How to Breach the 4 Lower Snake River Dams with a Pile of *Policy* Papers and Two D-8’s

• Prepared by Jim Waddell Civil Engineer, PE USACE Retired
Lower Granite Dam with Channel Bypass
Why Breach? Not a Topic of This Presentation, but to give 3 overarching reasons

• The 4 LSRD’s have never been economically viable and recent calculations indicate the BCR is well below 1 compared to Breaching which ranges between 4 to 1 and 19 to 1------depending on the desire to replace the lost power.

• Fullup costs to tax and ratepayers appear to have exceeded power revenues for the last 5 years and is adding to BPA “dire financial situation”

• In spite of over $1 Billion in passage improvements since 2002 EIS signed, the 4 dams and reservoirs are still the major cause of failure to meet Recovery goals and ESA requirements.

And, it needs to be done quickly!
The 5 Polices or Means That Make Breaching Feasible in a Short Time Frame

1. The Corps needs no new authorities to place the 4 LSRD’s into a “non-operational” status while normative river flows are reestablished by removing the dams’ earthen portions.

The Corps’ 2002 Environmental Impact Statement and Record of Decision provide the necessary NEPA coverage for breaching, although some updating may be required, 3-4 months.

3. Neither the ongoing litigation over the 2014 Federal Biological Opinion nor the Court’s order for a new EIS constrains the Corps from breaching the dams through channel bypass now.
The BiOp, 02 EIS & New EIS

- 1991 SOR
- 1994 Bi-Op
- 1995 Start NEPA
- 1998 Supplement Bi-Op
- 2000 New Bi-Op
- 2002 EIS / ROD
- 2004 New Bi-Op SUED!
- 2008 New Bi-Op SUED!
- 2010 Supplement 2008 Bi-Op SUED!
- 2014 Supplement 2008 Bi-Op Again SUED!
- 2016 Judge allows 5 Years for FCRPS NEPA / EIS
- 2016 Supplement 2-3 Months, Breach!
- 2021?

Warm Colors Action Litigated, Blue is Policy Approach
You will love what it says on page 25.

The 2002 Lower Snake River Feasibility Report (FR/EIS) also mentions dam removal as an alternative.

Meanwhile it is also committed to following the guidance of the 2002 FR/EIS as a framework for its actions.
4. Breaching can be financed through existing debt reduction and credits mechanisms as a fish mitigation action or direct funding by BPA. New appropriations are not necessary.
5. Breaching the 4LSRD’s is far easier than originally planned, making it possible to move from a decision to breach, to breaching in a matter of months, not years. And does not cost a billion or two, $300-340 Million with contingencies for adaptive construction.

So let's look at the cost of breaching

• The 2002 FR/EIS provided two costs; Complete Dam Removal and Channel Bypass, both often referred to as “breaching”

• Dam Removal $1,785 Million, True “sticker shock”, BCR for keeping the dams goes well over 1 by avoiding this cost.

• Bypass $859 million, still a lot and keeps the BCR over 1 for keeping the dams

• This is why we constantly hear breaching is going to cost billions no matter the method
The Corps selected Bypass since it would provide for salmon passage, but still unaffordable.

A careful review of the breach approach Appendix D of the FR/EIS cost reveals significant over estimates

1. Its not the math or the calculations.....its the assumptions

2. And, simplications in the breach are evident in the docement, but ignored, overlooked,...?
An Example

Road and Railroad Damage Repair at Lower Granite Dam Estimated at $109 Million Based on the assumption that there would be damage due to rapid drawdown thus slope failure, as observed in the 1992 Drawdown Test.

The $109 million was for armoring to prevent this damage.
However, a review of the widely distributed 1992 Drawdown Report revealed a “bit” different story:

This report gives the cost of actual repairs for Roads and Railroads damaged by drawdown at $519,000.

So the Corps was going to spend $119 million to prevent $519 thousand in damages......you gotta love that ”riprap” mentality.

