

Upper Snoqualmie Resilient River Corridor Management Plan  
Planning Level Cost Estimate of Restoration Opportunities and Actions.  
(\$2021)

Planning Level Estimate		
Reach	Action Numbers	Grand Total (Rounded Up to Nearest \$10k)
Confluence Reach	1-7	\$6,090,000
Meadowbrook Reach	8-10	\$40,490,000
City Reach	11-15	\$13,430,000
Kimball Creek Reach	16-20	\$16,780,000
Project Area	21-22	\$260,000
Total		\$77,050,000

**General Workbook Notes:**

1. Detailed values for each reach-action are provided in the action item breakdown tab.
2. The detailed construction estimate tab provides more information for proposed restoration projects.
3. The costs in the detailed construction estimate tab are provided on a per-unit basis, as opposed to lump sum, to allow for future scaling-up or scaling-down of restoration work as more information becomes available and decisions are made.

For Internal Tribal Use Only. July 2022 version.

Upper Snoqualmie Resilient River Corridor Management Plan  
List of Restoration Opportunities and Actions.

Action Number (see Map)	Reach/Zone	Opportunity/Description	RM	Project Type	Next step and time frame	Implementation time-frame (near-term (2-3 years), long-term (>3 years))	Benefit Time Frame (immediate, short delay, long delay)	Rough Opinion of Cost (2021 dollars) Construction		
								Included 10% Mobilization, 5% TESC, and 30% contingency. Costs rounded to nearest \$10,000.	Design and permitting of constructed projects were assumed to be 30%, 20% and 10% respectively, of construction cost. See Note 1.	
1	Confluence Reach	Conduct assessment of river and floodplain crossings within the confluence reach to evaluate their impact on river and floodplain processes. The assessment should include the two bridges over the Middle and North Fork of the Snoqualmie River as well as any floodplain overflow channels and wetlands. One potential outcome of the assessment could be proposing to improve the existing bridges. Develop alternatives for restoration and preferred restoration alternative (if any).		Infrastructure	Apply for grant to fund assessment, 1-2 years	N/A	Immediate benefit to river and floodplain processes if structures are improved		N/A	\$150,000
2a	Confluence Reach	Remove obsolete left bank riprap on NF (right at NF/MF confluence). Involves a hydraulic model, demolition plan, permitting and construction.	NF 0	Remove Armoring	Apply for grant, 1-2 years	Near-term	Immediate	\$	180,000.00	\$54,000
3	Confluence Reach	Increase connectivity of mainstem to cool-water tributary through ELJ installation (tributary – 48 deg. F.; Mainstem – 56 deg. F.) [Can be combined with bank armoring removal]	NF 0	ELJ	Preliminary design work, 1 - 2 years.	Near-term	Short delay (increased complexity at confluence through sediment aggradation. Formation of deep pool through scour during high flows)	\$	270,000.00	\$81,000
4	Confluence Reach	Channel and floodplain restoration of the Confluence Reach to encourage a multi-threaded anabranching channel morphology and restore the floodplain large wood cycle  Actions: Create forested islands within mainstem upstream of SF confluence through ELJ installation	RM 44.2 to 44.9	ELJ Forest Management	Apply for design and implementation funds, 1-2 years	Channel restoration could be implemented in a near-term timeframe to maximize time for channel to respond and vegetation to establish on forested islands Reforestation efforts are ongoing, this is a near term and long term action	Shade and root cohesion benefits will be seen in a few years. Large wood supply will take decades to realize. Immediate (pools, cover) and short-term (channel narrowing)	\$	1,270,000.00	\$381,000
5	Confluence Reach	Reinforce emerging forested island at RM 43.5 by constructing ELJs	RM 43.5	ELJ	Apply for design and implementation funds, 1-2 years	Channel restoration could be implemented in a near-term timeframe to maximize time for channel to respond and vegetation to establish on forested island	Immediate (pools, cover) and short-term (channel narrowing)	\$	310,000.00	\$93,000
