Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species
May 22-23 Policy Workshop Summary

This document highlights key presentation topics and recommendations from the May 22-23 Chehalis Basin Policy Workshop in Chehalis, WA. The purpose of the Policy Workshop was to present technical studies to the Governor's Chehalis Basin Work Group, Chehalis Basin Flood Authority members, tribal officials, state agency managers, and other interested parties and gain their input regarding the policy implications of the technical issues. The Governor's Chehalis Basin Work Group will make the project decisions that guide the direction of the Chehalis Basin Strategy. The Work Group recommendations are due to the Governor and legislature by November 2014. The Work Group will recommend a long-term strategy for reducing flood damage and enhancing aquatic species. They will also recommend a work program and budget for the next state biennium 2015-2017.

All workshop presentations are available on the Flood Authority website:
https://www.ezview.wa.gov/site/alias__1492/34798/meetings_2013-15.aspx#GovPolicyMay2014

Overview of Process to Develop Recommendations to the Governor and Legislature
This presentation provided an overview of the process to develop recommendations to the Governor and Legislature. The study period used for the economic analysis will be 100 years, with a baseline that includes current conditions as well as currently funded projects; Basin-wide, State, and Federal perspectives will be presented.

Alternatives being evaluated include baseline conditions, flood retention only dam, multi-purpose dam, WSDOT I-5 alternatives, small flood projects (including floodproofing), aquatic species enhancement plan (ASEP), and combinations of these projects. A draft benefit/cost economic analysis report will be available in September 2014. In September 2014, there will also be a series of technical and policy workshops, a Flood Authority meeting, and public meetings to present and discuss final results and solicit input for flood reduction and aquatic species enhancement recommendations. The Work Group will finalize recommendations to the Governor and Legislature in November 2014.

Flooding in the Chehalis
This presentation included an overview of the updated hydraulic model, an illustration of the level of flooding at different flood frequencies, and information on the number and type of structures in the floodplain. The design flood events being simulated for this project are:

- A modeled estimate of 10-, 20-, 100-, and 500-year flood events, focused on main stem Chehalis River
- 2-year event also being simulated
- The historical storms of December 2007, February 1996, and January 2009 are being used to calibrate the hydraulic model and effects of different actions can be estimated for these storm events. However, they will not be included in the benefit/cost analysis.

To improve flood damage estimates when evaluating alternatives, work has been done to identify structures in the Chehalis floodplain. Previous analyses relied on parcel boundaries and depth of water on ground, while the current analyses use actual structure locations and depth of water in buildings. This allows for estimates, based on the actual development in the Basin, about potential impacts and benefits of alternatives on particular structures. A total of 9,087 structures were evaluated: 5,512 were found to be "of significant value" and 3,575 others were not assigned a value. The total assessed value of the structures was $607M.

This presentation also provided a summary of the latest report from the UW Climate Impacts Group (CIG):

- Rain dominant basins (like the Chehalis) will see increase in 100-year flood of 11% to 26%
- The mean estimated increase is 18%
- Does not include projected changes in heavy rainfall
- Other researchers like Hamlet et.al. suggest the increase may be 10 – 50% or more (forthcoming paper).

There were no major suggested changes with the material presented at the workshop. Other key discussion topics and comments included:

- Clarifying that the structure survey uses assessed values, which is different from damage value estimates that will be done through the economic analyses.
- Some participants expressed the need to consider low flows in addition to heavier rainfall due to climate change.
    - This is being considered in the Aquatic Species Enhancement Plan.

Aquatic Species Enhancement Plan

This presentation provided the current information and assumptions regarding the ASEP. Methods used in the limiting factors analysis included Smith and Wenger, EDT model, and input and reviews by technical team member experts and local experts. In summary, there are a combination of factors limiting species abundance and productivity of salmon species. The most prevalent are riparian degradation, water quality, sedimentation, and associated issues.

The proposed habitat enhancement actions focused on salmon due to lack of information for other species. Actions were modeled for salmon using EDT and qualitatively assessed for other fish and non-fish species. Identified actions included:

- Remove/improve barriers to fish passage (culverts)
- Riparian Enhancement/Restoration/Preservation
- Add in-water wood structure – site specific depending on geomorphology and need
- Floodplain re-connection (this was not modeled but will be in the next steps)

- Working with landowners to improve protection of aquatic species habitat (this can't be modeled but will be a component of the aquatic species plan)

The table below presented at the workshop summarizes the cost and benefits of the three main enhancement actions for salmon.

