5 Means for Breaching the Lower Snake River Dams

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All essential components leading to both a viable hydrosystem and recovery of Salmon and Steelhead in the Columbia/Snake Basin are currently available, and they would save the public a fortune.

This paper outlines five existing, essential components or "means" which the US Army Corps of Engineers (Corps) and Bonneville Power Administration (BPA) can utilize to immediately breach the four Lower Snake River Dams (LSRDs). In doing so, the Corps and BPA will avoid financial and biological losses, decrease power rates for Washington, and finally put an end to a +25 year-long debate.

While this paper describes some of the economic, financial, and biological reasons for breaching the LSRDs, its primary purpose is to show *how* (not *why*) the dams can be breached very quickly without undo fiscal hardship on any one group, such as BPA rate payers. This discussion covers multiple areas which are interconnected. A "further discussion" section follows the five-means and explores details on *why* we should breach the LSRDS.

Many government reports / documents reveal the high costs of operating and maintaining the LSRDs and the benefit of returning the lower Snake River to free-flowing conditions. More recent reports also indicate the financial and biological conditions have degraded to the point that discussing breaching the LSRDs can no longer be "kept off the table." The fish returns[1] over the last three years reinforce the urgency of breaching these dams immediately.

The issue of "mothballing" units and using "disposition" studies has been discussed at BPA Federal Hydro IPR reviews as seen in the meeting notes from June 2016[2]. Importantly, NOAA Fisheries 2016 Proposed ESA Recovery Plan for Snake River Spring/Summer Chinook and Steelhead admits "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**."[3] Breaching was not among these options.

Immediate, collaborative action can lead to the financial and biological viability of our hydrosystem, free up government funding for other dams and habitat work, create thousands of new jobs, and likely end otherwise never-ending litigation. The five means which allow this to happen are:

1. The Corps needs **no new authorities** to place the LSRDs into a "non-operational" status while normative river flows are reestablished by removing the dams' earthen portions.
2. The Corps' 2002 Environmental Impact Statement[4] and Record of Decision provide the necessary **NEPA coverage for breaching.**
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.
4. **No new appropriations are needed.** Breaching can be financed through existing debt reduction and credits mechanisms as a fish mitigation action by BPA.
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).

Discussion of the Five Means

1. **The Corps needs no new authorities to place the LSRDs into a "non-operational" status, while normative river flows are reestablished by removing the earthen portion of the dams.**

The Corps has a fiduciary responsibility (ultimately derived from the Public Trust Doctrine) to protect the public interest and to fund only beneficial projects. A "beneficial project" is measured by the National Economic Development benefit-to-cost ratios (BCR) as exceeding 1; meaning for every dollar spent, at least one dollar in benefit is returned. *The LSRDs have a combined BCR of 0.15:1*. This means the LSRDs are returning only 15¢ for every $1 invested; we are losing $0.85 for every dollar we spend. This pales to projections that a free-flowing Lower Snake River could return $4-$19 for every $1 invested depending on what was done with the free-flowing river post-breaching[5]. This would be a BCR of 4:1 or 19:1, respectively.

Protecting the public's interest means the Corps can place an underperforming project, such as the LSRDs, into a "caretaker" or "non-operational" status. This does not require a specific or new authorization from Congress, nor does it require that the project be "deauthorized" by Congress first. Thus, the Corps has the fiduciary responsibility to place the LSRDs into a non-operational status, based on the BCR.

Further reasoning for this is that a project "authorization" is not a mandate. Authorization provides the Corps permission to build and operate a project for specific purposes so long as that project provides economic benefit, conforms to other applicable laws and policies, and receives appropriations. When one or more of these criteria is not met, the Corps does not have permission to continue operation.

An of example of placing a project into a "non-operational" status, is the Willamette Lock and Dam in Portland Oregon; placed into a non-operational status in December 2001, due to low use versus the cost of operations and maintenance[6].

It is important to note that discussions surrounding the LSRDs are often referred to in terms adhering to the "purpose and needs" as authorized by Congress. This is an unnecessary argument on the part of the regional federal agencies (primarily the Corps), to say that the "purpose" of a project cannot be changed without Congressional authorization. This is true; however, placing a project into a "caretaker" or "non-operational" status does not change the purpose. Hence, *the Corps is not constrained in anyway, from considering breaching.*

Just recently, the Corps' Northwest Division stated that a Corps engineering regulation, ER1165, provides guidance that breaching would require Congressional authorization. However, this ER's purpose is to prevent the Corps Field Officers from changing the purpose of a project (i.e. changing the purpose from hydropower generation to flood control) or increasing the scope of a project. Placing dams into a non-operational status does neither, thus this regulation is not applicable.