Corrected Cost: $1 million, saving $118 million on one feature
There were dozens more assumptions like this that drove the cost of armoring/riprap of embankments, bridge piers, abutments, etc, thru the roof......and these features were roughly 70% of the breach cost.
Image from 2002 EIS Summary, pg 19, showing various features of work. **Red Star** indicates features not required. **Yellow Star** reduced in cost by changed assumptions. **Green Star** needed. Most changed assumptions can be correlated with photographic evidence, the FR/EIS, related documents, or known practices at the time of construction.
Establish more intensive vegetation development/planting in draws on newly exposed reservoir areas

Repair railroad/highway embankments where necessary

Establish vegetation on exposed reservoir lands

Stabilize rock of railroad fill

Protect cultural resources at known or newly discovered sites
Note the raised construction area, this was left in place. This area exposed to free flowing river for several years.

Costs for dike construction and Channelization substantially reduced.
Note Bridge pier armor, reinforced when project levees encroached on channel width. Cost engineers assumed this would need to be substantially replaced. Not likely, it was built to protect against high velocities for several years then covered by 14’ of backwater. Image from 92 drawdown.
Modify draft tube bulkheads (visible openings on powerhouse tailrace)
Modify turbines and support equipment for outlet use
Modify intake gates for proposed turbine operation (top of powerhouse)
Construct temporary adult fish passage facilities at Little Goose and Ice Harbor
Install site security to prevent unauthorized access to abandoned site (fence and gates on top of the levee and around facility)
So let's look at those red stars to see how “easier” further reduced costs.

1. The supplemented breach used a one dam per year schedule as the two dams per year the Corps proposed. Thus tailwater from lower reservoir allows turbine use w/o modifications. However............there is now a need to breach the 1st two dams in year 1
2. Corps original plan calls for removing turbines to dewater the reservoir below spillway crest. Unnecessary, as their model runs show turbines can be run with just 20 feet of head for long enough to dewater.......so why did they ignore this....?

3. Corps plan uses a ”rapid drawdown” rate of 2 feet per day, with little explanation of why except that was the rate in the 92 test*. Revised plan starts at 6 inches per day and slowly speeds up as the reservoir is drawn down. This lessens risk of slope failure and lowers seeding and cultural protection costs.
4. Corps plan used mechanical excavation and hauling to an offsite location requiring nearly round the clock effort with many pieces heavy equipment until they are working in the "wet" between coffer dams. The remaining 20 feet of dam would be hydraulically washed out by river flows.

Revised plan cuts a notch in the earthen portion requiring two dozers (one is really a backup) to 20 feet below spillway crest. Material is pushed down the face of the dam, not hauled off. At this point a controlled hydraulic breach is started using turbine wicket gates to control flow to a desired CFS.

This saves $54 million on Lower Granite and Little Goose, the first two to go.

Lower two breaches will require cutting into the earthen abutments so savings will depend on soil type.
WinDam B software used for breach modeling.

Note that 100 more CFS could be used for breaching and not exceed max spring flows.

With a faster drawdown and higher breach discharge 1st two dams could be breached in one in work window.
Drawdown Pool Elevation, at spillway crest only 25% of the reservoirs volume remains.

Each dam has 6 turbines.
Walla Walla District approach for original plan was to use “fixed Price” contracts. This would have required plans, engineering and design (PED) of $55 million, plans & specs and contract docs another $25 million.

But as you can see, this is no more than a rental or ”time and materials” contract requiring a ”design” effort of less than $1-2 million.
Table 8: Four Dam Totals  
(Costs shown in the tables are in thousands of 1999 dollars)