Scenario	Cost Range ($ M)	Spring Chinook	Coho	Fall Chinook	Winter steelhead
1. Culverts	26 - 50	0%	12%	3%	24%
2. Managed forests	-	15 – 26%	11 – 22%	6 – 9%	8 – 15%
3. Non-managed forests	37 - 84	40 – 76%	17 – 28%	6 – 11%	7 – 12%
Total	63 – 134	55 – 102%	40-62%	15 – 23%	39 – 51%

For aquatic species other than salmon, there is limited information available. Limiting factors are based on known limiting factors for species and are not known to be limiting in the basin; available information and best professional judgment was used. Key findings for other fish species were:

- Silt free substrate is important to many of the species
- Non-native predators are likely negatively impacting many of these species
- Floodplain connectivity is important to many of these species

Key findings for other aquatic species were:

- Exotic aquatic predators are probably limiting to all key amphibian species and the turtle.
- The lack of suitable aquatic and riparian habitats adjacent to each other are likely limiting for Northern red-legged frog, western toad and the turtle, although the type of riparian habitat and width desired varies with the species.
- Older seral stage coniferous forest that can produce large wood may be limiting for coastal tail frog and Van Dyke's salamander.
- Information on distribution and abundance of all non-fish taxa remains a major gap that needs address to better direct options.

Regarding the climate change analysis for effects on salmon, early modeling results show:

- Reduced numbers of Chinook and Steelhead estimated with climate change in all scenarios
- Slight increase in coho numbers between climate change and the continuation of existing conditions

There were no major suggested changes or issues raised in regards to the effects of managed forest riparian buffers, climate change considerations, species focus, or level of effort and cost for benefits of enhancement.

The representative from the Quinault Indian Nation expressed concern with some of the modeling results, especially regarding effects on spring Chinook, and requested that tribal staff look at the data and models in more detail.

Other key discussion topics and comments included:

- Department Ecology staff noted that it would be useful to model a combination of climate change and forest practice assumptions.
- Meeting participants requested abundance summary slides show numbers, instead of just percentage increases.
- WDFW staff would like to put more emphasis on understanding the impacts of off-channel connectivity efforts for other-fish and non-fish species.
- Clarifying that enhancement efforts are geared to provide a lift for all salmonids, though the focus is on spring Chinook.
- Clarifying that rainbow trout and cutthroat trout are considered.

Water Retention

This presentation provided information on the design, operation, and costs for the three water retention alternatives, including the benefits for flood damage reduction and environmental implications. The dam structure options selected for further evaluation are:

- Flood Retention Roller Compacted Concrete (RCC) Dam (FR-RCC)
- Multipurpose RCC Dam (MP-RCC)
- Multipurpose Rock Fill Dam (MP-Rockfill)

Fish passage options were also selected for further evaluation. For upstream passage, CHTR facility, conventional fishway, experimental fishway, and tunnels through dam were chosen. For downstream passage, combination collection facilities, forebay collector, and tunnels through dam were chosen.

Preliminary Class 5 cost estimates were provided. The expected accuracy range for the estimates is +40/-20% in 2014 dollars. Cost estimates included base construction costs and contingencies for design unknowns, construction change orders/claims, design and site investigations, permitting, and construction management and engineering support. Cost estimates *did no*t include O&M costs, mitigation costs, land purchase, or state administration costs and taxes.

Cost estimates for the three water retention alternatives and fish passage alternatives are summarized below. These costs are preliminary Class 5 estimates for screening purposes only; they should not be used for budgetary purposes

Preliminary Class 5 Cost Estimate: 2014 $M, Avg. Estimated Value and +/- Range					
	Dam	**Fish Passage Upstream**	**Fish Passage Downstream**	**Hydropower**	**Total Range**
FR-RCC	265-421				265-421
MP-RCC	322-512	10-18	17-30	20-25	369-585
MP-Rockfill	408-566	40-70	27-47	20-25	495-708

In regards to dam operations, the proposed operating rules for a flood retention only dam are:

- Available flood storage capacity = 65,000 acre-feet
- The objective is to operate the facility without impounding water except during a flood that causes damage in downstream areas
- When flows at Grand Mound gage are predicted to be above the "Major Flood" stage of 38,800 cfs within 48 hours, the reservoir starts impounding water
- The reservoir outflow is reduced at a rate of 200 cfs per hour until the reservoir outflow reaches 300 cfs.
    - The 200 cfs per hour rate was selected to reduce fish stranding in downstream areas. The 300 cfs flow is the recommended instream flow for the upper Chehalis River in winter.