6	Confluence Reach	Riparian reforestation on south banks (left bank) in a minimum 100-ft wide buffer from the channel bank. Remove Scot's broom and blackberry on gravel bars, plant with cottonwood and willow. Supplemental planting with conifers or early seral deciduous species (cottonwood, big leaf maple) as indicated by existing conditions in stand.	RM 43.5 to 44.9	Forest Management	Develop restoration plan, including identifying and working with land owners, identifying a funding source, and plant sources.	Near term and long term	Immediate (invasive removal), short-to-long term (reforestation)	\$	2,390,000.00	\$717,000
7	Confluence Reach	Plan and analysis regarding conservation/protection of well-connected left bank floodplain. Landowner outreach and potential land acquisition.	RM 43.5 to 44.9	Forest Management	Coordinate with current landowners. Potentially apply for conservation easement/ acquisition funding	Near term	Immediate (reducing development pressure in planning area)	N/A		90000
2b	Meadowbrook Reach	Remove derelict right bank groin near RM 43.5. Involves a hydraulic model, demolition plan, permitting and construction.	RM 43.5	Infrastructure	Apply for grant, 1-2 years	Near-term	Short delay (increased connectivity and channel migration potential to right bank floodplain)	\$	60,000.00	\$18,000
8	Meadowbrook Reach	Restoration of floodplain processes within Meadowbrook Slough and adjacent floodplain.  Specific actions include: A) Removal of left bank revetment to increase connectivity with Meadowbrook Slough B) Revegetation and invasive species removal in left bank floodplain within Meadowbrook Slough dog park C) Re-routing of Snoqualmie Valley trail and removal of elevated rail-road berm from Meadowbrook Slough to the trestle bridge D) Construction of flood and erosion control measures on edge of floodplain to protect local residents, city property, and infrastructure E) Removal of Trestle bridge to improve flood conveyance and safety	RM 42.6-43.5	Infrastructure	Apply for grant to conduct feasibility and benefits assessment, 1-2 years	N/A - Implementation timeframe will be assessed following completion of feasibility assessment	Upon implementation:  <b>Immediate:</b> Increase in floodplain connectivity and wood recruitment potential. Flood and erosion risk reduction Short-delay: Reduce downstream flood risk and improve aquatic habitat by increasing floodplain connectivity <b>Long-delay:</b> Increased south side shading and riparian forest health once forest establishes and matures	\$	25,980,000.00	\$7,794,000
9	Meadowbrook Reach	Revegetation of left bank at dog park area - wide buffer for shade, resilience to erosion, and ultimately large wood recruitment. Existing forest nearest the river requires conifer underplanting and invasive plant species control.		Forest Management	Talk to landowners and figure out what is feasible. Apply for grant once feasibility is figured out.	Reforestation efforts are ongoing, this is a near term and long term action	Benefits to the river will take decades to realize, immediate terrestrial habitat benefits.	\$	4,750,000.00	\$1,425,000
10	Meadowbrook Reach	Relocate powerlines and convert to forested buffer. If powerlines cannot be moved, convert blackberry acreage to native shrub community and plant trees along riverbank.		Forest Management	Evaluate feasibility of powerline relocation through assessment and coordination with stakeholders	Short-term: Feasibility evaluation Long-term: Powerline relocation	Short-delay (benefits not realized until native vegetation is established)	\$	150,000.00	\$45,000
11	City Reach	Add more wood to LB timber revetment to increase structural integrity and improve fish habitat along bank	RM 41.9	Infrastructure	Coordinate with on-going City/County efforts to improve revetment, 1-2 years Apply for design and implementation funds, 2-5 years	Near-term	Immediate (pools, cover)	\$	5,800,000.00	\$1,740,000
12	City Reach	Build mid-channel ELJ on bar adjacent to Sandy Cove park to establish flow split, increase shade, and increase pool frequency and complex cover. Enhance side channel habitat along right bank floodplain to increase channel length and shade, provide slow velocity habitat, increase cover, and potentially add additional flood storage.	RM 41.6	ELJ	Apply for design and implementation funds, 1-2 years	Near-term	Immediate (pools, cover) and short-term (channel narrowing)	\$	660,000.00	\$198,000