<table>
<thead>
<tr>
<th></th>
<th>Original Cost</th>
<th>Corrected Cost</th>
<th>Difference</th>
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<tbody>
<tr>
<td>Grand Totals (thousands of dollars)</td>
<td>$858,939</td>
<td>$255,026</td>
<td>$603,913</td>
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<tr>
<td>Power House Turbine Modifications</td>
<td>$31,707</td>
<td>$6,341</td>
<td>$25,366</td>
</tr>
<tr>
<td>Dam Embankment Removal</td>
<td>$161,930</td>
<td>$83,000</td>
<td>$78,930</td>
</tr>
<tr>
<td>River Channelization</td>
<td>$148,202</td>
<td>$54,000</td>
<td>$94,202</td>
</tr>
<tr>
<td>Temporary Fish Handling Facilities</td>
<td>$37,754</td>
<td>$0</td>
<td>$37,754</td>
</tr>
<tr>
<td>Project Dam Decommissioning</td>
<td>$6,009</td>
<td>$6,009</td>
<td>$0</td>
</tr>
<tr>
<td>Railroad Relocations</td>
<td>$20,182</td>
<td>$18,705</td>
<td>$1,477</td>
</tr>
<tr>
<td>Bridge Pier &amp; Abutment Protection</td>
<td>$51,858</td>
<td>$11,371</td>
<td>$40,487</td>
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<tr>
<td>Reservoir Embankment Protection</td>
<td>$178,815</td>
<td>$15,104</td>
<td>$163,711</td>
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<tr>
<td>Drainage Structure Protection</td>
<td>$8,556</td>
<td>$8,556</td>
<td>$0</td>
</tr>
<tr>
<td>Railroad/Roadway Damage Repair</td>
<td>$130,007</td>
<td>$3,000</td>
<td>$127,007</td>
</tr>
</tbody>
</table>

These estimates still include about 30% contingency
It is all right here. NEPA pros at Corps estimate a team of 5 could complete this supplement from scratch in 2-3 months. But it is mostly done here and from publically available documents.

http://damsense.org/reports/
What Is the Current Situation with Returns? Biologist tell me it is a “disaster”

Hence, the Urgency ....... more so than each previous year

Source: Columbia Basin Research
“Figure 4.1. SARs from smolts at uppermost Snake River dam to Columbia River returns (including jacks) for wild Snake River spring/summer Chinook, 1964-2013. The NPCC (2014) 2%-6% objective for listed wild populations is shown for reference; SAR for 2013 is complete through 2-salt returns only.”

Reference: Fish Passage Center 2015 CSS Annual Report
Figure 9. Weighted SARLGR-to-LGR for Dworshak NFH spring Chinook (1997–2013) and Clearwater-B hatchery steelhead (2008–2012). Migration year 2013 is incomplete for yearling Chinook, with Age 2-salt adult returns through 9/14/2015.

Reference: Fish Passage Center: 2015 Dworshak National Fish Hatchery Report
The Five Critical Policy Means Allow for Immediate Breach

1. The Corps needs no new authorities to place the 4 LSRDs into a “non-operational” status while normative river flows are reestablished by removing the dams’ earthen portions.

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5. Breaching is far easier than originally planned, making it possible to move from a decision to breach, to breaching in a matter of months, not years.

Source Doc at: http://damsense.org/reports/
2002 EIS

- Breaching is the “preferred environmental alternative”
  “*further improvements in the hydro system passage system are unlikely to recover listed Snake River stocks*”
- 7 Years & $33 Million
- Dam maintenance underestimated
- Cost of breaching overestimated
- Remains the operable EIS for the dams, Asst Sec Army Reaffirmed this basic policy
- NO matter what the BiOp says, it is still an opinion for an action agency, ie., the Corps, to *consider* in an EIS
2002 EIS Summary

“...the chance of meeting NMFS survival and recovery criteria for the four listed species Alt 1 [doing nothing] would likely be the same or slightly better than Alternatives 2 and 3 [passage improvements]. Alternative 4 (breaching) provides the highest probability of meeting the survival and recovery criteria...... The analyses indicate that further improvements in the hydrosystem passage system are unlikely to recover listed Snake River stocks...”

Conclusion.....we gambled over a billion dollars on doing something that was slightly worse than doing nothing, lost, and point fingers at habitat loss, fisherman, birds, and marine mammals and the catch all excuse, Ocean Conditions.