2. **The Corps' 2002 Environmental Impact Statement and Record of Decision provide the necessary NEPA coverage for breaching, although some updating may be required.**

The 2002 Environmental Impact Statement (EIS) details breaching as a reasonable alternative. This EIS is used to this day to guide mitigation actions on the dams, as confirmed by the Assistant Secretary of the Army (Civil Works) in January 2017[7]. The 2002 EIS states that of the four reasonable alternatives,

breaching provides the best opportunity to recover salmon and steelhead. It also states doing nothing (Alternative 1, the "existing condition" at that time) was slightly better than "transportation" of juveniles in barges around the dams (Alternatives 2) or more "system improvements" in the form of fish bypass hardware (Alternative 3). Nevertheless, the Corps selected a modified Alternative 3, which eventually included much of Alternative 2[8]. Since selecting these two alternatives in 2002, the Corps has spent nearly $1 billion on them with virtually no improvement towards salmon or steelhead recovery. This is on top of the nearly $1 billion already spent since 1988 when the Columbia River Fish Mitigation Program (CRFM) was authorized in an effort to improve fish passage around the LSRDs and McNary Dam, with similar results.

In anticipation of the likelihood the Corps would want to, or would be pressured to, carry out Alternative 4, a group of qualified individuals have updated the 2002 EIS with the necessary data.

Over the past several years a diverse group of economic, engineering, and environmental professionals and volunteers from various technical backgrounds, including retired Corps staff (with considerable experience on the LSRDs), have reviewed, updated, and corrected much of the 3,000 pages of the 2002 EIS. In nearly all cases this work followed Corps planning guidance and used data in the EIS; or if missing, compiled it from Corps, BPA, and NOAA data and reports. This document can be found online at http://bit.ly/BreachPlan2016.

An estimate made by knowledgeable NEPA and planning staff with Corps' experience, indicates that five people working full time for four to five months could complete this update on their own. Updating is also made easier since a decision to breach would be based on the fact the two non-breach alternatives of the EIS have largely failed to improve salmon / steelhead survival and initiate recovery. There is no need to update the non-breach alternatives, other than to acknowledge their inability to recover listed species and the need to move onto the remaining alternative in the 2002 EIS: breaching through channel bypass. Therefore, the most important part of the EIS to update and / or supplement is the Natural River Drawdown Engineering and Economics Appendices. These were rigorously reviewed and updated by the previously mentioned group of professionals, revealing that corrections of current costs and economics readily show additional justification for the "reasonable and prudent" use of the breach alternative.[9] [10]

3. **Ongoing litigation over the 2014 federal biological opinion and the Court's order for a new EIS does not limit or constrain the Corps from acting in the meantime to accelerate salmon and steelhead recovery via breaching and channel bypass.**

A letter received from Assistant Secretary of the Army, Civil Works department in January 2017 confirms that the Court's (Judge Simon) direction for a new and broader NEPA process is a separate action.[11] Meaning it does not prevent the Corps from exercising its responsibilities to comply with existing law and regulation today. In other words, the Court's ordered EIS is not a "get out of jail free" card to avoid any action until said EIS comes out - which is probably 6-9 years away, since this new EIS will be a "programmatic" type for the entire Federal Columbia River Power System (FCRPS).

Should breaching the LSRDs be included in this new programmatic EIS and a decision be made to develop a breach plan, a second, more specific EIS would have to be prepared. By then the salmon and steelhead biological condition will have significantly degraded and the economic failures (evident but ignored today) will be painfully obvious. Thus, a new EIS would have to be started largely from scratch.

If the Corps and BPA adopt the policy approach outlined in this paper and begin breaching in the very near term (i.e. within the year), it would be up to the Court to decide what (if any) further NEPA, biological opinions, or EIS work would be necessary to satisfy the Court's intentions to address recovery of listed species. Breaching certainly would largely satisfying these goals and likely would end the litigation altogether. Furthermore, to update the current 2002 EIS and move forward with breaching as the selected alternative would not require much effort.

4. **No new appropriations are needed. Breaching can be financed through existing debt reduction and credits mechanisms as a fish mitigation action by BPA.**

This fourth means can be broken into three subtopics: BPA's fish mitigation credits, the Corps' overestimation of breaching costs, and amassed debt accumulated by previous failed attempts to recover the fish species.

First, since BPA is responsible for 92% of the cost of these four dams, BPA is responsible for at least 92% of the breach cost (92% is an average; the cost share ranges from 98.4% for Lower Granite dam to 78% for Ice Harbor dam)[12]. If BPA sought to pursue breaching the LSRDs as the most cost effective "fish mitigation" measure for salmon and steelhead recovery under the 1980 Power Planning and Conservation Act, BPA can book a 22% credit against the US Treasury debt on these dams. This has the added advantage of avoiding any of the appropriation and authorization conundrums involved in attempting to get Congress to act.