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Action Number (see Map)	Reach/Zone	Opportunity/Description	RM	Project Type	Next step and time frame	Implementation time-frame (near-term (2-3 years), long-term (>3 years))	Benefit Time Frame (immediate, short delay, long delay)	Rough Opinion of Cost (2021 dollars) Construction		
								Included 10% Mobilization, 5% TESC, and 30% contingency. Costs rounded to nearest \$10,000.		Design and permitting of constructed projects were assumed to be 30%, 20% and 10% respectively, of construction cost. See Note 1.
13	City Reach	Vegetation - inside of 100' riparian buffer, control invasives (knotweed, blackberry), plant conifers, willow, dogwood, plant 2 currently unvegetated bars	RM 41 ish	Forest Management	Develop forest stewardship plan with City and County, with implementable steps and funding sources identified. Consider applying for a grant to support this planning process.	Near and long-term	Short delay	\$	3,750,000.00	\$1,125,000
14	City Reach	Conduct Mill Pond water quality, environmental cleanup, recreational and river connectivity assessment to evaluate potential risks to environmental quality and develop solutions to improve conditions. Consider road removal or enhancing side channel connectivity under road. Wetland restoration opportunities.	RM 41-42.6	Assessment	Apply for grant to conduct assessment, 1-2 years		Benefit time frame will be evaluated as part of proposed assessment	N/A		Department of Ecology or EPA? This will likely cost millions.
15	City Reach	Improve tribal access to top and bottom of Snoqualmie Falls.		Access	Develop plan for improving access with utility and others.	Near term	Immediate	N/A		TBD
16	Kimball Creek Reach	Initiate development of protection strategy and implement to protect Coal and Fisher Creeks, which are providing colder, higher DO water to mainstem Kimball Creek. Much of these watersheds is currently forested, but with extensive private property ownership there could be clearing and development actions. Start with plan for property acquisition.	N/A	Protection	Develop protection strategy and identify opportunities, 1-2 years	Implement acquisitions, easements, or incentives for properties identified in the protection strategy, 3-20 years	immediate	N/A		80000
17	Kimball Creek Reach	Possible riparian reforestation around Coal Creek where it avulsed into an unforested channel at a location referenced in Baerwalde (2011, p. 10). Exact location and current riparian status need to be assessed. Start with assessment.	N/A	Forest Management	Identify and assess referenced location, 1 year	Coordinate with landowners and implement reforestation, 1-2 years	Short to medium delay for effective shading of an approximately 30 ft channel	N/A		40000
18	Kimball Creek Reach	Riparian reforestation along the Meadowbrook reach of Kimball Creek, see maps showing low canopy cover and high reed canarygrass grass, and description in Baerwalde (2011, p. 11).	N/A	Reforestation	Coordinate with landowners and begin reforestation, 1-5 years	Same.	Medium delay - need substantial growth for shading of wide channel (approximately 250 ft) and water bodies (approximately 200-500 ft wide) in this area.	\$	11,550,000.00	\$3,465,000
19	Kimball Creek Reach	Stream restoration in previously dredged section of Kimball Creek, which could include regrading over-steepened banks, instream wood placements to add complexity and retain gravels that are coming in from Coal and Fisher Creeks.	N/A	In-Stream Restoration	Assessment and design, 1-2 years	Coordinate with landowners and implement restoration actions, 3-6 years	short delay	\$	1,160,000.00	\$348,000
20	Kimball Creek Reach	If not already implemented, use best management practices (BMPs) recommended in Baerwalde (2011) at Casino detention pond and in application of salts to road. Casino detention pond was identified as a source of high pH and warm effluent to tributary "KT", which ultimately flows into Kimball Creek.	N/A	BMPs	Assess current status of BMP implementation, 1 year	Coordinate with Casino leadership to implement BMPs if necessary, 1-2 years	immediate	N/A	\$	75,000.00
21	Project Area	Create Forest Stewardship Program	N/A	Strategy and Implementation Plan	Develop forest stewardship plan with City, with implementable steps and funding sources identified. Consider applying for a grant to support this planning process.	mid-term	short delay	N/A	\$	80,000.00
22	Project Area	Flood and erosion risk analysis with climate change and river resiliency actions	N/A	Strategy and Implementation Plan	Conduct climate change flood and erosion risk analysis in conjunction with future resilient river corridor action analysis. Consider applying for a grant to support this planning process.	mid-term	short delay	N/A	\$	180,000.00
Key Assumptions and Notes										
Note 1. Costs which are based off of a percentage of the construction costs may be overestimated for expensive projects and underestimated for smaller projects. Goal of this approach was consistency and affording range of low and high estimates for decision making and grant writing purposes.										



Upper Snoqualmie Resilient River Corridor Management Plan  
List of Restoration Opportunities and Actions.

