MEMORANDUM

Date: June 28, 2021
To: Vickie Raines, Chair, Chehalis Basin Board
Cc: Chehalis Basin Board Members
From: Andrea McNamara Doyle, Office of Chehalis Basin Director
Re: Summary of Previous Basin-wide Flood Damage Reduction Alternatives

Introduction

This memorandum was developed in response to your June 16, 2021 request to summarize work that has been previously completed to evaluate basin-wide flood damage reduction actions. As you and other Board members are aware, the Office of Chehalis Basin's (OCB) mission is to aggressively pursue an integrated strategy and funding for long-term flood damage reduction and aquatic species habitat restoration. Both are integral to the success of the Chehalis Basin Strategy. However, in light of your request, this memorandum focuses on long-term flood damage reduction.

Given the large number of studies and volume of previous reports and presentations on this subject, I have attempted to provide an executive level summary of the collective results and attached a key document as an Appendix. A list of additional reference documents is also included.

A chart summarizing flood damage reduction alternatives previously evaluated was prepared for the Board in June 2020 (see Appendix A). The chart includes a short description of the previous analyses and conclusions related to each alternative considered, along with links to the source documents. The chart also includes potential elements of a Local Actions Program identified in the Local Actions Alternative Technical Analysis Review memorandum prepared by Natural Systems Design, Inc. and Northwest Hydraulic Consultants, submitted as part of the Quinault Indian Nation's comments on the draft SEPA EIS in early 2020.

Through all the analyses summarized in the chart, and the more recent Local Actions Advisory Group process, it is clear there is no single action, or simple solution, that will significantly reduce flood damage in the basin. It has also become clear that any "Plan B" or "non-dam alternative" will need to address flood damage to existing development through an aggressive, broad-scale program of voluntary elevations, buyouts, and relocations. Such a program would be needed to have support from thousands of property owners in the upper basin to voluntarily elevate or relocate their existing homes/businesses. A broad-scale relocation assistance component would also be needed to help the hundreds of families (both homeowners and renters) who would need to move out of neighborhoods at high risk of significant flood damage from current or future flood major and catastrophic flooding. For such a program to be viable, it would need to provide some level of financial assistance to local governments to

replace the loss of current tax revenues that are collected based on existing land use values, and it would need to identify one or more public or non-governmental entities willing and able to own and maintain the purchased floodplain properties in perpetuity.

Although the Local Actions Advisory Group process began exploring these issues, the scope and scale of such a voluntary floodplain buyout/relocation effort is significantly larger and more complex than has previously been defined or evaluated for the Chehalis Basin. In addition, several of the local governments have not indicated an interest in significant relocation of their residents and businesses.

Background

Significant flooding has occurred in the Chehalis Basin eight times in the past 60 years, causing major damage, loss of property, crops and livestock, major disruptions and damage to transportation systems including the temporary closure of Interstate 5 (I-5), and impacts on public health and safety and natural resources. Since the 1930s, there have been over 900 studies that examined ways to reduce damages from major and catastrophic floods in the Chehalis Basin. As part of these studies, structural approaches such as infrastructure bypass options, levees, floodwalls, floodproofing, and flood retention facilities of various scales and in various locations have been assessed for effectiveness in reducing flood damage as well as mitigating and recovering from floods. Large-scale restorative flood protection actions, large-scale and localized buy-outs, changes in land use management, and localized restoration actions have also been assessed for effectiveness in reducing flood damage as well as mitigating and recovering from floods.

The focus and breadth of technical work and policies to reduce flood damage increased following the devastating 2007 flood, including the evaluation of various non-dam alternatives. Since 2007, this work has included a review of all previous studies (Ruckelshaus Center 2012), preparation of a State Environmental Policy Act (SEPA) Programmatic Environmental Impact Statement (PEIS; Ecology 2017) and two project-level Draft EISs (Ecology 2020 for SEPA and Corps 2020 for NEPA). The two project-level Draft EISs (state and federal) assessed impacts from a flood retention facility and alternatives to the proposed action, with a focus on reducing flood damage in the upper Chehalis Basin.

The PEIS assessed broad program-level actions related to implementing an integrated strategy for reducing flood damages and restoring aquatic species habitat. Large-scale and local-scale flood damage reduction actions were considered, including two types of flood retention facilities that could retain 65,000 acre feet or more, airport levee improvements, I-5 projects, the Northshore levee in Aberdeen-Hoquiam, restorative flood protection, local projects, floodproofing, land use management and flood warning system improvements. Additionally, a number of elements were considered but not carried forward in the PEIS alternatives, as described in PEIS Section 2 – Alternatives.