The second financial consideration is the cost of breaching. When originally estimated by the Corps in 1999, the cost for full dam removal was estimated to be $1.8 billion.[13] That amount is often used as the basis for claiming that removal would cost $2-$3 billion in today's dollars. However, full dam removal was not the Corps' recommendation for the breach alternative; it was channel bypass. Channel bypass involves removing the earthen berms on all four dams and part of the natural embankment along the two lower dams. This concept restores normative flows and habitat in the entire 140 miles stretch of the lower Snake River while leaving the concrete structures intact. With channel bypass, the concrete structure stays in place, making breaching much cheaper while still satisfying all the biological and safety considerations.

In 1999, breaching through channel bypass for the LSRDs was estimated to cost $859 million[14]. However, subsequent and careful review of the planning assumptions used to develop this estimate indicates many assumptions were incorrect or unnecessary and led to gross overestimates. For instance, in order to prevent $400 thousand in rail and railroad damage, $109 *million* was estimated for bank stabilization on just one reservoir. $400 thousand was the actual cost to repair such damage after the 1992 drawdown test of Lower Granite Dam[15].

A more reasonable estimate based on corrected assumptions gives an estimate of $255 million in 1999 dollars for breaching via channel bypass[16]. In 2018 dollars, the cost would be about $384 million for all LSRDs. The breach cost for the first dam, Lower Granite after taking a 22% credit, would cost only $34 million. The next dam, Little Goose, would cost $33 million to breach. Lower Monumental and Ice Harbor would cost $69 and $79 million respectively, due to the need to excavate and widen the river embankment and to relocate a rail line at Ice Harbor.

Cost of Breaching after 22% credit (2018 dollars)

Lower Granite	$34 Million
Little Goose	$33 Million
Lower Monumental	$69 Million
Ice Harbor	$79 Million
Total	$215 Million

To put these costs into some perspective, the Corps will end up spending about $120 million by the end of 2018 for juvenile fish bypass improvements just on Lower Granite dam. Of this, BPA and its ratepayers would have to repay roughly $110 million (or 92% of the cost).

The third financial component concerns the debt and debt service resulting from these LSRDs. While BPA has been slow at paying down its debt burden, it must make timely interest payments to the US Treasury. These interest payments alone account for about 44% of BPA's cost to operate, maintain, and repair the LSRDs and bypass systems (mitigation), and will continue to increase without debt relief[17]. If not already, these interest payments will soon be greater than the Operations and Maintenance costs for the dams. Hence, interest payments on debt will be the largest cost item for the ratepayers' bill for the LSRDs.

Given the failed alternatives selected by the Corps in the 2002 EIS, and the nearly $1 billion spent since 2000 on these failed alternatives (e.g. little or no improvements in Smolt-to-Adult Returns for salmon and steelhead), BPA ratepayers can make a good argument for not repaying this debt nor the interest bearing on it. Likewise, Corps' CRFM expenditures prior to signing the EIS yielded few (if any) sustained recovery benefits.

Ratepayers should not be held accountable for the decisions made by the Corps, especially in light of the fact that over 80% of the individual comments to the Corps in 1999 supported dam breaching. Therefore, these expenditures also should be exempt from repayment by BPA's ratepayers.

In addition to CRFM expenditures, to date 92% of the Corps' Operations & Maintenance and Lower Snake River Fish and Compensation Plan expenditures add to the debt burden and interest payments. Additionally, BPA's cost or debt that will accrue for the repair and replacement of the $2 billion CRFM investment in the "systems improvements" that must be maintained if the LSRDs are to be kept in an operational mode, is still unaccounted for in these estimates. These repair and replacement costs are roughly 50% of the initial cost every 20 years. Those systems will cause additional fish mortality and likely will further exacerbate the Corps "jeopardy" situation under the Endangered Species Act, if not properly maintained.

Given all this, what is a fair and equitable solution to reduce this financial burden for all concerned? BPA should utilize the existing 4(h)(10)(C) credits of the 1980 Power Planning and Conservation Act[18], an accounting mechanism for "fish credits" for the $384 million breach cost. To have ratepayers cover the cost of breaching because of failed mitigation efforts by the Corps is onerous. While this author has not been able to ascertain the total debt already on the books at BPA for the LSRDs, it is likely in excess of $2 billion (based on $1.5 billion in CRFM debt portrayed in the BPA Focus 2028 Federal Hydro review[19]),

and the $1 billion debt noted on page 12-1 in the Economics Appendix of the 2002 EIS. While these numbers are dated, a lot more debt has accumulated with little evidence of repayment. These are mostly interest payments (20% of *all* BPA interest payments for the hydrosystem), is disproportionally high for the LSRDs, since the LSRDs represent about 12% of the net hydropower generation[20].

