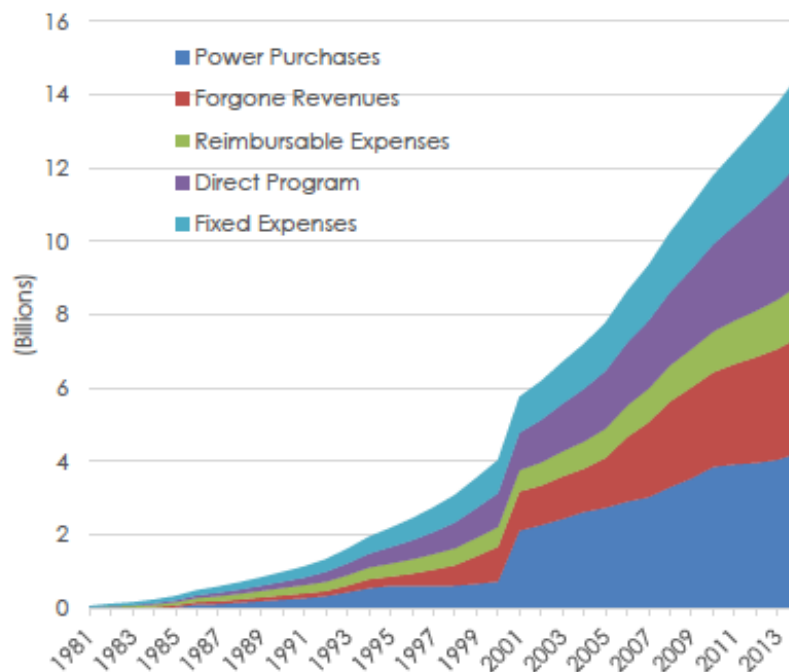
The previous section dealt with the actual, day-to-day, operation of the four LSRD. There is very little in the cost numbers associated with mitigation for the damage caused by the dams. Mitigation spending is an entirely separate category of spending on top of the annual spending directly on the dams and other navigation-related expenses.

For mitigation numbers, RME looks to the Northwest Power and Conservation Council (NW Council) and the 2014 Columbia River Basin, Fish and Wildlife Program, Costs Report, 14TH ANNUAL REPORT TO THE NORTHWEST GOVERNORS (CRBFW).

Chart 11

Figure 7B: Cumulative Costs 1978-2014,
By Major Spending Area

Total of \$14.5 billion does not reflect \$2.56 billion
in obligations to capital projects or \$1.98 billion in credits



Source: Bonneville Power Administration

Bottom line: BPA spent \$782.3 million in 2014 in an effort to mitigate the damage caused to fish and wildlife by the Snake and Columbia River Dams.

\$782 million is a big enough number that it sounds like a total or complete project number. Rather, it is a single year's number that is part of \$14.5 billion spent to date in an effort to partially compensate for the damage done by dams in the Columbia-Snake River drainage.

BPA and The Council get credit for the detail and transparency of their spending on fish and wildlife. The problem, from RME's perspective, is that attributing fish and wildlife spending to one particular dam, or to just the navigation portions of the four LSRD is still a judgment call.

Since the mitigation spending is related to the entire Columbia basin, it would be a mistake to attribute all the costs to the four LSRD. There is a sense in the literature that the four LSRD get a lion's share of the blame for fish related damage and thus are responsible for the bulk of ongoing mitigation spending, but a precise percentage is not available.

Further, while a precise accounting of the need for mitigation on a dam-by-dam basis is desirable, it is not essential for this purpose. The mitigation numbers are big and getting bigger. The same is true for the base costs of operating and maintaining the dams themselves. The only numbers that are decreasing are those on the benefit side of the ledger.

To proponents of the dams, adding in the mitigation costs will look a little like piling-on. However, costs are costs and it would be a mistake to pretend they don't exist. They are related to the presence of the four LSRD.

In recognition of the difficulty breaking out LSRD specific costs, RME will take four separate approaches to estimating LSRD navigation related mitigation costs.

1. Total Columbia River Basin Fish and Wildlife Program Costs Report

For this iteration RME will take a quasi-arbitrary total cost approach. The Waddell numbers included about \$35 million for hatcheries directly related to the LSRD. It would be double counting to include this spending in the Council numbers. Subtracting \$35 million from 2014 spending of \$782.3 million brings the Council's total down to \$747.3.