The proposed operating rules for a multi-purpose dam are:

- The Multi-Purpose facility would have a conservation pool of 65,000 acre-feet and a flood storage pool also with 65,000 acre-foot capacity. The conservation pool would be utilized to provide instream flows during period of low flow (typically summer). The flood storage pool would capture high flows to reduce downstream flooding.
- During Large Flood Events
    - Similar to Multi-Purpose alternative except some of the flow may be retained for the conservation pool, depending on its storage volume. If the flood storage pool is being utilized during a flood, releases following the flood are increased at a rate of 1,000 cfs per hour to evacuate the flood storage pool. The peak release rate is dependent on the total storage and is as high as 11,000 cfs.
- Smaller (Non-Flood Causing) Storm Events
    - To help maintain geomorphic processes downstream of the reservoir, moderate events that occur multiple times per year on average (inflows 2,800 cfs and above) would be allowed to pass through (releases equal to inflow) as long as the flow at Grand Mound is not predicted to be in a flood condition.

Hydraulic model results show that a water retention structure would provide decreases in water surface elevation throughout the basin, which are greatest in the upper basin, in major storm events; a large

number of structures in the floodplain would also be kept dry. Below are the major results predicted from a water retention structure in regard to flooding.

- The reservoir would retain water 1 percent of time based on historic record of storm events.
- It would reduce flows by @15% for 10-100 year
- The 100 year flood would be reduced to 40 year event, the flood elevation would be 1.5 feet lower near Centralia, 0.5 lower near Montesano.
- I-5 would be closed less frequent and for less time
- Multi-purpose would increases summer low flows by factor of 3-6.

Structures flooded above first floor	100 Year Baseline	100 year With Dam	Difference	Climate
Floodplain Structures	1384	821	563	2202
Value of Structures ($Mil)	$137	$73	$64	$255

The preliminary modeling results (EDT and Shiraz) on the effects of flood retention alternatives on salmon show:

- Largest impact on spring-run Chinook and winter-run steelhead (basin scale)
- Largest change in abundance on Upper Chehalis sub-populations
- Some benefit from the permanent reservoir with the multi-purpose facility on coho
- Some positive effects from the multi-purpose facility on middle-to-lower river populations of Spring Chinook due to assumption that fish would benefit from cooler temperatures and increased flows in the summer
- The general pattern between dam alternatives (EDT) shows impacts on salmon from a flood retention only structure are greater than the multi-purpose alternative

The table below summarizes the estimated effect of a dam on four species of salmon. There are two scenarios estimated for the effect of a flood retention only dam. One scenario assumptions 100 percent of the Spring Chinook spawning habitat is degraded and another scenario assumes 50 percent is degraded.

Species	Current	Multi-purpose	Flood Retention 100%	Flood Retention 50%
Coho salmon	60,000	-2%	-3%	-2%
Fall Chinook	16,000	-3%	-3%	-3%
Spring Chinook	2,500	-2%	-12%	-10%
Winter Steelhead	10,500	-8%	-6%	-3%

For other aquatic species, the effects of flood retention alternatives show:

- Response varied with species thermal preferences (adaptations), life stage, location (reach)
- Low flows during summer months appear to be a limiting factor
- Increased summer flows may have a positive effect on some species
- Much more data is needed to determine in-channel effects on Other Fish and Non-Fish species
- Increase in inundation would have a positive effect and a decrease in inundation would have a negative effect on the off channel suite of species
- Much more data is needed to determine off-channel effects on Other Fish and Non-Fish species

Key discussion topics and comments included:

- Some participants raised concern about the need to better understand the potential impact of changes in the amount of large woody debris.
- Some participants raised concerns about changes to the habitat post 2007 and 2009 events, and express that the region has not fully recovered from those events. (there's a changing baseline)
- WDFW staff cautioned that the modeling results are preliminary, especially in regards to the potential benefits of a multi-purpose dam on spring Chinook in the lower main stem.
- Some participants expressed concern that the model for a multi-purpose dam does not accurately account for potential habitat improvements due to improved instream flows.
- The consultant team was asked look deeper at understanding the impacts from a dam on fish, especially in regards to looking at changes in habitat upstream and the effects on spawning and rearing upstream, as well as the impact of episodic events.
- Clarifying that recurring maintenance costs for a dam will be looked at later in the analysis and will factor into cost estimates.
- WDFW staff noted that in light of information presented regarding potential extended periods of reservoir inundation due to management of large woody debris and/or climate change, the agency still needs to consider if a redundant form of fish passage would be required.

- WDFW staff noted that they are still looking for ways to quantitatively account for the need for juvenile upstream migration.
- Some participants raised concerns about logging upstream of the proposed dam and debris. How would these activities be managed to prevent landslides, etc.?