Within the Draft SEPA EIS, a Local Actions Alternative was described and evaluated. The SEPA Local Actions Alternative includes a variety of local-scale actions that approximate the Applicant's (Chehalis

River Basin Flood Control Zone District) objective through improving floodplain function, land use actions, buying out at-risk properties or structures, improving flood emergency response actions, and increasing water storage from Pe Ell to Centralia. Additional local actions were considered but were not further evaluated, such as groundwater infiltration improvements and road and bridge constriction removal. Ecology also completed an analysis of a number of other flood damage actions and alternatives, as described in the Draft SEPA EIS Appendix 1 – Proposed Project Description and Alternatives.

Within the Draft NEPA EIS, the U.S. Army Corps of Engineers (Corps) identified 61 alternatives to the proposed flood retention facility/airport levee project for consideration in the screening process. These alternatives included bypass options, levees and floodwalls, dredging, flood retention facilities, I-5 Projects, bridge replacements, restorative flood protection, Community Flood Assistance & Resilience (CFAR), and local actions. The local actions included floodproofing, protecting local critical infrastructure and priority areas, land use management, regulatory flood data, floodplain protection, modifying construction standards, flood warning system improvements. Of those 61 alternatives, two were carried forward into the Draft NEPA EIS (e.g., Flood Retention Expandable Facility and Flood Retention Only Facility). The Corps' detailed screening process is further described in the Draft NEPA EIS Appendix D – Selection and Description of the Alternatives.

Following the publication of the Draft SEPA EIS, at the governor's and Board's direction, OCB led an advisory group process to consider a Local Actions Program aimed at achieving a set of Board-approved flood damage reduction outcomes. These objectives were much broader than the objectives identified by the FCZD for the proposed retention facility/airport levee project, although both include reducing flood damages to existing structures and critical infrastructure in the upper part of the Chehalis Basin including the populated areas of Chehalis and Centralia.

The initial evaluation of a Local Actions Program occurred between September 2020 and March 2021 based on Board guidance and following the steps outlined by OCB Staff to the Board in August 2020 related to composition and membership of the Technical and Advisory Groups. The Board's guidance also included adoption of measurable flood damage reduction outcomes and planning assumptions the Board agreed should be used to evaluate potential actions.

Given the Board's desire to respond to the governor by March 2021, the effort considered what kinds of projects and actions a Local Actions Program might need to include in the absence of the proposed dam, as well as how the program – or individual projects within it – might differ if implemented in conjunction with the proposed dam. The two advisory groups considered different options for reducing damage including floodplain storage, structural actions such as levees, elevations, buyouts, and relocation. Based on their assessments, OCB included funding options for the Board's consideration to advance several potential actions to reduce flood damage.

Importantly, the process was not designed to fully define or complete a detailed quantitative evaluation of a "Plan B" or "Non-Dam Alternative" to the proposed flood retention facility/airport levee project. Rather, it was designed to generate a scope, budget, and schedule for developing a Local Actions Program that could be considered by the Board, either as an alternative to the proposed flood retention facility or as a potential supplemental suite of actions that could be implemented along with proposed flood retention facility.

The advisory groups also were not tasked with developing consensus recommendations to the Board on which specific projects or combination of actions should make up the flood damage reduction elements of the Strategy. Rather, they were tasked with reviewing previous analyses, generating and vetting new ideas to reduce flood damage, identifying important technical and policy implications, and surfacing key issues of agreement and disagreement.

Throughout the advisory group process, all information considered by and generated from the Technical and Implementation Advisory Groups between September 2020 and March 2021 was publically available. Advisory group meetings were publicized and open to the public, and OCB also sought and received public input through a series of three evening public meetings.

Summary of Non-Dam Alternatives and Findings

Flooding in the Chehalis Basin is variable in severity and geographic extent, yet the majority of extreme precipitation occurs in the upper Chehalis Basin as described in the *Chehalis Basin: Extreme Precipitation Projections* (University of Washington, Climate Impacts Group 2021). Peak annual flows from the 1996, 2007, and 2009 floods rank in the top five at stream gages at the Chehalis River near Grand Mound, the Newaukum River near Chehalis, and the South Fork Chehalis River. The majority of the flood damage has occurred in the cities of Chehalis and Centralia where there is more intensive development in the floodplain, including I-5.