And Wasted Several Billion Dollars or Your Tax Money and Caused Your Power Bills to Go Up.
A Few More Recent Gov Statements

- **NOAA**’s 2016 & 2017 Snake River Spring/Summer Chinook Proposed Recovery Plan sums this up with this statement on page 219: *This recovery plan contains an extensive list of actions to move the ESU and DPS towards viable status; however, the actions will not get us to recovery.*

- *For more than 20 years, the federal agencies have focused on essentially the same approach to saving [Snake River] salmon—minimizing hydro mitigation efforts and maximizing habitat restoration. Despite billions of dollars spent on these efforts, the listed species continue to be in a perilous state.* Judge Michael Simons, May 2016.

- Wild Snake river runs are trending down the last few years, NOAA data
Breaching’s Effect On Other Recovery Efforts, eg., Habitat?

- Habitat restoration investments will be optimized in the Snake basin due to large numbers of returning fish that can make use of previous improvements.
- Opens roughly 80 miles of Chinook spawning and rearing habitat.
- Millions in fish passage mitigation funding can shift to riparian restoration on lower Snake and habitat work on other tributaries.
- More Corps funds available to other restoration initiatives such as Puget Sound Near Shore Restoration.
- Increased Snake runs relieve fishing and prey pressures on Salish Sea and Coastal stocks speeding their recovery.
After Breaching, Lower Granite Dam will look like this...

Image from the Corps 2002 EIS.....So they did study it!!
Four Lower Snake Dams  
Cost/Economics

• Benefit to Cost ratio over the life of the four dams is **15 to 1**
• Annual expenditures over the last 5 years have exceeded earnings
• LSR Dams are 2-4 times more expensive than mainstem dams on Columbia
• Three Turbine rehabs at Ice Harbor are now 3-4 times costlier than original estimates and 10 years behind schedule.
• Turbine rehabs of remaining 21 turbines not economically viable for BPA thus consumers.
• $2.5 billion spent on passage improvements with no improvements in SAR’s for Snake runs
• Oversupply of power in PNW increasing due to conservation, wind & solar.
LGR to BON is approximately 286 miles [7 dams]
RIS to BON is approximately 308 miles [6 dams]
*Snake River Hatchery Chinook is an average of annual hatchery specific estimates
Cost/Economics with Natural River

• Corrected breach cost now around $340 million, not 1 or 2 billion
• Benefit to cost ratio is at least 4 to 1 if the hydro power is replaced
• But, not really needed and will free up grid space allowing more wind and solar, 2000 megawatts of solar alone in BPA Integration que
• Breaching will save money for BPA/Corps which can be used on higher value dams and habitat restoration efforts. Eg., Puget Sound Near Shore, $400 million needed.
• Provides 7-8 thousand more jobs in State
• Land lease for restored viticulture and orchards could add $30 million a year to State School budgets and $200 million in direct economic benefit
• ETC...
But, Can It Be Done and In Time, YES!!

- Corps can place dams into a "non-operational" status without Congressional authorization since dams do not provide an economic benefit and are causing significant harm to the environment.
- Since dams are 92% hydro, BPA pays the breach bill under the allocation rules and the 1980 Power Planning Act as Fish Mitigation.
- NEPA? The Corps has the 2002 EIS that covers breaching, the only remaining reasonable alternative, can be updated in a matter of months.
- Breaching via removal of earthen berm portion of dam by controlled hydraulic breach requires little further engineering or complex contracting.
- Could and should begin in December of 2017!
Harvest

- More salmon and steelhead for fisheries, endangered Southern Resident Killer Whales, other marine mammals and critters.
- Removes stocks from endangered status thus eliminating incidental take restrictions in mixed stock fisheries.
- Increased fishing of ever more larger fish has numerous spinoff economic benefits to the State and region.

Hatcheries

- Lower Snake Compensation Plan hatcheries built to mitigate salmon losses due to dam construction along mainstem should be closed, others modified of phased out over time, BPA saving go to other hatchery programs or restoration efforts.
And lets not forget the greater PNW ecosystem

• Greater numbers of larger salmon will increase the amount of biomass and nutrients moving from the ocean to the interior
• Other endangered aquatic species such as lamprey and sturgeon will benefit with breaching
• Riparian areas in the Snake basin will see sustainable increases in overall diversity and population density.
• Fewer algae producing reservoirs reduces methane emissions, a powerful global warming gas.
So What Are We Waiting For?