Action Number (see Map)	Reach/Zone	Opportunity/Description	CLOMR, LOMR, No Rise, Possible Re-map	Grand Total	No Rise Permitting Needed?	Physical Benefits/What problem does this address	Bank length Affected (feet)	Floodplain Area Affected (acres)	Temperature Benefit (None to High)
			5% of Construction Cost for projects under \$5,000,000; 2% for projects between \$5,000,000-\$10,000,000; 1% for projects greater than \$10,000,000. Assume reach-based permitting (i.e. all confluence reach projects get analyzed together); cost increases if permitted separately. See Note 1.						Low = possible reconnection to a colder water source or groundwater  Medium = north side shading  High = south side shading or connection to known cold water source
1	Confluence Reach	Conduct assessment of river and floodplain crossings within the confluence reach to evaluate their impact on river and floodplain processes. The assessment should include the two bridges over the Middle and North Fork of the Snoqualmie River as well as any floodplain overflow channels and wetlands. One potential outcome of the assessment could be proposing to improve the existing bridges. Develop alternatives for restoration and preferred restoration alternative (if any).	N/A	\$150,000	N/A	Increases in floodplain connectivity and SW/GW exchange. Improvement in floodplain forest health. Potential decreases in flood and erosion risk to infrastructure. Reduce constraints on channel migration.	~15,000		High (increase connectivity at known cool water 800 source. Improve south side shading, especially of floodplain waterbodies)
2a	Confluence Reach	Remove obsolete left bank riprap on NF (right at NF/MF confluence). Involves a hydraulic model, demolition plan, permitting and construction.	\$9,000	\$243,000	Yes	Increase floodplain connectivity with left floodplain, potential SW/GW connection to cool water source; restore natural bank migration process; improve bank habitat	600 feet of bank restored	11 acres	Low
3	Confluence Reach	Increase connectivity of mainstem to cool-water tributary through ELJ installation (tributary – 48 deg. F.; Mainstem – 56 deg. F.) [Can be combined with bank armoring removal]	\$13,500	\$364,500	Yes	Cooler temperatures within confluence	~200 feet	N/A	High (increase connectivity and pool frequency at known cool water source)
4	Confluence Reach	Channel and floodplain restoration of the Confluence Reach to encourage a multi-threaded anabranching channel morphology and restore the floodplain large wood cycle  Actions: Create forested islands within mainstem upstream of SF confluence through ELJ installation	\$63,500	\$1,714,500	Yes	<u>ELJs</u> : Long-term restoration of anabranching plan form, to increase shade (to decrease water temp), increase pool frequency, and increase complexity of aquatic habitat <u>Reforestation</u> : Improves over-water shade and provides source of large wood for river. Also provides terrestrial habitat and healthy forest structure.		13,000 ~280	High (south side shading, channel narrowing, transition from braided to anabranching morphology)
5	Confluence Reach	Reinforce emerging forested island at RM 43.5 by constructing ELJs	\$15,500	\$418,500	Yes	Long-term restoration of anabranching plan form, to increase shade (to decrease water temp), increase pool frequency, and increase complexity of aquatic habitat		2,800	8.5 High (increased south and north side shading)
6	Confluence Reach	Riparian reforestation on south banks (left bank) in a minimum 100-ft wide buffer from the channel bank. Remove Scot's broom and blackberry on gravel bars, plant with cottonwood and willow. Supplemental planting with conifers or early seral deciduous species (cottonwood, big leaf maple) as indicated by existing conditions in stand.	N/A	\$3,107,000	N/A	Improves over-water shade and provides source of large wood for river. Also provides terrestrial habitat and healthy forest structure		10,000 ~70	High (increased south side shading)