Floodplain Storage

The opportunity for additional floodplain storage along the mainstem Chehalis River in a 100-year flood events is quite limited. This is because flooding during a large event is, in most cases, already valley wall to valley wall. Past and recent analyses show that available additional floodplain storage along the mainstem Chehalis River and in the South and North forks of the Newaukum River would not provide any beneficial reduction in large flood flows or flood damage in modeled current and modeled future 100-year flood events (Corps 2003, Abbe et.al. 2016 and 2020, CRBFA 2018, WSE and Anchor QEA 2020). While there are potentially modest flood storage benefits along some tributaries, especially smaller tributaries, the flood damage reduction benefits are limited in extent and magnitude.

The analyses to date indicating very limited distributed retention/storage potential upstream of the cities of Chehalis and Centralia means that the depth and extent of flooding inundation in these areas

from extreme precipitation events cannot be meaningfully reduced in the absence of the proposed retention facility/airport levee project. The results of these previous analyses also mean that existing structures in the populated inundation areas around Chehalis and Centralia would need to be protected in other ways besides water retention, such as through elevations or retrofits, by relocating the structures, or by buying out the property and relocating the occupants.

Buy-outs and Relocations Through Voluntary Acquisitions

The recent Local Actions Program Implementation and Technical Advisory Groups reviewed experiences from state and local floodplain acquisition and relocation efforts from across country, including work in Washington in Hamilton and Taholah, to understand how voluntary acquisitions could be part of a comprehensive flood damage reduction strategy. The advisory groups identified a range of potential acquisition strategies, such as fee simple purchases, acquiring development rights, and conservation easements. They also considered the different approaches that would be needed for addressing individual landowners' interests in rural areas (e.g., buying or relocating one structure), versus addressing broader neighborhood and community needs associated with relocating larger clusters or groups of residents (both landowners and renters) living in flood prone areas within more densely populated cities and towns (e.g., master planning for new receiving communities). The advisory groups emphasized the importance of any acquisition program being voluntary and designed based on the needs of local communities in the Basin.

The ASRP early action reach sponsors have gained some limited experience acquiring individual structures from willing sellers as part of the ASRP's habitat protection and restoration priorities. These have been in rural areas, and have not involved acquisition of clusters of residential structures or relocation assistance for groups of homeowners or their renters.

A voluntary floodplain acquisition program that includes property purchases (buyouts) and/or relocation assistance for willing sellers could help achieve the Strategy's dual goals of reducing flood damage by moving people and structures out of harm's way and restoring aquatic and riparian habitat by reconnecting the floodplain; however, there are still a lot of unknowns about what a larger-scale, more comprehensive acquisition program in the Basin would require to be feasible and successful.

Based on the advisory group process, OCB Staff proposed for the 2021-2023 biennium, that the Board could further design and develop an acquisition program that: (a) is a coordinated program within a broader suite of actions to achieve the desired Board outcomes for flood damage reduction; (b) consider both habitat and flood priorities; and (c) include extensive community outreach and education efforts along with feasibility analyses of different geographic areas in the Basin.

OCB Staff further proposed engaging local and tribal government land managers, and other representatives from the affordable housing and economic development sectors, in the design of a potential broad-scale voluntary floodplain acquisition program. This was suggested to ensure that any

program designed would thoughtfully consider both the economic and social implications for local governments and communities that would flow from purchasing and removing large numbers of structures, and simultaneously relocating large numbers of residents (both landowners and renters) and businesses out of flood prone areas. Early and extensive involvement by local land managers, affordable housing and economic development experts, was also suggested in order to help design the program in ways that could avoid, minimize or mitigate negative economic impacts to local governments, and also to make it attractive enough for landowners to voluntarily participate.

The scope and scale of a voluntary floodplain buyout/relocation effort that would be needed in the absence of the proposed flood retention facility/airport levee project is significantly larger and more complex than has previously been defined for the Chehalis Basin.