• Many elected officials, government leaders, environmental NGO’s and the media are fixated on the BiOp litigation over the last 15 years
• And, seemed to have gone out of their way to forget that the Corps is operating and conducting mitigation activities today with the 2002 EIS
• While a litigation “victory” for some NGO’s, another decade of studies to develop the programmatic FCRPS EIS and then a breach EIS, is too long for salmon.
• Meanwhile actions in the 2002 EIS are an ongoing track and independent of the Court ordered studies, which do not relieve the Corps from acting sooner.
• These Court actions do not relieve the Corps from their inherent responsibilities to meet the Federal Objective and the Endangered Species Act.
• The 02 EIS has breaching as the only remaining reasonable alternative

Senior Corps officials have noted that neither the State, NW Delegation, Environmental NGO’s nor the Tribes have actually asked the Corps to breach the dams since 2000. They have asked for many other things, such as more spill, flow augmentation, studies, even studies to honestly consider breaching, but not immediate breach.
And Then There Is the Money

$2.5 Billion spent since 1988 on the 4 LSRD’s with No improvement

“Record Runs” are achieved by putting ever more hatchery fish into the Snake, since there SAR’s are so low and will continue to decline because they are genetically inferior and depend on an ever declining number of wild stocks to boost their genetics. About $35 mill this year escalating at 5% per year.

Big looser is habitat investments that could have been made with this money.

Habitat investments that were made are sub optimized by lack of Snake stocks in the ecosystem.
### Benefit Cost Ratios

#### National Economic Development Benefit Cost Ratios

<table>
<thead>
<tr>
<th>Keep the Dams</th>
<th>Remove the Dams</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endangered Species Mitigation</strong></td>
<td><strong>Economic / Ecologic Change</strong></td>
</tr>
<tr>
<td>Endangered Southern Resident Killer Whales (SRKW) &amp; Salmon Species</td>
<td>Positive</td>
</tr>
<tr>
<td>Climate Change Challenges</td>
<td>Neutral</td>
</tr>
<tr>
<td>The USACE spent $800.0M over 15 years on failed system improvement efforts for juvenile salmon passage thru the four dams</td>
<td>Negative</td>
</tr>
<tr>
<td>Warming reservoirs kill salmon and favor predators, methane emissions increase</td>
<td>AA = Average Annual Cost at 6.0% Discount Rate</td>
</tr>
<tr>
<td><strong>Hydropower</strong></td>
<td>Only remaining alternative in EIS for ecosystem recovery, increasing salmon numbers and prey availability for SRKW</td>
</tr>
<tr>
<td>Benefit</td>
<td>Diurnal cooling in natural rivers increases fish survival, allowing more fish to utilize high elevation spawning grounds in Idaho</td>
</tr>
<tr>
<td>$202.6M AA, high side</td>
<td><strong>Cost</strong></td>
</tr>
<tr>
<td>Power generated is 2.9% of regional, with production trending downward due to aging infrastructure and the benefit likely a transfer from idle wind turbines</td>
<td>$0 - $261.8M AA</td>
</tr>
<tr>
<td><strong>Life Cycle Implementation</strong></td>
<td>Shift to wind or other surplus sources; costs trending downward, regional grid surplus is 5 times production of LSR dams</td>
</tr>
<tr>
<td>Cost</td>
<td><strong>Cost / Loss</strong></td>
</tr>
<tr>
<td>$269.4M AA, 91% of costs</td>
<td>$7.6M AA, high side</td>
</tr>
<tr>
<td><strong>Transportation Inland N</strong></td>
<td>AA, 9% of dam</td>
</tr>
<tr>
<td>Down 50%</td>
<td><strong>Cost</strong></td>
</tr>
<tr>
<td>B</td>
<td>$29.0M AA, breach 1 dam / yr</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td><strong>AA</strong></td>
</tr>
<tr>
<td><strong>Cost</strong>/Loss improvement</td>
<td>$7.6M AA, high side</td>
</tr>
<tr>
<td>$100M</td>
<td>AA, 9% of dam</td>
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</table>
2002 Corrected + Future Costs