Since the breach costs would still be a fraction of the CRFM debt, further debt reduction and credits could be used by BPA to cover mitigation costs for irrigators on Ice Harbor pool (recently reengineered and estimated at $18 million) to cover the construction of extended pump intakes, screens, additional pumps, etc. The 2002 EIS addresses this issue as an economic cost, but not necessarily a cost of breaching, since the irrigation system is not a federal system. Note, this cost was originally estimated by the Corps at $251 million in 1998 dollars, which was more than the farmland was worth. This lead 15 irrigation farmers to vehemently oppose dam breaching. The correct cost should have been around $14 million and well within a mitigation package for BPA and the Corps. A recent report estimated cost replacements to be $18 million in 2016 dollars.[21]

The 2002 EIS lists five other non-federal mitigation modifications likely required for breaching, such as water intakes and effluent diffusers for the Clear Water Paper Company in Lewiston, Idaho, but does not provide cost estimates[22]. By my estimates, together these modifications should not exceed $20 million and are well within the scope of what could be covered with mitigation credits. All other mitigation associated with breaching impacts is covered in the above-estimation breach costs of $384 million.

If this approach to financing via debt reduction were taken, taxpayers at least would benefit from increased salmon / steelhead runs. Local economies would benefit from the survival of other listed species, such as the Southern Resident Killer Whales who depend on the Chinook runs for more than 80% of their diet, a large part of which should be composed of Snake River runs. Breaching would allow for the very positive economic benefits to many communities, derived from a natural river, in terms of several thousand more agricultural, recreational, and fishing jobs, direct expenditures in the region in excess of $700 million annually, and $20-$30 million in land-lease revenues per year for the Washington State School budget, should the project lands be conveyed to the State.

For those taxpayers who are also ratepayers of BPA, this approach would lessen the financial risk BPA is facing in light of $16-$17 billion in total debt, making them the worst public utility in the country in terms of an asset-to-debt ratio of 93% according to a BPA's budget officer[23]. This approach would also shift Corps and BPA funds to other projects that would benefit the environment and taxpayers far more than the existing situation.

At this point with the deteriorating and harmful LSRDs in place, BPA can only continue to raise rates, which will make the entire hydrosystem less competitive. Lowering costs has rightfully been a BPA priority for decades. However, an aging hydrosystem costs more money to operate, maintain and rehabilitate. The effects of cost-cutting have been apparent for years in lower reliability ratings, unplanned outages, fewer in-service turbines, etc. Only some significant cost reduction measure, like shutting down the LSRDs as outlined here, will keep the FCRPS a viable energy producer into the future.

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).

Given the relative ease of hydraulically breaching an earthen embankment, there is no need for lengthy modeling, engineering, design, or complicated and lengthy contracting. New dam-overtopping

modeling software has been developed since the 2002 EIS was drafted which allows a safe breach plan to be created quickly.

The breach itself is done in two phases:

1. First, drawdown of the reservoir begins. While this takes place, earth moving equipment (likely two D8 bulldozers and an excavator) will be cutting a notch in the earthen portion of the dam.
2. When drawdown is below the spillway crest and the notch cut to that depth, controlled hydraulic breaching will begin, which uses the turbine gates to control flow. This takes approximately 8 hours with maximum flows, not exceeding high flows normally encountered during spring runoff.

Armoring protection and other channelization work can also be accomplished with several pieces of heavy equipment. The entire "construction" effort can easily be accomplished through "Time and Materials" or rental contracts. Details to the breach approach can be found in the 18 Feb 2016 Supplement (unofficial) to Appendix D Natural River Drawdown Engineers of the 2002 EIS[24], as referenced on page 3.

In short, what the Corps' Walla Walla District originally estimated would take several years in modeling, engineering, design, and contracting and well over $70 million, can be done in a matter of months for around $1 million.

Further Discussion

This dam situation is analogous to the reluctant transition from steam to diesel power which, when accomplished, became the major contributor to the resurrection of American railroads in the 20th century. The Pacific Northwest should immediately drop wasteful dams and retool the rest of the system to propel us into an age of economically and environmentally sustainable power. As further justification for this action, below are some common areas of concern.