To make measurable progress toward achieving the Board's desired outcomes for reducing damages from major and catastrophic flooding, a "non-dam alternative" floodplain acquisition program will need to address large populated areas with existing at-risk development through a program in which:

- Hundreds of property owners in the upper basin would agree to voluntarily elevate or relocate their existing homes and businesses, or sell their land and/or the vested development rights in their land
- Assistance would be provided to hundreds of families (both homeowners and renters) to relocate out of neighborhoods at high risk of significant flood damage from current or future flood major and catastrophic flooding
- Financial support would be provided to local governments to offset current tax revenues that are collected based on existing land use values
- One or more public or non-governmental entities would agree to own and maintain the purchased floodplain properties in perpetuity

A floodplain acquisition program of this magnitude has not previously been defined or evaluated for the Chehalis basin.

Local Flood Protection

In addition to the local flood protection projects that have been studied and implemented by the Chehalis River Basin Flood Authority, the OCB identified potential approaches to protect high value structures and critical infrastructure in high priority areas. These include:

- Implementation of the CFAR Program (see Draft CFAR Program Framework Memorandum and one-pager)
- Identification of 14 potential priority areas that could be protected by levees or structure removal (Anchor QEA 2020a), which the Board subsequently focused to four priority areas

- Identification of potential opportunities to protect structures through retrofits, acquisitions, and/or relocation through a Floodplain Acquisition Program

Bank Erosion

Riverbank erosion occurs in many areas of the Chehalis Basin and can affect property and infrastructure adjacent to the rivers and streams, within the valley bottom, or on adjacent hillslopes. Depending on the rate of erosion, or during an avulsion or major channel shift, a river could move rapidly outside of its current channel into a new or historical channel. Areas of easily erodible soils, such as sand and gravel deposits from alluvial processes or from past glacial deposition, or loamy soils, are particularly susceptible to bank erosion and channel migration. Areas with limited vegetation cover can also be more susceptible to erosion.

As part of the Local Actions Program analysis, the OCB identified potential ways to address damage from accelerated bank erosion, including development of initial maps for up to 100 miles of high priority areas and a preliminary erosion management approach (Anchor QEA 2020b, 2021a and 2021b).

Floodplain Management Land Use Recommendations

The OCB has proposed floodplain land use recommendations that would:

- Support continuation of subdivision regulations for rural areas to prevent new lots wholly in floodplain
- Discourage upzones or urban growth area (UGA) expansion into flood prone areas
- Provide guidance to standardize implementation of zero rise policy and compensatory storage requirements
- Establish an acquisition program to acquire development rights and/or use other incentives to discourage expansion of high density zoning, maintain low density zoning in rural areas, and prevent environmental damage

As a result of previous analyses, Chehalis basin jurisdictions have also been encouraged to consider implementing the other past floodplain management recommendations (French & Associates 2017) as appropriate for their jurisdictions.

Interstate 5

Based on available studies and previous analyses, WSDOT has indicated that, whether or not the proposed flood retention facility/airport levee project is built, the agency will plan and implement practical solutions to mitigate flooding risks to the traveling public on I-5 that do not involve elevating or relocating the interstate. WSDOT does not believe that constructing walls and levees adjacent to I-5 would be effective in reducing freeway closures based on future climate change predictions without a flood retention facility. The types of practical solutions that WSDOT might employ would differ depending on if the flood retention facility/airport levee project is constructed or not. In any case,

WSDOT has indicated it will continue to coordinate with OCB and local floodplain planning efforts as the agency engages in its own transportation improvement and congestion relief planning.

Skookumchuck Dam Evaluation

OCB is currently conducting near-term data compilation and review to identify potential options to modify the operations of the existing Skookumchuck Dam to benefit aquatic species habitat and/or flood damage reduction. If the Board approves funding for a more in-depth evaluation, the analysis will be directly linked to achieving the Chehalis Basin Board's Local Actions Program Outcomes and is an integrated Chehalis Basin Strategy issue that could also benefit aquatic species habitat.

Conclusion

Through the course of the more than 900 studies since the 1930s that have examined ways to reduce damages from major and catastrophic floods in the Chehalis Basin, it has become clear there is no single action, or simple solution, that will solve all significant flood damage problems in the basin. Previous efforts to narrow the range of options through a Programmatic Environmental Impact Statement resulted in advancing a multi-pronged approach for further design and review.

The multi-pronged approach to basinwide flood damage reduction that emerged from the PEIS included a combination of large-scale and local-scale flood damage reduction actions. The proposed flood retention facility/airport levee improvement project was the largest-scale project to emerge from the PEIS, and would have the capacity to retain and slow the release of up to 65,000 acre feet, or 24 Seahawk's stadiums full of water, during a major storm event. Many other actions, including the North Shore Levee in Aberdeen-Hoquiam, restorative flood protection, local projects, floodproofing, land use management and flood warning system improvements were also identified through the PEIS as possible components of a multi-pronged approach to reducing flood damage throughout the basin.