Reference: Cost Report, July 2014, Jim Waddell
Lower Snake River (LSR) Dam Costs

Millions

<table>
<thead>
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<th>Year</th>
<th>Cost</th>
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<tr>
<td>2001</td>
<td>$1500</td>
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<tr>
<td>2011</td>
<td>$2000</td>
</tr>
<tr>
<td>2021</td>
<td>$2500</td>
</tr>
<tr>
<td>2031</td>
<td>$3000</td>
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End of Paper Graph

Keeping Dams

Dam Breaching
Reasons For Breaching

Dams are driving species to extinction

$2.5 \text{ Billion} \text{ failed efforts for salmon passage}

Climate change poses new challenges

Dams could violate U.S. Treaties
River transportation in long-term decline, farmers shifting to rail

Hydropower already replaced

Corps Walla Walla District understated cost of keeping the dams by $161M per year
Dams cost millions in lost economic benefits

Increased recreation will provide 2,350 – 4,100 jobs

The Corps can no longer afford non-productive infrastructure
Why The Universal Belief That Dam Breaching Is Too Costly?
2002 EIS Keep vs Breach

Figure 3.8-1. Comparison of Annual Implementation Costs
Reference: Lower Snake Feasibility Report / Environmental Impact Statement
2002 Corrected Annual Costs

Annual Dam Costs in Millions of Dollars

Reference: Cost Report, July 2014, Jim Waddell
Cost errors revealed & corrected

Breaching dams

Most Reasonable and Prudent Alternative

Frees up millions of dollars

Increases economic benefits
Recreation

$290 - $501 Million

2,350 - 4,100

Jet boaters & skiers, rafters, kayakers, canoeists, swimmers, picnickers, campers, hikers, mountain bikers, hunters & anglers

The spending associated with recreation along a free-flowing LSR will generate substantial economic activity throughout the region, with the greatest economic activity occurring in the first four years.

Photo Ben Knight
White Salmon Before and After Condit Dam
Leaders have been misinformed since 2002

Political Mission Impossible: keeping salmon and the four lower Snake River dams

Lack of political will

Lack of community insistence to breach dams now
Biological, technical, economic and financial data support dam breaching

EIS provides authority to breach and funding mechanisms in place: freed up money can be re-applied to Columbia River dams and Habitat work

Congressional action not necessary
What Legacy Will We Leave?

A Free Flowing Snake River with Salmon for Life

or

Extinctions for Salmon and SRKWs

“You can always count on Americans to do the right thing – after they’ve tried everything else!”

Winston Churchill
### Summary - Economic Effects

**Relative Average Annual Costs - $Millions**

<table>
<thead>
<tr>
<th>USER AREA</th>
<th>MAX TRANSPORT</th>
<th>SYSTEM IMPROVEMENT</th>
<th>DAM BREACHING</th>
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<tbody>
<tr>
<td><strong>COST</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td>($271)</td>
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<tr>
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<tr>
<td>Irrigation</td>
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<td>Implementation</td>
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<td>($49)</td>
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<td>($359)</td>
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<td>Comm. Fishing</td>
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<td>Avoided Costs</td>
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<td>Implementation</td>
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<td>Recreation</td>
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<tr>
<td>S/T Benefits</td>
<td>$14</td>
<td>$10</td>
<td>$113</td>
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**NET ECONOMIC EFFECT**

$14 $4 ($246)

*Note: Numbers reflect change from current condition (base case).*

*From CORPS 1999-2000 INFORMATION BRIEFS*
## Summary - Economic Effects

(Relative Average Annual Costs - $Millions)

<table>
<thead>
<tr>
<th>COST</th>
<th>MAX TRANSPORT</th>
<th>SYSTEM IMPROVEMENT</th>
<th>DAM BREACHING</th>
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<tbody>
<tr>
<td>Power</td>
<td>-</td>
<td>-</td>
<td>($271)</td>
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<td>Navigation</td>
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<td>($24) ($12)</td>
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<td>-</td>
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<td>($6)</td>
<td>($49) ($87)</td>
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<td>S/T Costs</td>
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<td>($359) ($320)</td>
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<table>
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<th>BENEFITS</th>
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<tbody>
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<td>Comm. Fishing</td>
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<td>$29 ($217)</td>
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<tr>
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<td>$14</td>
<td>$10</td>
<td>$113 ($389)</td>
</tr>
</tbody>
</table>

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$69 Mill AVRG. ANL.