Fish Biology Precedence

Despite the billion of dollars spent on system improvements and billions spent on harvest, habitat, and hatchery improvements, we have not begun to move the needle closer to recovery. [25] Indeed, the Smolt-to-Adult Ratios (a metric used to determine recovery of a species) have been nearly 0 for the past 3 years and have never reached their required 4% in the past 20 years. NOAA Fisheries 2016 Proposed ESA Recovery Plan for Snake River Spring/Summer Chinook and Steelhead admits "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."[26] Breaching is not among these options.

The biological need to accelerate fish recovery would require breaching 2 dams the first year (2019); Lower Granite and Little Goose could be breached starting in December 2019, followed by breaching one dam per year for the last two dams.

Since this paper was written, another biological irony has surfaced in the bypass system. Invasive walleyes have found the bypass system a convenient place to find and eat juvenile salmon and steelhead, and now must be fished out by hand at the rate of around 40 a day to prevent significant ESA listed fish kills.

Breaching the LSRD's would eliminate the invasive walleye and enable millions of smolts to survive the Snake River and cross the remaining dams on the Columbia River. These would grow to adults who would be more likely to make it to their historical spawning grounds in "Salmon Country" on the Snake River. This great need cannot be put off any longer.

Spill

Over the years, studies have looked at drawing down the LSRD reservoirs to spillway crest, or below, to improve the migratory corridor and recover lost Chinook habitat. Some assume this can be achieved simply by keeping the spillway gates open and letting river-full flows pass over the spillway; often referred to as "maximum spill." However, maximum spill would have significant engineering and safety challenges.

First, since the dams would continue to be obstacles to migrating fish, maximum spill would require complete and expensive design and construction of new fish ladders. Second, the dams were designed under the assumption that the spillways would not be used continually at full-flow without interruption. Within a matter of a few years, the spillway aprons would start eroding back into the face of the dam, which would lead to undermining and eventual failure of the concrete structure. "Apron erosion" already has happened at least once on the LSRDs.

Second, drawdown to the spillway crest also would leave at least 50 miles of the 140-mile corridor in a reservoir condition. This minimizes the biological benefits and still eliminates all benefits from hydropower and navigation. In other words, there is not much point to drawdown to the spillway crest.

Likewise, to simply "mothball" the turbines without drawdown and using only spillways, would lead to catastrophic dissolved gas levels. Indeed, this was the sole reason the remaining 12 turbine units were installed in the turbine bays after completion of the dams in 1975. To avoid deadly dissolved gas levels caused by excessive flow over the spillways, it has been suggested that the turbine wells be used to convey all or part of the flows. Whether, at full pool, partial, or complete drawdown, mothballing the turbine units cannot be done without removing the turbines and making very costly modifications to the turbine wells and draft tubes. Allowing continuous flows without these modifications would impose hydrodynamic forces on the dam that would lead to structural failure. Once again, there is not much point to "mothballing" these turbines.

The most economically and biologically sound solution is to breach the LSRDs via channel bypass.

Politics

Congressional representatives and governors are often reluctant to support deauthorizing a project for fear of being perceived as taking something away from their constituents. It is also a long held cultural (or institutional) norm for local Corps districts and divisions to ignore the economic reality of a project, and instead, go to great lengths to defend the project. (This is understandable to some degree, since the Corps district offices are trying to protect their budget and livelihood. But this does not conform to the Corps' stated values toward public service and avoiding squandering taxpayer dollars, nor does it comply with the Public Trust Doctrine.)

This leads to frequent arguments between the Senior staff in Headquarters US Army Corps of Engineers and the Assistant Secretary of the Army for Civil Works on one hand, and the Corps' field commander/staff and elected officials on the other hand. In short, there is never enough money to fund even high performing projects, and with the administration trying to further reduce the Corps' Civil

Works budget, the Corps should pay particular attention to eliminate poor performing projects in the manner proposed in this paper.

Seeing as the "needs" for these four dams never has been economically demonstrated[27] [28], it is high-time to move forward with breaching and improve the economic standing in eastern Washington.

Available Funds and Lack Thereof

Many government reports together reveal both the high costs of the LSRDs, and the benefits derived from retuning the lower Snake River to a free-flowing condition. More recent reports also indicate that financial and biological conditions have degraded to the point that discussing breaching the LSRDs can no longer be "kept off the table."

There are two areas that are lacking funds for both BPA and the Corps. The first is replacing 21 turbines that have exceeded their design life.[29] The reliability of these units continues to decline. Reliability is now around 75%. Currently there is at least one turbine down for major repairs at each dam. Other turbines are temporally unavailable due to various technical issues. Indeed, as an example of breakdowns plaguing these dams, last year, 5 of 6 turbines at Lower Monumental dam were down for an extended time. It appears from reviewing programing documents, that BPA has concluded the cost of replacing these units does not pencil out. Failure to replace these turbines will mean further and longer outages, further loss of revenue, and higher dissolved gas concentrations caused by additional spill that will harm fish.