Through these decades of studies, and the recent Local Actions advisory group process, it has also become apparent that other options to reduce flood inundation levels in the populated areas near Chehalis and Centralia are extremely limited at best. As a result, for a Local Actions Program to achieve measurable reductions in flood damage risk to existing development in the upper basin without the proposed dam/airport levee project, it would need to move or retrofit several thousand public and private structures. Based on past analyses, it is not clear the feasibility of relocating or elevating such a large number of structures within the Chehalis Basin, or the level of interest of people to move.

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APPENDIX A
FLOOD DAMAGE REDUCTION ALTERNATIVES CONSIDERED (JUNE 4, 2020)

Memorandum

APPENDIX A

Date: June 4, 2020
To: Chehalis Basin Board
From: Andrea McNamara Doyle, OCB Director
Re: Flood damage reduction alternatives previously considered or currently being evaluated besides the Flood Control Zone District's proposed Chehalis River Basin Flood Damage Reduction Project

Flood Damage Reduction Alternatives Previously Considered

OPTIONS PREVIOUSLY CONSIDERED	SUMMARY OF ANALYSIS & CONCLUSION	LINK TO SOURCE DOCUMENT(S)
USACE Twin Cities Project	• Beginning in 1980s, USACE considered project consisting of 11 miles of new levees (from RM 75 to RM 64) on the Chehalis River, the lower 2 miles of Dillenbaugh and Salzer creeks, and the lower 2 miles of the Skookumchuck River to the confluence with Coffee Creek. This alternative would include raising approximately eight structures near the airport, I-5, Skookumchuck River, and Salzer Creek. This alternative would also modify the Skookumchuck Dam to increase flood storage by 11,000 acre-feet • Levees were part of the recommended plan from USACE's 2003 reevaluation report • In 2011, USACE stopped work on project after determining: – Project would not protect I-5 in 100-year flood event • Would not pass USACE benefit-cost test	• 2003 Centralia Flood Damage Reduction Project Chehalis River, USACE. • 2011 Centralia Flood Risk Management Project, USACE. • 2012 Chehalis Basin Flood Mitigation Alternatives Report, Ruckelshaus Center.
Floodwater Bypass Routes	• 1998 PIE report included evaluation of "hydraulic capacity improvements": – River channel excavation – Floodway/floodplain excavation – Levee improvements • Recommended combination of Skookumchuck dam modifications, floodway excavation in Mellen Street Bridge, and floodplain modifications in the vicinity of SR 6 • In 2012, WSE/WEST Hydraulic Model report found floodwater bypass routes evaluated near Mellen Street and SR 6 would: – Provide little flood reduction benefit and increase water levels downstream	• 1998 Chehalis River Basin Flood Reduction Project, Pacific International Engineering. • 2012 Chehalis River Hydraulic Model Development Project, Watershed Science and

OPTIONS PREVIOUSLY CONSIDERED	SUMMARY OF ANALYSIS & CONCLUSION	LINK TO SOURCE DOCUMENT(S)
	– Create potential to become "fish sink" • In 2012, Work Group decided to not move forward based on hydraulic model results/downstream impacts.	Engineering and WEST Consultants. (see Appendix J, page 440) • 2012 Chehalis Basin Flood Mitigation Alternatives Report, Ruckelshaus Center.
Bridge Replacements	• In 2012, Ruckelshaus Center report analyzed several bridge replacements: – Removing the SR 6 Bridge and Approach Fills. Move the SR 6 Bridge, west of Chehalis over the mainstem Chehalis River, and associated features, out of the floodplain (Ruckelshaus 2012). – Removing the Mellen Street Bridge and Approach Fills. Move the Mellen Street Bridge, in Chehalis over the mainstem Chehalis River, and associated features, out of the floodplain. – Removing the Galvin Road Bridge and Approach Fills. Move the Galvin Road Bridge, in Galvin over the mainstem Chehalis River, and associated features, out of the floodplain. – Removing the Porter Creek Road Bridge and Approach Fills. Move the Porter Creek Road Bridge, in Porter over the mainstem Chehalis River, and associated features, out of the floodplain. – Removing the Wakefield Road (South Elma) Bridge and Approach Fills. Move the Wakefield Road Bridge, in Elma over the mainstem Chehalis River, and associated features, out of the floodplain. – Removing Multiple Bridges and Approach Fills in the Upper Chehalis Basin. Move the SR 6 Bridge, Mellen Street Bridge, and Galvin Road Bridge over the mainstem Chehalis River, and associated features, out of the floodplain. • In 2012, WSE/WEST Hydraulic Model report found bridge replacements would provide limited upstream flood reduction benefit and would result in increased flows and water levels downstream • In 2012, Work Group decided to not move forward based on hydraulic model results/downstream impacts.	• 2012 Chehalis Basin Flood Mitigation Alternatives Report, Ruckelshaus Center.
I-5 Levees and Walls	• In 2014, WSDOT evaluated I-5 levees and walls project, including construction of: – Earthen levees and floodwalls along I-5 – New one-mile long Chehalis Ave. levee – Bridge replacements over Dillenbaugh and Salzer Creeks	• 2014 Chehalis Basin I-5 Flood Protection near Centralia and Chehalis, Washington Dept. of Transportation.