7	Confluence Reach	Plan and analysis regarding conservation/protection of well-connected left bank floodplain. Landowner outreach and potential land acquisition.	N/A	\$90,000	N/A	Conserves well functioning floodplain forest	~10,000	~400	High (preservation of shaded and well connected floodplain will allow for continued shade and hyporheic processes)
2b	Meadowbrook Reach	Remove derelict right bank groin near RM 43.5. Involves a hydraulic model, demolition plan, permitting and construction.	\$3,000	\$81,000	Yes	Improves floodplain connectivity and channel migration potential through constrained portion of channel		1,000 90 (full right bank floodplain surface included)	Low
8	Meadowbrook Reach	Restoration of floodplain processes within Meadowbrook Slough and adjacent floodplain.  Specific actions include: A) Removal of left bank revetment to increase connectivity with Meadowbrook Slough B) Revegetation and invasive species removal in left bank floodplain within Meadowbrook Slough dog park C) Re-routing of Snoqualmie Valley trail and removal of elevated rail-road berm from Meadowbrook Slough to the trestle bridge D) Construction of flood and erosion control measures on edge of floodplain to protect local residents, city property, and infrastructure E) Removal of Trestle bridge to improve flood conveyance and safety	\$259,800	\$34,033,800	Yes	Improve floodplain connectivity by allowing additional flow into Meadowbrook slough during floods. Improve channel migration potential and subsequent floodplain formation/large wood recruitment processes. Increase shade, bank cohesion and wood recruitment through forest restoration. Reduce flood/erosion risk by moving infrastructure (trail) out of floodplain.		5,100	High (south side shading and increased floodplain 300 connectivity and subsequent SW/GW exchange. Increased shading of floodplain waterbodies)
9	Meadowbrook Reach	Revegetation of left bank at dog park area - wide buffer for shade, resilience to erosion, and ultimately large wood recruitment. Existing forest nearest the river requires conifer underplanting and invasive plant species control.	N/A	\$6,175,000	No	Increase shade. Increase bank cohesion. Increase wood recruitment	N/A - Floodplain area	300 acres	High
10	Meadowbrook Reach	Relocate powerlines and convert to forested buffer. If powerlines cannot be moved, convert blackberry acreage to native shrub community and plant trees along riverbank.	N/A	\$195,000	No	Increased shade. Increase bank cohesion. Increase wood recruitment. Remove invasives.	~200	~2	Low - minimal bank length effected
11	City Reach	Add more wood to LB timber revetment to increase structural integrity and improve fish habitat along bank	\$116,000	\$7,656,000	Yes	Immediate benefits to aquatic habitat through increased cover and pool habitat. Increased erosion protection benefits for City due to repairing failing revetment		4,000 N/A	Low (minor temperature impacts related to creation of pools)
12	City Reach	Build mid-channel ELJ on bar adjacent to Sandy Cove park to establish flow split, increase shade, and increase pool frequency and complex cover. Enhance side channel habitat along right bank floodplain to increase channel length and shade, provide slow velocity habitat, increase cover, and potentially add additional flood storage.	\$33,000	\$891,000	Yes	Immediate benefits to aquatic habitat through increased cover and pool habitat. Increased shading by narrowing existing channels and encouraging establishment of mature riparian vegetation		1,200	2 High (increased north and south side shading)