Another cost-avoidance feature is the Corps' failure to conduct "conveyance" dredging on the Lower Snake River at Lewiston, Idaho, which was conducted until 1997. Conveyance dredging is needed to remove about half of the 2 million cubic yards of material that is deposited annually in the backwater of Lower Granite reservoir. This is not the same as the dredging to maintain navigation through these same deposits but is in addition to it. Due to the lack of Navigation Program funds, and the fact that additional conveyance dredging is not needed for barge traffic to reach Lewiston, these deposits have been building up since 1997. The build-up has formed a bench-like obstruction in the Snake River which creates a backwater condition during high water events, which could overtop the levees protecting Lewiston. Therefore, the lack of necessary dredging is causing the potential for flooding in Lewiston. The risk for ratepayers will be realized when Lewiston *is* flooded, and the insurance companies come looking for the deep pockets to sue[30].

Another investment area directly impacted by the failed CRFM program is habitat restoration work in the Snake River basin and indirectly in other parts of the Columbia Basin. Low escapement of adult fish above the LSRDs means fish are not there in sufficient numbers to take advantage of habitat improvements. The subsequent lack of nutrients left by the absence of adult carcasses is further reducing the habitat function. Restoration work in the rest of the Columbia Basin, coastal rivers and estuaries along the Oregon and Washington coast and the Salish Sea has been negatively impacted. This is because the failure to increase runs on the Snake River has created greater "incidental take" pressure from fishing and predation on other runs in the Pacific Northwest, thus minimizing the effects of habitat restoration in those other areas. Of course, breaching would immediately increase runs due to reduced mortality, lessen "take" on other stocks, and thus allow full benefit of habitat investments in the region.

Since BPA, State, or Tribal funded habitat restoration all have been impacted as noted above, or because funds were diverted from other habitat programs to fund the mitigation work on the LSRDs, debt reduction credits should be used to fund this much needed habitat work. The formula for doing so is beyond the scope of this paper, but some immediate compensation should be estimated no later than

the start of breaching, given the biological urgency facing the Pacific Northwest ecosystems. The timing of developing near term estimates of these credits (no more than one year), should also be a part of the renegotiation considerations for the Columbia River Accords.

Regarding Compensation Plan hatcheries, these are also in need of rehabilitation or replacement. Whether BPA or Corps funded, this will add additional cost / debt burden to BPA and its ratepayers.

For BPA, in the event of dam breaching, they should consider further debt reductions. The credit could be based on the cost difference between lost hydropower revenue and power purchases required to meet loads in BPA's balancing area. While current and projected conservation measures along with a power oversupply situation may limit the credit just described, some form of credit should be given serious consideration as a matter of compensation for debt generated by the failed CRFM program, perhaps even complete debt relief from all CRFM expenditures.

Additional Savings

While this debate of breaching continues, the Court ordered EIS (described in Means #3) is estimated to cost is the $80 million. Initial estimate for the new EIS (which likely will end up costing more than $100 million). If breaching is started in 2018, at least $120 million of these costs could be avoided - which is enough to cover the costs of breaching *three* of the four LSRDs.

Furthermore, the "needs" for these four dams never has been economically demonstrated[31] [32].

Section 216 Study

When the Corps places a project into a "non-operational" status, its intent is to stop spending money on it. Therefore, the Corps must first ensure that before placing a project into a non-operational status it does not create a safety hazard, damage the environment, or become a nuisance, and that the project requires only minimal funds once it is non-operation. Breaching the earthen berm is the action which ensures the dams channel is secure.

It is the Corps' policy to conduct a disposition study for existing projects. This is done in the form of a Section 216 process and would require Congressional direction and study appropriations. However, and a critical point, disposition studies are normally done on projects that are *already* in a non-operational status. At best, this study would show that the dams would need to be placed into a non-operational status first. Or the study could spell out and request authorizing language from Congress that would allow breaching and continuation of operations appropriations prior to and during breaching, in order to place the dams into a non-operational status prior to complete disposition. If this sounds like a confusing, convoluted and contradictory use of the authorizations and appropriations process, it is - and could happen only with a very determined majority effort on the part of the federal / state agencies and Congress to breach. One could assume Congress could skip the Section 216 study process, but it doesn't simplify the conundrum noted, nor is it necessary. Thus, the most appropriate use of a Section 216 study would be in parallel to the breach process in order to determine the final disposition of lands and remaining dam structures. That is why the Corps / BPA strategy (outlined in Means #3) appears to be the only way to break out of the intractable and seemingly endless process that has been going on for at least 20 years, with no end in sight.