OPTIONS PREVIOUSLY CONSIDERED	SUMMARY OF ANALYSIS & CONCLUSION	LINK TO SOURCE DOCUMENT(S)
	• In 2014, WSDOT's report stated that this alternative was not advanced "since it is anticipated that construction of a dam will be pursued." The report also stated this I-5 Levees & Walls alternative "would be recommended if a dam was not planned to be constructed." • WSDOT has not yet evaluated how to mitigate for impacts of the I-5 levees and walls project, e.g., initial modeling showed that 100-year water levels in areas not protected by the levees could rise by as much as two feet or more, and landowners affected by this voiced significant concerns. A detailed mitigation strategy/approach would need to be developed if WSDOT pursues this project in the future.	• 2017 Chehalis Basin Strategy Programmatic Environmental Impact Statement, Washington Dept. of Ecology.
Other I-5 Protection Projects	• In 2014, WSDOT evaluated other I-5 protection projects: – Raise and Widen I-5. Raise I-5 using fill material to elevate the road surface above the desired flood protection elevation, widening I-5 from four to six lanes, and raising bridges. Raising I-5 would require reconstruction of all pavement, stormwater systems, illumination systems, and guardrail in the affect area. In addition, the I-5 interchanges at 13th Street, SR 6, and Chamber Way, and the West Street bridge would need to be reconstructed. – I-5 Express Lanes (berms). Construct 4 miles of new express lanes adjacent to I-5 to provide traffic the opportunity to bypass I-5 if the main interstate was closed by floods. The express lanes would diverge from I-5 at 13th Street and follow the existing Tacoma Rail line through Chehalis. This alternative would include construction of new bridges over West, Prindle, and Main streets in Chehalis. The express lanes would be at least 3 feet above the 100-year flood elevation and would be available to traffic with or without flood conditions. – I-5 Temporary Bypass. Construct 4 miles of temporary bypass lanes diverging from I-5 at 13th Street, and then follow the existing Tacoma Rail line through Chehalis, with a bridge over Main Street. These lanes would only be used during floods. The intersections with Prindle and West Streets would be at-grade, and flood gates would close during flood events to keep floodwaters out of the temporary bypass. The bypass lanes would be constructed a minimum of 3 feet above the 100-year flood elevation. This would provide a local bypass opportunity if the main part of I-5 were to be closed by major floods. – I-5 Viaduct. Elevate I-5 on piers to build a viaduct from SR 6 to Mellen Street, widen I-5 to six lanes, and reconstruct all interchanges in the affected area. – I-5 Relocation. Relocate I-5 outside the flood area, including widening I-5 to six lanes and constructing new interchanges.	• 2014 Chehalis Basin I-5 Flood Protection near Centralia and Chehalis, Washington Dept. of Transportation.