Upper Snoqualmie Resilient River Corridor Management Plan  
List of Restoration Opportunities and Actions.

Action Number (see Map)	Reach/Zone	Opportunity/Description	CLOMR, LOMR, No Rise, Possible Re-map	Grand Total	No Rise Permitting Needed?	Physical Benefits/What problem does this address	Bank length Affected (feet)	Floodplain Area Affected (acres)	Temperature Benefit (None to High)
13									Low = possible reconnection to a colder water source or groundwater  Medium = north side shading  High = south side shading or connection to known cold water source
	City Reach	Vegetation - inside of 100' riparian buffer, control invasives (knotweed, blackberry), plant conifers, willow, dogwood, plant 2 currently unvegetated bars	N/A	\$4,875,000	No	Increase shade. Increase bank cohesion. Increase wood recruitment		1050 Acres	High
14	City Reach	Conduct Mill Pond water quality, environmental cleanup, recreational and river connectivity assessment to evaluate potential risks to environmental quality and develop solutions to improve conditions. Consider road removal or enhancing side channel connectivity under road. Wetland restoration opportunities.	N/A	\$0	N/A	Improve water and ecosystem quality by cleaning up contaminated area. Increase connectivity to large floodplain area if remediation is conducted.		12000	Temperature benefit will be evaluated as part of 430 assessment. (Temperature of Mill Pond relative to river is current data gap)
15	City Reach	Improve tribal access to top and bottom of Snoqualmie Falls.	N/A	\$0	N/A	Removes access barriers to significant cultural landscape.	N/A	N/A	N/A
16	Kimball Creek Reach	Initiate development of protection strategy and implement to protect Coal and Fisher Creeks, which are providing colder, higher DO water to mainstem Kimball Creek. Much of these watersheds is currently forested, but with extensive private property ownership there could be clearing and development actions. Start with plan for property acquisition.	N/A	\$80,000	N/A	temperature, DO	Varies	Varies	High.
17	Kimball Creek Reach	Possible riparian reforestation around Coal Creek where it avulsed into an unforested channel at a location referenced in Baerwalde (2011, p. 10). Exact location and current riparian status need to be assessed. Start with assessment.	N/A	\$40,000	N/A	temperature (shading)	Unknown; need to identify exact location.	Unknown. Need to identify exact location. Baerwalde (2011) notes that a narrow buffer would be sufficient.	High
18	Kimball Creek Reach	Riparian reforestation along the Meadowbrook reach of Kimball Creek, see maps showing low canopy cover and high reed canarygrass grass, and description in Baerwalde (2011, p. 11).	N/A	\$15,015,000	no	temperature (shading)	8000 ft of north-side shading enhancement possible; 3000 ft of south-side shading enhancement possible.	Assuming 50 ft of buffer, could be up to approximately 13 acres	High for south-side shading; medium for north-side shading
19	Kimball Creek Reach	Stream restoration in previously dredged section of Kimball Creek, which could include regrading over-steepened banks, instream wood placements to add complexity and retain gravels that are coming in from Coal and Fisher Creeks.	\$58,000	\$1,566,000	Yes	Habitat complexity; pool creation; gravel retention	At least 4000 ft to assess for possible stream restoration actions	Unknown. Stream restoration actions such as adding large wood or re-grading the banks may affect the frequency and duration of floodplain inundation.	Low.
20	Kimball Creek Reach	If not already implemented, use best management practices (BMPs) recommended in Baerwalde (2011) at Casino detention pond and in application of salts to road. Casino detention pond was identified as a source of high pH and warm effluent to tributary "KT", which ultimately flows into Kimball Creek.	N/A	\$75,000		Improve water quality by lowering salinity, lowering pollution, lowering temperature	N/A	N/A	Low.
21	Project Area	Create Forest Stewardship Program	N/A	\$80,000	No	Solves problem of forest decline and supports future source of woody debris, habitat logs, biodiversity, and other benefits.	Several miles	Thousands of acres	High
22	Project Area	Flood and erosion risk analysis with climate change and river resiliency actions	N/A	\$180,000	No	Solves problem of addressing questions about flood and erosion risk with river resiliency actions and climate change.	Several miles	many acres	n/a
			Total	\$77,030,300					
Key Assumptions and Notes									
Note 1. Costs which are based off of a percentage of the construction costs may be c									