Benefit

As of 1 Jan 20XX

A DIFFERENCE OF $315 Million!!
## Summary - Economic Effects

(Below Average Annual Costs - $Millions)

<table>
<thead>
<tr>
<th>COST</th>
<th>USER AREA</th>
<th>MAX TRANSPORT</th>
<th>SYSTEM IMPROVEMENT</th>
<th>DAM BREACHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>-$</td>
<td>-</td>
<td>-</td>
<td>($271)</td>
</tr>
<tr>
<td>Navigation</td>
<td>-$</td>
<td>-</td>
<td>-</td>
<td>($24)</td>
</tr>
<tr>
<td>Irrigation</td>
<td>-$</td>
<td>-</td>
<td>-</td>
<td>($15)</td>
</tr>
<tr>
<td>Implementation</td>
<td>-$</td>
<td>-</td>
<td>-</td>
<td>($49)</td>
</tr>
<tr>
<td>S/T Costs</td>
<td>-</td>
<td>($6)</td>
<td>-</td>
<td>($350)</td>
</tr>
</tbody>
</table>

### BENEFITS

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Comm. Fishing</td>
<td>-</td>
<td>-</td>
<td>$2</td>
</tr>
<tr>
<td>Avoided Costs</td>
<td>-</td>
<td>-</td>
<td>$29</td>
</tr>
<tr>
<td>Implementation</td>
<td>$4</td>
<td>-</td>
<td>$313</td>
</tr>
<tr>
<td>Recreation</td>
<td>$2</td>
<td>$2</td>
<td>$82</td>
</tr>
<tr>
<td>Power</td>
<td>$8</td>
<td>$8</td>
<td>$172</td>
</tr>
<tr>
<td>S/T Benefits</td>
<td>$14</td>
<td>$10</td>
<td>$489</td>
</tr>
</tbody>
</table>

**NET ECONOMIC EFFECT** $14  $4 ($245)

**Note:** Numbers reflect change from current condition (base case).

**Corrected Numbers Brought Forward to 2015 @ 6.88% Discount Rate.**

**158 Million AVG, ANL. BENEFIT**
Overall, freight volumes passing through the Ice Harbor locks (the lowest on the Snake River) have declined 20 percent since the 2002 study. Barges on LSR reservoirs are used to transport wood chips, wheat and barley, pulses (e.g., garbanzo beans), and rapeseed (canola). Commodity producers can choose shipping via rail or road. Since 2008, in large part a pipeline has moved petroleum to a refinery in Salt Lake City. Container-on-barge shipping down the Columbia effectively ended after container ships abandoned the Port of Portland in 2015.

Table 3: Tonnage by Commodity Group (000 tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood chips</td>
<td>550.5</td>
<td>634.0</td>
<td>236.0</td>
<td>-57%</td>
<td>-63%</td>
</tr>
<tr>
<td>Grain</td>
<td>3,051.4</td>
<td>3,038.0</td>
<td>2,800.0*</td>
<td>-8%</td>
<td>-8%</td>
</tr>
<tr>
<td>Petroleum</td>
<td>116.4</td>
<td>120.0</td>
<td>15.8</td>
<td>-86%</td>
<td>-87%</td>
</tr>
<tr>
<td>Total</td>
<td>3,718.3</td>
<td>3,792.0</td>
<td>3,051.8</td>
<td>-18%</td>
<td>-20%</td>
</tr>
</tbody>
</table>

Water Supply

WATER SUPPLY
Approximately 34,000 acres of irrigated farmland use the reservoirs produced by the Lower Snake River dams for water supply. Should the dams be breached, these farms would either need to drill wells to reach the aquifers or modify their water withdrawal systems. The water supply values do not reflect the value of the water that is supplied, but the modification costs that would be incurred if the dams were to be breached. Because of this, there are no costs or benefits associated in the “with dams” scenario.