OPTIONS PREVIOUSLY CONSIDERED	SUMMARY OF ANALYSIS & CONCLUSION	LINK TO SOURCE DOCUMENT(S)
	• In 2014, WSDOT did not recommend further evaluation of these projects, deeming them either: – Cost prohibitive – Negatively impactful to built and natural environment – Increasing flood elevations in urban areas	
Restorative Flood Protection Alternative (RFPA)	• In 2017, Programmatic EIS evaluated RFPA that would rebuild natural flood storage capacity by reversing landscape changes that contribute to downstream flooding and erosion. • In 2018, NSD reported preliminary results of pilot feasibility evaluation in Newaukum, which showed peak flood flow reductions ~1/4th of what was predicted in the PEIS in larger floods. Feasibility evaluation findings transferrable to other parts of Chehalis Basin. • In Fall 2018, Chehalis Basin Board elected not to move forward with further development of the RFP based on preliminary results. The Board agreed that RFPA findings related to erosion/channel migration should be incorporated into CMZ component of the Community Flood Assistance & Resilience (CFAR) program. • In 2020, NSD's final advanced feasibility evaluation for the North and South forks of the Newaukum River completed. "The Restorative Flood Protection Evaluation benefited the Chehalis Basin by exploring an important alternative to traditional flood protection, adding valuable data and information on the basin, and demonstrating that some elements of the RFP can be integrated into comprehensive floodplain management, reducing risks and improving environmental conditions." • More specifically, it found: "Based on the RFP work, we can identify low gradient areas that once had a more significant role on attenuating downstream flood peaks. One example is the main stem Chehalis River between the Newaukum and Skookumchuck confluences… This same area has become heavily developed and not viable for an RFP approach, but highlights the area's susceptibility to flooding. Since many other low gradient areas within the Chehalis Basin have not yet been analyzed in a meaningful way, it is recommended the RFP analysis be expanded to assess these areas throughout the basin."	• 2017 Chehalis Basin Strategy Programmatic Environmental Impact Statement, Washington Dept. of Ecology. • 2017 Restorative Flood Protection Technical Report, Natural Systems Design. • 2020 Restorative Flood Protection Feasibility Assessment, Natural Systems Design.

Flood Damage Reduction Alternatives Currently Being Evaluated

OPTIONS CURRENTLY BEING EVALUATED	SUMMARY OF ANALYSIS & CONCLUSION	LINK TO SOURCE DOCUMENT(S)
Community Flood Assistance & Resilience Program (CFAR)	To reduce flood losses by providing technical and funding support to property owners for the acquisition, relocation, or modification of individual floodprone buildings. To prevent property losses by providing funding support for identifying hazard areas, and the acquisition or relocation of buildings threatened by a migrating stream channel. Fund small habitat enhancing and permittable bank protection projects; large-scale, traditional levees and landward revetments intended to stop erosion are not eligible project types. The Chehalis Basin Board is evaluating the CFAR program as a potential element of the long-term Chehalis Basin Strategy.	• CFAR Program Strategy Outline
Local Flood Damage Reduction Projects	In general, local projects reduce flood damage caused by floods of the Chehalis River and its major tributaries. The damage could be to public or private improvements. If a local project is proposed to reduce flood damage to private property, there must be a public benefit. Local projects are generally: • Projects that improve emergency response. • Projects that protect public infrastructure from major river flooding or erosion. • Projects that improve local or community flood hazard reduction, including local flood planning and local flood proofing (e.g., elevations, buy-outs, foundation venting, demolitions, etc.) caused by major river flooding or erosion. • Projects that implement Conservation District initiated flood hazard reduction (e.g., farm pads, evacuation routes, landowner support/participation, etc.). The Chehalis Basin Board is continuing its biennial evaluation of additional local project proposals as part of the long-term Chehalis Basin Strategy.	• Local Projects Background Document
Land Use Management	The following actions were evaluated in the Programmatic SEPA EIS: • Land Use Management. Revising land use regulations and practices on the local level to protect floodplain functions and minimizing floodplain development. This alternative may include restricting the creation of developable parcels in the floodplain through open space preservation,	• 2017 Chehalis Basin Strategy Programmatic Environmental Impact