A final noteworthy point is a draft Section 216 study for the Willamette Lock & Dam was just completed[33]… 16 years after the project was placed into a non-operational status[34]. To follow suit with the LSRDs would be synonymous with signing a death order for the salmon and our tax money.

References & Endnotes:

[1] NOTE: As of 10 September 2017 Snake river Spring/Summer Chinook returns to Lower Granite Dam are down 55% form the 10 year average, Fall Chinook are down 60%, steelhead are down 73% and predictions for 2018 based on "jack" chinook returns looks to make it the 3rd consecutive year of plummeting returns. Source: Corps of Engineer fish ladder counts as displayed by http://www.cbr.washington.edu/dart/query/adult_daily, for each run and year. For more background as to the urgency, see the December 2015 Salmon White Paper and Surrogate Appendix, http://www.damsense.org/wp-content/uploads/2014/12/1.Snake-River-Endangered-Salmon-White-Paper-11-4-15.pdf, and appendix, http://www.damsense.org/wp-content/uploads/2014/12/1.2-Appendix-1-Fall-Chinook-Surrogates.pdf, and the White Paper on Southern Resident Killer Whales, http://www.damsense.org/wp-content/uploads/2016/05/7.-White-Paper-Southern-Resident-Killer-Whales-2.24.16.pdf.

[2] http://www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDocuments/Fed%20Hydro%20IPR%202%20Notes.pdf, page 1

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[7] http://damsense.org/wp-content/uploads/2014/12/Waddell-Dec-w-Darcy-Letter-TO-Honorable-Michael-H-Simon-2.23.17.pdf,

[8] http://www.nww.usace.army.mil/portals/28/docs/environmental/lsrstudy/Summary.pdf, page 25

[9] http://www.damsense.org/wp-content/uploads/2016/05/Cost-of-Dams-Rebuttal-7-29-2015.pdf, and, http://www.damsense.org/wp-content/uploads/2015/07/Cost-LSR-Dams-1-1-2015F-2-vers-7-30-15.pdf,

[10] http://www.damsense.org/wp-content/uploads/2014/12/National-Economic-Analysis-of-the-Four-Lower-Snake-River-Dams-2.16.pdf, and http://www.damsense.org/wp-content/uploads/2014/12/Regional-Economic-Dev-Summary-Reevaluation-Lower-Snake-Dams-22-Feb-16.pdf,

[11] http://damsense.org/wp-content/uploads/2014/12/Waddell-Dec-w-Darcy-Letter-TO-Honorable-Michael-H-Simon-2.23.17.pdf,

[12] http://www.nww.usace.army.mil/portals/28/docs/environmental/lsrstudy/Appendix_I.pdf, page I12-3, para 12.2.1

[13] http://www.nww.usace.army.mil/portals/28/docs/environmental/lsrstudy/Appendix_D-AnnexX.pdf,

[14] Ibid

[15] US Army Corps of Engineers Walla Walla District, 1992 Reservoir Drawdown Test, Lower Granite and Little Goose Dams, page 133.

[16] http://www.damsense.org/wp-content/uploads/2016/05/4.-Breach-Plan-Estimate-JW-21-Feb-2105.pdf, Page 6.

[17] Bonneville Power Administration. 2017-2030 Hydro Asset Strategy, page 23.

[18] 4(h)10(c) is a section of the 1980 Power Planning and Conservation Act which BPA refers to when applying for US Treasury credits resulting from the non-hydro portion (e.g. navigation and irrigation) of various fish and wildlife expenses. The section says little about this but is frequently cited, since the clause refers to the Act not changing past accounting practices, that is taking a 22% credit for the non-hydro expenses. A display of these cost can be found on chart 22 of the briefing at: http://www.bpa.gov/Finance/CostVerification/Documents/20130719-Slice-True-Up-101-Presentation.pdf

[19] http://www.bpa.gov/Finance/FinancialPublicProcesses/2028/doc2028/Focus%202028_Federal%20Hydro.pdf, page 7.

[20] http://www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf, chart 23.

[21] Sampson, R. 2018 *A brief review of the impacts to irrigated farmland from breaching the four dams on the Lower Snake River. https://damsense.org/wp-content/uploads/2018/10/Irrigation-Impacts-LSR-Dams.pdf*

[22] http://www.nww.usace.army.mil/portals/28/docs/environmental/lsrstudy/Appendix_D-AnnexX.pdf, Annexes O through T.

[23] http://www.cbbulletin.com/438250.aspx,

See also financial report from Moody's that says that Asset to Debt ratio is 95%, http://www.bpa.gov/Finance/FinancialInformation/Debt/RatingAgencyReportsArticles/Moody's%20April%202016%20Final%20Report.pdf.