WITH DAMS
Although the Snake River reservoirs provide irrigation to approximately 37,000 acres of farmland, the costs versus benefits have not been calculated as the 2002 FR/EIS assessed this as a net change over the existing with dam condition.

BREACH DAMS
There have been no additional studies conducted on the cost of not having a reservoir for irrigation, and therefore the point estimate used in the analysis is the $15.4 million ($22.5 million in 2015 dollars) estimate from the 2002 FR/EIS. However, review to date indicates that the pumping capacity used to calculate these increased pumping costs is significantly overstated. The FR/EIS shows that the increased pumping costs would yield 1 foot of water across 37,000 acres every 19 days. The FR/EIS also assumes that the land would no longer be used for crop production, as opposed to switching to crops that demand less water, e.g., wheat or wine grapes.


**Recreational Expenditures & Jobs Without Dams**

The spending associated with recreation along a free-flowing LSR will generate substantial economic activity throughout the region, with the greatest economic activity occurring in the first four years.

- Jet Boating, Jet Skiing
- Raft / Kayak / Canoe
- Swimming
- Picnic / Primitive Camping
- Developed Camping
- Hike and Mountain Bike
- Hunting
- Angling

Table 5. Expected expenditures as a result of recreation from a free-flowing Lower Snake River (Values in millions, 2015 USD)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Asotin</th>
<th>Columbia</th>
<th>Franklin</th>
<th>Garfield</th>
<th>Walla Walla</th>
<th>Whitman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>$501.1</td>
<td>$120.4</td>
<td>$23.6</td>
<td>$141.8</td>
<td>$30.1</td>
<td>$50.5</td>
<td>$134.7</td>
</tr>
<tr>
<td>Year 5</td>
<td>$291.6</td>
<td>$74.5</td>
<td>$13.1</td>
<td>$77.4</td>
<td>$19.5</td>
<td>$28.8</td>
<td>$78.1</td>
</tr>
<tr>
<td>Year 10</td>
<td>$347.9</td>
<td>$86.8</td>
<td>$16.0</td>
<td>$94.7</td>
<td>$22.4</td>
<td>$34.7</td>
<td>$93.4</td>
</tr>
<tr>
<td>Year 20</td>
<td>$373.1</td>
<td>$92.4</td>
<td>$17.2</td>
<td>$102.5</td>
<td>$23.7</td>
<td>$37.3</td>
<td>$100.2</td>
</tr>
</tbody>
</table>

Table 7. Jobs supported by recreation expenditures

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Asotin</th>
<th>Columbia</th>
<th>Franklin</th>
<th>Garfield</th>
<th>Walla Walla</th>
<th>Whitman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>4161</td>
<td>1104</td>
<td>181</td>
<td>1177</td>
<td>219</td>
<td>529</td>
<td>951</td>
</tr>
<tr>
<td>Year 5</td>
<td>2380</td>
<td>663</td>
<td>99</td>
<td>640</td>
<td>135</td>
<td>294</td>
<td>526</td>
</tr>
<tr>
<td>Year 10</td>
<td>2876</td>
<td>788</td>
<td>121</td>
<td>785</td>
<td>157</td>
<td>357</td>
<td>640</td>
</tr>
<tr>
<td>Year 20</td>
<td>3098</td>
<td>843</td>
<td>131</td>
<td>849</td>
<td>168</td>
<td>385</td>
<td>691</td>
</tr>
</tbody>
</table>

The 4 Dams Need to Be Breached Now
But How?

- Reevaluate Corps 2002 Report
- Value Engineer Breach Plan
- Update the EIS
- Update the Cost and Economics
- Develop Financial Strategy
- Inform ALL of new & corrected information
- Develop Breach Execution Plans
Likely Last Call for Snake River Wild Salmon
Like the Free Flowing Elwha Below
Snake River Will Recover If We Let It