Next, there are 8 dams fish must pass to migrate to the ocean or return to Lewiston. All of them impact fish survival to some degree. The literature appears to place a greater share of the blame on the LSRD but there is no exact amount. For this report, to be very conservative, RME will use only 25%. This brings the mitigation number down to \$186.8 million.

RME is, to a certain extent, showing mercy to the COE and BPA by using "only" 25% of total mitigation spending. Reasonable arguments can be made to run the number up to at least 50%. The use of 50% here would allocate \$373.65 mitigation costs to the LSRD, add \$37 million to the annual costs and result in a BCR of about .014:1.

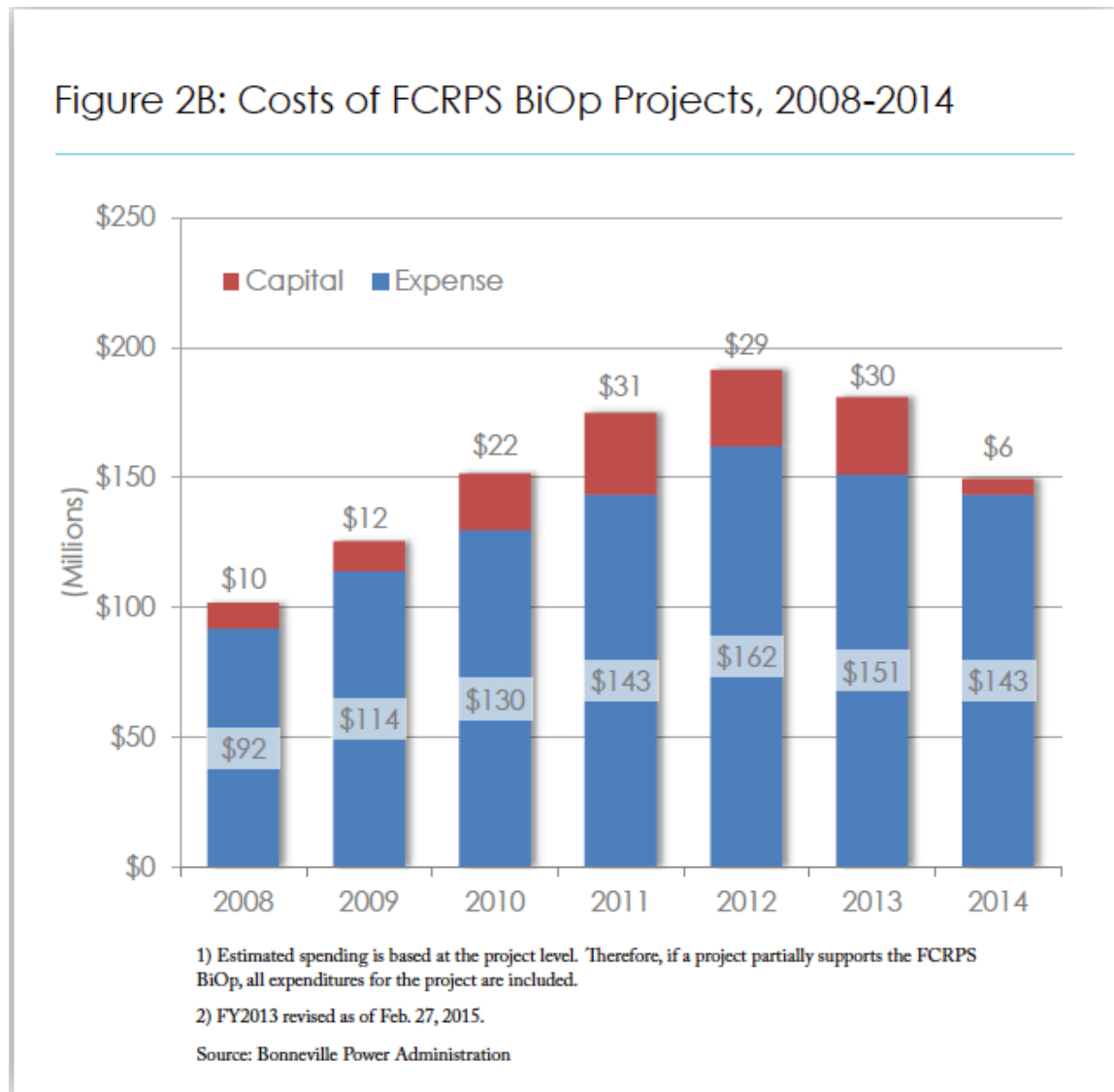
Next, as before, RME assigns 10% of the cost to the navigation side of the LSRD. That brings mitigation spending related to navigation down to \$18.7 million.