Interstate 5 Alternatives

WSDOT presented information on the design, benefits, and impacts on alternatives being investigated for protection of the flood-prone five-mile stretch of I-5. WSDOT will identify a recommended alternative with and without-dam. Four concepts had been considered for I-5 protection:

- Levees and walls
- Raising I-5
- Interstate express lanes (concept on hold pending outcome of City/County study of railroad)
- Interstate emergency by-pass (concept on hold pending outcome of City/County study of railroad)

WSDOT is presently refining only the "Levees and walls" concept, which would protect I-5 with a combination of earthen levees and structural walls along I-5, improvements to the existing Chehalis-Centralia Airport levee, a new mile-long levee in southwest Chehalis, and may include short sections of raising I-5 in the vicinity of bridges over water. Recent design considerations are focusing on several areas, including:

- Airport Levee – avoidance of airspace encroachment
- Chehalis Avenue Levee – stormwater runoff
- Dillenbaugh & Salzer Creek Bridges

Hydraulic model results show that even with a water retention structure portions of I-5 would still flood in a major flood event, e.g., 100-year or 2007, thereby requiring additional investment in the "levees and walls" option to protect I-5 in both a with or without-dam scenario. The cost of the "levees and walls" alternative may decrease slightly if a water retention structure were built, though not significantly. Structure survey results show that in a 100-year event 571 structures would see a 0.5-6" increase in water surface elevation. Preliminary pre-scoping estimates for US 12 and SR 6 improvements are $30-40M, which does not include mitigation costs.

The UW Transportation Research Center (TRAC) is working on a study on overall travel costs to impacted drivers for closures of I-5, SR 6, and US 12 due to flood events. The preliminary estimated value of travel disruptions on I-5 for a 100-year flood event without a flood control structure is $10-15M. However, this cost estimate does not include broader societal costs that could be substantially higher

Key discussion topics and comments included:

- Participants requested a better summary of how the UW TRAC's estimated value of travel disruptions on I-5 are extrapolated into overall transportation impact costs.

- Participants requested more refined data on which structures are affected in the walls and levees option; in case the project moves forward, they may need to be targeted for buyouts or floodproofing.
- Clarifying that the freeboard required in the projects takes climate change into account.
- Participants requested that graphics showing the number of homes impacted are scaled proportionally.
- Some participants were concerned with the pre-scoping cost estimates for US 12 and SR 6, given that they don't take into account the potential for damage to surrounding areas.
    - WSDOT staff clarified that the estimates are just magnitude of costs, and in no way reflect an actual project design.

Comprehensive Flood proofing/Buyout Program and Localized Projects

This presentation summarized the work to identify small scale projects to consider for reducing flood damage in the Chehalis Basin. The list of projects identified will serve two purposes:

- Provide flood damage reduction as an alternative to or in combination with large projects (Dam, I-5 Alternative)
- Provide a list of recommendations to the legislature for funding as part of the 2015-17 Capital Budget

The primary criteria used to evaluate these projects included the ability to affect a broader area of the mainstem Chehalis River; estimated flood damage reduction benefits; and size of human population at risk. Secondary criteria included the ability to permit and implement the project; the need and complexity the project will have for continued costs (O&M); ability to provide environmental benefits; and adaptability to provide benefits under climate change and in combination with other projects.

The projects selected for additional analysis include:

- City of Napavine, Kirkland Road Flooding
- WSDOT/Lewis County, SR 6 Overflow
- City of Chehalis, Dillenbaugh Creek Realignment
- City of Chehalis, Main Street Regrade
- Lewis County, Salzer Creek
- Town of Bucoda, Main Street Regrade
- Chehalis Tribe, Black River Bridge
- Chehalis Tribe, Roundtree Creek
- Grays Harbor County, Wynoochee Valley Road Regrade
- City of Aberdeen, Fry Creek
- Floodproofing all structures in floodplain

In regards to a large scale floodproofing program, preliminary cost estimates are estimated to be $82-138M (100-year to 2007 event). These costs rise by 77% when climate change is accounted for (from $82M to $145M for 100-year event)

Key discussion topics and comments included:

- Some participants were concerned that cost estimates for floodproofing commercial and agricultural structures underestimate the actual costs.
- Clarifying that the small project list does not have a significant, measurable effect on mainstem flooding.

Scenarios for Benefit Cost Analysis

It was proposed that the following scenarios be assessed in the benefit cost analysis

- Baseline (no new projects, but including funded projects)
- Following Scenarios would include airport levee, some floodproofing and small projects
- Water Retention
- I-5 Walls and Levees
- Water Retention and I-5 Walls and Levees

The analysis would also include the effects of climate change. There were no major suggested changes to the scenarios.

For more information regarding the policy workshop or the work of the Governor's Chehalis Basin Work Group, please contact Jim Kramer at 206 841-2145 or at jkramer.consulting@gmail.com.