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	subdivision set asides, and low-density zoning. Other elements may involve increasing the cost of future development in the floodplain and include filling restrictions and freeboard requirements on new or elevated structures. • Regulatory Flood Data. Requiring additional flood data beyond those provided on Flood Insurance Rate Maps (FIRMs) to be used in flood regulations. The regulatory floodplain and flood elevation would be defined by the flood of record where there is no Base Flood Elevation (BFE) on the FIRM, or where the flood of record is higher than the BFE. In addition, all permit applicants in areas without a BFE on the FIRM would be required to conduct an on-site flood study, or use an existing, current study, to calculate the BFE. Permit applicants for single-family residences on existing lots would have the option of elevating the house 5 feet or more above grade without funding a study. • Floodplain Protection. Implementing higher development standards in flood-prone locations, including the following: – Preserving open space in the floodplain – Requiring new subdivisions and other large developments to set aside all or part of their flood-prone areas as open space – Prohibiting any fill in the floodplain or requiring compensatory flood storage – Not allowing low-density zoning districts within the floodplain to be amended to allow more dense development • Modifying Construction Standards. Setting more stringent construction standards in the floodplain, including the following: – Increasing the amount required freeboard for new construction or substantial improvements of existing structures – Prohibiting new critical facilities (e.g., hospitals, fire stations, hazardous materials facilities) from the 500-year floodplain or protect them from damage or loss of access during a 500-year flood – Requiring a permit applicant seeking to elevate or improve a building on floodwalls to sign an agreement that areas below the Base Flood Elevation or flood protection elevation would not be converted to a use (e.g., a residential living space) or be constructed with materials that are subject to water damage • Flood Warning System Improvements. Improving the existing Chehalis River Basin Flood Warning System.	Statement, Washington Dept. of Ecology.

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	The Chehalis Basin Board is evaluating how land use management can be incorporated as a potential element of the long-term Chehalis Basin Strategy.	
Aberdeen-Hoquiam North Shore Levee	In 2017, Ecology evaluated an alternative in the Programmatic SEPA EIS to construct approximately 5.8 miles of levees to protect the Cities of Aberdeen and Hoquiam, and the North Shore Levee, which would encircle Aberdeen's city center and portions of Hoquiam along the north side of Grays Harbor. In addition, the City of Hoquiam is currently evaluating the North Shore Levee West project, which aims to install a levee (earthen, concrete and sheet pile) for 4.7 miles bordering the City of Hoquiam. This The Chehalis Basin Board is evaluating continued support for the North Shore Levee as a potential element of the long-term Chehalis Basin Strategy.	• 2017 Chehalis Basin Strategy Programmatic Environmental Impact Statement, Washington Dept. of Ecology.
Forest Practices Study	DNR is conducting an independent and peer-reviewed study to evaluate how contemporary forest practices affect streamflow in the Chehalis Basin. At the conclusion of the study (estimated in 2024), watershed specific ecohydrology models informed by basin specific information will allow managers to understand the effects of patterns associated with forest management, expected changes in land use and impacts to streamflow, and a more thorough understanding of the effects of increased precipitation in the future to better inform and prioritize projects that may influence local or basin-scale flooding	• RCO-DNR Interagency Agreement #18-2275
Local Actions Program	The Quinault Indian Nation's comments on the draft SEPA EIS stated: "It is our conclusion that the shortcomings in the DEIS analyses and conclusions result in an underestimation of potential viability of the LAA [Local Actions Alternative] and related actions that could be taken to accomplish flood damage reduction at a lower environmental, social, and economic cost to the Chehalis Basin. We believe that the Local Actions Alternative could be developed into a viable Local Actions Program with enough specificity to enable comparison of benefits and impacts against the proposed project, and to enable the State to evaluate implementation feasibility and community support." As part of the Nation's SEPA comments, NSD/NHC developed a technical memo that explores key elements needed for development of a viable Local Actions Program and offer examples of area-	• 2020 Local Actions Alternative Technical Analysis Review, Natural Systems Design and Northwest Hydraulic Consultants

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	specific strategies for applying Local Actions Program elements in the Chehalis Basin. Below is a summary of the elements outlined in the NSD/NHC memo: • Develop more accurate flood models for entire Chehalis Basin with focus on sub-basins. • Develop a comprehensive strategic plan for prioritizing local actions. • Delineate erosion hazards through a comprehensive channel migration zone delineation of Chehalis and its tributaries. Develop recommendations of areas where bank protection is acceptable and guidelines on how it should be done. • Improve floodplain function with regards to temporarily storing flood waters. • Land use management actions. • Local flood protection actions. • Floodplain agriculture 'stay-in-place' assistance tailored to address site-specific flood and erosion risks. • Acquisition of flood-prone land • Relocating people out of harm's way • Improving flood emergency response actions. • Increase floodplain water storage along South Fork Chehalis River, Newaukum River, mainstem Chehalis River from Pe Ell to Centralia and other upper watershed sub-basins. The Chehalis Basin Board agreed at its May 7 Board meeting to learn more about the Nation's recommendations, and to look into other new ideas or re-examining previous ideas in a new way. It is currently determining how to evaluate and consider elements of the Local Actions Program as an element of the long-term Chehalis Basin Strategy.	