Adding \$18.7 million to the previously determined operating cost of \$17.8 million brings us to an annual cost of navigation for the LSRD of \$36.5 million. Dividing navigation benefit of \$7.6 million by \$36.5 million we arrive at a BCR of a scant .21.

2. Federal Columbia River Power System (FCRPS) - BiOp

Of the various categories detailed by the Council, the FCRPS BiOp Projects are very specific to the operation of the LSRD. FCRPS funding has run as high as \$191 million per year. In 2014 it was lower at \$149 million. There is no sense that spending of similar amounts will go away as long as the LSRD exist.

Chart 12



If we use 10 percent of the most recent year's spending as navigation's portion, the result is \$14.9 million.

Adding \$14.9 million to the previously determined operating cost of \$17.8 million brings us to an annual cost of navigation for the LSRD of \$32.7 million. Dividing navigation benefit of \$7.6 million by \$32.7 we arrive at a BCR of .23:1, very close to the BCR derived from the data in #1 immediately above.

3. A-Fish (5 yr. Avg.)

In the 2014 Columbia River Basin Fish and Wildlife Program Costs Report, Figure 2A lists cost by Types of Species ranging from anadromous fish to terrestrial species. Out of a total of \$269.1 million total in 2014, \$166.7 million is targeted for anadromous fish, the single category that most closely fits the mitigation requirements of the LSRD. Noting that A-Fish are also factors with other dams, RME also notes that LSRD impacts go well beyond A-Fish. As with the other sections, this number is not exact and likely underestimates the LSRD's total impact.

For this example RME used the five-year average of \$166.7 per year spending on A-Fish related costs.

Taking 10 percent of the total results in a navigation portion of \$16.7 million. Adding this to the COE direct cost of \$17.8 million results in a combined direct and mitigation cost of \$34.5 million and a BCR of .22:1.

4. ESA Listed Fish

In the 2014 Columbia River Basin Fish and Wildlife Program Costs Report, Figure 2C lists costs associated with individual ESA listed fish. Out of a total of \$194.6 million, \$66 million is targeted for Snake River: Fall Chinook, Spring/ Summer Chinook, Sockeye, and Steelhead.

In the entire report the spending related to these four species of fish, on just the Snake River, is the spending most specifically related to just the LSRD. It is also the lowest cost of the four iterations explored by RME.

RME notes that mitigation efforts related to the LSRD go beyond these four fish, and beyond fish in general. RME also notes that while the spending seems prodigious, the various species populations remain at levels significantly below "recovered". In other words, it seems reasonable to view the costs in this example as a lower bound.

Taking 10 percent of the \$66 million total results in a navigation portion of \$6.6 million. Adding this to the COE cost of \$17.8 million results in a combined direct and mitigation cost of \$24.4 million and a BCR of .31:1.

Table 6 - Summary Cost Table

		Total CRB F&W Costs	FCRPS BiOp	A-Fish (5 yr. Avg.)	ESA Listed Fish (1)
Mitigation Costs	Cost	\$782.3	\$149.0	\$166.7	\$66.0
	Minus COE Spending	\$35.0	\$ 0	\$ 0	\$ 0
	Net Cost	\$747.3	\$149.0	\$166.7	\$66.0
	LSRD Portion (%)	25%	100%	100%	100%
	LSRD Portion (\$)	\$186.8	\$149.0	\$166.7	\$66.0
	Nav. Portion @10%	\$18.7	\$14.9	\$16.7	\$6.6
Direct Cost		\$17.8	\$17.8	\$17.8	\$17.8
Direct + Mit		\$36.5	\$32.7	\$34.5	\$24.4
Benefit		\$7.6	\$7.6	\$7.6	\$7.6
BCR		0.21	0.23	0.22	0.31

1 Includes costs for Snake River: Fall Chinook ESU (Threatened), Spring/ Summer Chinook ESU (Threatened), Sockeye ESU (Threatened), Steelhead DPS (Threatened).

Reductio ad Absurdum

RME is aware that the LSR dams are controversial. The dams have well known detractors. They also have proponents that will allege, absent all facts, that navigation is justified. They will attack this paper as biased and accuse RME of skewing the numbers against the projects when in reality RME has frequently taken positions most favorable to the continued existence of the LSR waterway. This section is being presented as an exercise in *Reductio ad absurdum*.

The issue in this section is: Would the assumptions necessary to produce a result supporting continued LSR navigation look absurd?