[24] http://www.damsense.org/wp-content/uploads/2016/05/4.-Breach-Plan-Estimate-JW-21-Feb-2105.pdf

[25] NOTE: As of 10, September 2017 Snake river Spring/Summer Chinook returns to Lower Granite Dam are down 55% from the 10-year average, Fall Chinook are down 60%, steelhead are down 73% and predictions for 2018 based on "jack" chinook returns looks to make it the 3rd consecutive year of plummeting returns. Source: Corps of Engineer fish ladder counts as displayed by http://www.cbr.washington.edu/dart/query/adult_daily, for each run and year. For more background as to the urgency, see the December 2015 Salmon White Paper and Surrogate Appendix, http://www.damsense.org/wp-content/uploads/2014/12/1.Snake-River-Endangered-Salmon-White-Paper-11-4-15.pdf, and appendix, http://www.damsense.org/wp-content/uploads/2014/12/1.2-Appendix-1-Fall-Chinook-Surrogates.pdf, and the White Paper on Southern Resident Killer Whales, http://www.damsense.org/wp-content/uploads/2016/05/7.-White-Paper-Southern-Resident-Killer-Whales-2.24.16.pdf.

[26] http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/proposed_snake_roll_up_10.25.16.pdf, page 219

[27] Corps of Engineers, Special Report on Selection of Sites Lower Snake River, March 14, 1947, paragraph 394 comes to justify a positive BCR (the report's economic calculations showed in preceding chapters that it cost more to produce than could be made from selling it) by including two "if" conditions that are inconsistent with fair and reasonable economic calculation of benefits: "***IF*** credit were taken for indirect navigation and power benefits, *which admittedly are great* and ***If*** additional credit were taken for the use of cheap hydroelectric power over electrical power produced by the next most economical means, full economic justification of this project on the inflated 1946 cost index would be assured". Emphasis added. These conclusions used to justify the "need" are an example that "two wrongs can make a right" in the Corp's world of twisting the logic and wording to get the answer they wanted.

[28] http://www.damsense.org/wp-content/uploads/2014/12/National-Economic-Analysis-of-the-Four-Lower-Snake-River-Dams-2.16.pdf,

[29] Citations are difficult to find, as it is the absence in programming documents that show the turbine replacements are not scheduled to occur, at least for the next 20 years.

[30] The information in this paragraph is derived from the Programmatic Sediment Management Plan (PSMP) prepared by the Corps Walla Walla District. This $17 million study and plan was prepared in order to satisfy environmental concerns related to maintaining dredging on the lower Snake River. Principally in the Lewiston, Idaho area. The District did not however, consider breaching and the elimination of waterborne navigation in the alternatives, as they claimed it did not satisfy the "purpose and needs" argument. When challenged with public comments showing that the BCR for navigation was too low to justify the "need ", the District then used economic data incorrectly from the 2002 EIS to support their claim for the "need". Based on the 2002 EIS, their claim of substantial navigation benefits was shown to be in error in a paper entitled *"Commercial Navigation on the Lower Snake River, Two Wrongs Don't Make a Right"*, and can be found at http://www.damsense.org/wp-content/uploads/2014/12/Report_LSD-Commercial-Navigation.pdf. It is important to also note that this PSMP shows that movement and deposition of sediment deposits in the river is not harmful to the river ecology and that the continuing deposition of sediments in the Lewiston and Clarkston area of the river are a significant problem in terms of elevating flood risk in Lewiston. Both these points, and the fact that these sediments are a natural part of this river system, are further supportive of the breaching alternative. The PSMP can be found at http://www.nww.usace.army.mil/Portals/28/docs/programsandprojects/psmp/PSMP_FEIS_Final_Combined_8-13-14.pdf.

[31] Corps of Engineers, Special Report on Selection of Sites Lower Snake River, March 14, 1947, paragraph 394 comes to justify a positive BCR (the report's economic calculations showed in preceding chapters that it cost more to produce than could be made from selling it) by including two "if" conditions that are inconsistent with fair and reasonable economic calculation of benefits: "***IF*** credit were taken for indirect navigation and power benefits, *which admittedly are great* and ***If*** additional credit were taken for the use of cheap hydroelectric power over electrical power produced by the next most economical means, full economic justification of this project on the inflated 1946 cost index would be assured". Emphasis added. These conclusions used to justify the "need" are an example that "two wrongs can make a right" in the Corp's world of twisting the logic and wording to get the answer they wanted.

[32] http://www.damsense.org/wp-content/uploads/2014/12/National-Economic-Analysis-of-the-Four-Lower-Snake-River-Dams-2.16.pdf,
[33] http://www.nwp.usace.army.mil/willamette/locks/