For starters, RME previously concluded that the benefit of the projects is \$7.6 million per year. RME believes that number to be reasonably sound. Given the ongoing reduction in shipping volumes and the converging of rail and barge shipping rates, this result is consistent with previous COE and RME conclusions. However, for the sake of argument, what if the number is low by half? That would bring the total benefit up to \$11.4 million per year.

On the cost side, everyone involved, from proponents of the dams to the dam's detractors, readily admit to the difficulty of placing a firm number on the costs associated with maintaining the dams. Further, the more detail attempted, such as getting a navigation specific number, the more room for error.

In the preceding text RME used 80% of the Walla Walla COE's 2015 budget as the portion belonging to the LSR, and then took 10% of the product as the portion belonging to navigation. For the sake of argument, what if only 50 percent should be attributed to the LSRD? In that case 50% of \$227 million is \$113 million. A 10% share for navigation brings the navigation related cost down to \$11.35 million and puts the BCR at 1.004 : 1. This BCR may be infinitesimally greater than one but only by ignoring all mitigation spending.

As regards mitigation spending, RME will also take a devil's advocate view of the previous analysis.

First, RME previously pared the Council's mitigation total down to \$747.3 million.

Next, RME previously lopped 50% off the revised total to bring the mitigation number down to \$373.7 million. Instead of cutting 50% out of the budget let's eliminate 90% and use only the remaining 10% as the LSRD's impact. RME doesn't think there is much argument that the LSRD are at the root of at least 10% of the mitigation spending in the Columbia-Snake River drainage. That brings the total LSRD related mitigation spending down to \$74.7 million per year.

As before, RME assigns 10% of the cost to the navigation side of the LSRD. That brings mitigation spending related to navigation down to \$7.5 million. In other words, in this exercise, RME is applying less than 1 percent of the fish and wildlife spending to LSRD navigation.

Adding \$7.5 million to the previously determined operating cost of \$11.35 million results in an annual cost of navigation for the LSRD of \$18.85 million. Dividing a navigation benefit of \$11.4 million by costs of \$18.8 million we arrive at a BCR of .606:1.

To summarize, after arbitrarily increasing the benefit calculation by 50%, including a scant 5% of the Walla Walla district's annual operating costs, plus an absurdly small 1% of the annual mitigation spending, the LSRD navigation still shows a sub-1, shut down level, BCR.

How low does mitigation spending have to be for navigation to claim a favorable BCR (> 1:1)?

The assumptions in this exercise increased the benefit calculation by 50 percent and lowered the COE's direct cost by nearly 40 percent. The increase in benefits and reduction in costs, not including any mitigation costs, came to within \$100,000 of break even.

In other words, unless mitigation spending attributable to navigation on the LSRD falls from somewhere in the \$7 million to \$19 million per year range to less than \$100,000 per year, a 99 percent or greater reduction of mitigation costs, the BCR will be less than 1:1.

Go back to the issue at hand: Would the assumptions necessary to produce a result supporting continued LSR navigation look absurd?

The answer is yes.

Using assumptions absurdly skewed in favor of navigation, the BCR still shows the combined COE and BPA getting only 60 cents back on every dollar spent.

The navigation related costs of the LSRD exceed their benefit by a wide margin.

Appendices

Appendix 1

¹⁶3.8.4.2 Dam-Related Operation, Maintenance, Repair, Replacement and Rehabilitation

Avoided costs for dam-related operation, maintenance, repair, replacement and rehabilitation (O, M,R,R&R) that would be incurred under Alternatives 1 through 3 include:

- Approximately \$7.7 million to operate and maintain the dams (i.e., average annual operation and maintenance costs). After breaching, there would no longer be a need to operate and maintain the dams.
- Approximately \$3.1 million to operate and maintain the navigation system (i.e., average annual costs for lock operation and maintenance, dredging and other items related to navigation). After the dams are breached, there would no longer be a need to operate and maintain the navigation system.
- Approximately \$2.7 million to operate and maintain the fish barge system (i.e., average annual operation and maintenance costs for barge and truck components of the fish barging program). After the dams are breached, there would no longer be a need to transport fish.
- Approximately \$10.3 million to operate and maintain the buildings and grounds. After the dams are breached, there would no longer be a need to operate and maintain the grounds and buildings associated with the dams. These costs would not be incurred under Alternative 4—Dam Breaching and are, therefore, considered avoided costs.

To summarize.	\$7.7 Dams
	\$3.1 Navigation
	\$2.7 Fish Truck and Barge Operation
	\$10.3 Building a d Grounds
	\$23.8 Total

Navigation Equals \$13% of O&M

¹⁶ F I N A L, F e b r u a r y 2 0 0 2, Lower Snake River Juvenile, Salmon Migration Feasibility Report/Environmental Impact Statement, APPENDIX I, Economics, pp. I3-214,

Appendix 2

In the Draft DMMP/EIS, October 2001, Section 1-12, U.S. Army Corps of Engineers, Walla Walla District, the COE estimated the saving to shipping by barge versus rail to be \$43.9 million (that is, \$458.33 (rail cost) minus \$414.43 (barge cost)).

“A similar evaluation was presented in the December 1999 Draft FR/EIS. The Draft FR/EIS estimated the increased average annual transportation costs resulting from the elimination of barge transportation at \$27.5 million in 1998 dollars [appendix I, Economics of the Draft FR/EIS (Corps, 1999)].”¹⁷

In the DMMP the COE used the cost of shipping from the LSR to Portland instead of Wallula, Wa., the closest port on the Columbia River. In the process they added roughly 220 river and or rail miles to the cost of shipping. This improperly increased the COE’s calculation of the benefit of using the LSR navigation system.

Proper economic analysis requires looking no further than the next best alternative. In the case of the LSR navigation system the next best alternative is to use the difference between rail and barge only as far as Wallula, Wa., or perhaps Hermiston, OR. It was common practice for Idaho shippers to load onto barges in Hermiston then, and they continue to do so today. It is also a common practice of shippers using the Washington Grain Train to move wheat and barley from eastern Washington to Wallula.

Had the COE performed this calculation correctly, the benefit of the navigation system would have been only about \$18 million.

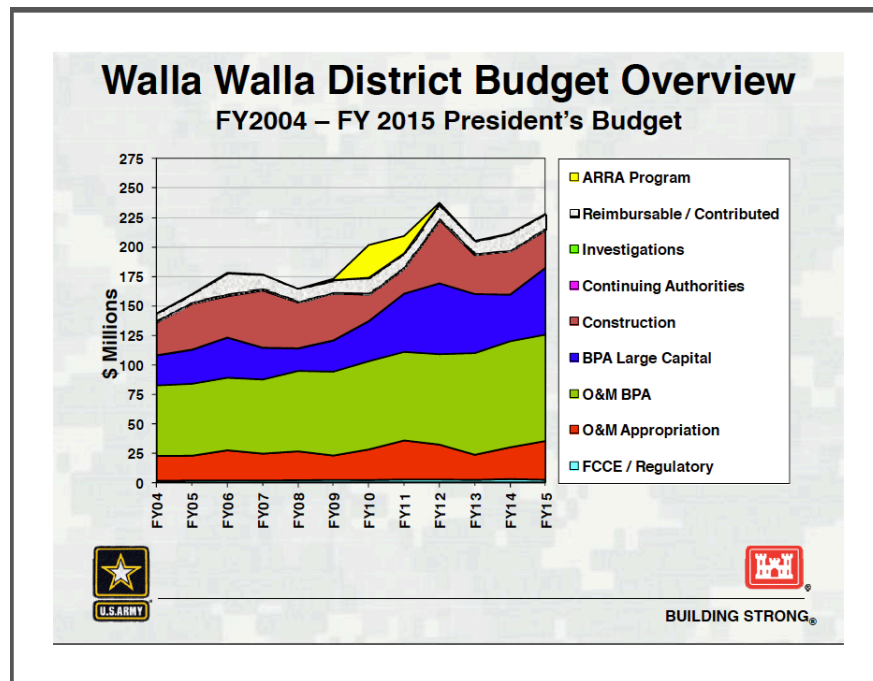
Fast forward to 2015, the difference between barge rates and rail rates is smaller by nearly half and the tonnage moved on the river is lower by about 1/3.

After correcting the economics and incorporating the 2015 freight rates and reduced tonnage, the benefit of the navigation system is now a much lower \$7.6 million per year.

¹⁷ Draft DMMP/EIS, October 2001, Section 1-12, U.S. Army Corps of Engineers, Walla Walla District

Appendix 3

Chart 13



Applying a constant 8% (10% of 80%) to the totals since 1990 and dividing by ton-miles on the LSR, it is clear that the COE's per ton cost has long been on the rise.

In 2014, to move a ton of grain a mile on the LSR, the farmer paid \$0.039 and the COE paid \$0.057, for a total of \$0.096 per ton-mile. Compare that to the rail rate of \$0.063