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Action Number (see Map)	Reach/Zone	Opportunity/Description	Aquatic Habitat Benefit (Low to High)	Terrestrial Habitat Benefit (Low to High)	How will this action affect climate change resiliency benefits?	Risks/Issues?
			Low = Improves aquatic habitat conditions (i.e. increases available cover) but does not initiate restored river and floodplain processes;  Medium = Initiates some restoration of river and floodplain processes but primarily focused on short term benefits such as improved cover or pools;  High = Initiates restored self sustaining river and floodplain processes	Low = Improves terrestrial habitat conditions (i.e. increases forest cover) but does not initiate regenerative forest processes;  Medium = Initiates some restoration of forest processes but primarily focused on short term benefits such as improved stem density;  High = Initiates restored self sustaining forest processes	Low = little effect on human impact of increased peak flows  Medium = some effect on human impact of increased peak flows  High = significant effect on human impact of increased peak flows	
1	Confluence Reach	Conduct assessment of river and floodplain crossings within the confluence reach to evaluate their impact on river and floodplain processes. The assessment should include the two bridges over the Middle and North Fork of the Snoqualmie River as well as any floodplain overflow channels and wetlands. One potential outcome of the assessment could be proposing to improve the existing bridges. Develop alternatives for restoration and preferred restoration alternative (if any).	High (increased floodplain connectivity and restoration of unvegetated floodplain areas)	High (improved quantity and quality of floodplain forest)	-Improve flood attenuation and decrease flood/erosion risk to floodplain infrastructure. -Increase groundwater storage and potentially Increase late summer stream flow. -Improve connectivity to known cold water source	Potential risks will be evaluated as part of the proposed assessment
2a	Confluence Reach	Remove obsolete left bank riprap on NF (right at NF/MF confluence). Involves a hydraulic model, demolition plan, permitting and construction.	Medium (increased floodplain connectivity and associated processes)	Medium (improved floodplain forest)		Low risk. Bank armoring not protecting any residences.
3	Confluence Reach	Increase connectivity of mainstem to cool-water tributary through ELJ installation (tributary – 48 deg. F.; Mainstem – 56 deg. F.) [Can be combined with bank armoring removal]	Medium (isolated process restoration)	Low	The small scale of this action will have limited effects on climate resiliency. However, the limited influences include the creation of a cool-water refugia area for aquatic species.	Benefit may be limited by small scale of actions. Potential mixing with larger river may dampen benefits.
4	Confluence Reach	Channel and floodplain restoration of the Confluence Reach to encourage a multi-threaded anabranching channel morphology and restore the floodplain large wood cycle  Actions: Create forested islands within mainstem upstream of SF confluence through ELJ installation	High (restoration of floodplain large wood cycle processes)	High (improved quantity and quality of floodplain forest)	-Improved resiliency to increases in peak flows through increased roughness and floodplain connectivity -Improved resiliency to summer drought conditions by creating narrower and deeper channels and increasing SW/GW exchange	Recreation risk due to ELJs in commonly utilized area
5	Confluence Reach	Reinforce emerging forested island at RM 43.5 by constructing ELJs	High (restoration of floodplain large wood cycle processes)	Medium (establish forested island)	-Improve flood attenuation through increases in roughness -Increase stream shading by narrowing channel and establishing riparian vegetation	Potential risk to recreation due to ELJs being constructed in heavily used area
6	Confluence Reach	Riparian reforestation on south banks (left bank) in a minimum 100-ft wide buffer from the channel bank. Remove Scot's broom and blackberry on gravel bars, plant with cottonwood and willow. Supplemental planting with conifers or early seral deciduous species (cottonwood, big leaf maple) as indicated by existing conditions in stand.	High (restoration of floodplain large wood cycle processes)	High (initiates self-sustaining forest processes)	-Improved flood attenuation through increases in roughness -Improved resiliency to summer drought conditions by increasing shade	N/A
7	Confluence Reach	Plan and analysis regarding conservation/protection of well-connected left bank floodplain. Landowner outreach and potential land acquisition.	High (preservation of well connected floodplain)	High (floodplain habitat preserved)	-Maintain existing flood attenuation properties of floodplain -Maintain shade function of floodplain forest will maintain existing resiliency towards summer drought.	
2b	Meadowbrook Reach	Remove derelict right bank groin near RM 43.5. Involves a hydraulic model, demolition plan, permitting and construction.	Medium (improved floodplain connectivity and processes. Improved wood recruitment potential and channel migration)	Medium (improved floodplain forest)	-Improve flood attenuation within right bank floodplain surface	Potential for increased flooding and erosion risk to private property
8	Meadowbrook Reach	Restoration of floodplain processes within Meadowbrook Slough and adjacent floodplain.  Specific actions include: A) Removal of left bank revetment to increase connectivity with Meadowbrook Slough B) Revegetation and invasive species removal in left bank floodplain within Meadowbrook Slough dog park C) Re-routing of Snoqualmie Valley trail and removal of elevated rail-road berm from Meadowbrook Slough to the trestle bridge D) Construction of flood and erosion control measures on edge of floodplain to protect local residents, city property, and infrastructure E) Removal of Trestle bridge to improve flood conveyance and safety	High (restore floodplain large wood cycle and floodplain formation processes)	High (restore currently un-forested areas in floodplain. Improve quality of existing habitat)	-Improve flood attenuation through increases in floodplain connectivity, removal of infrastructure, and improvements of flood defenses will potentially help mitigate increases in peak flow. -Potential increases in late summer stream flow through increased SW/GW exchange -Increased south side shading will help mitigate temperature increases	Potential risks will be evaluated as part of the proposed assessment. Potential risks include: -Impact on flooding and erosion of private and public property -Impacts on recreation (trail and dog park)
9	Meadowbrook Reach	Revegetation of left bank at dog park area - wide buffer for shade, resilience to erosion, and ultimately large wood recruitment. Existing forest nearest the river requires conifer underplanting and invasive plant species control.	Low	High	-Improved flood attenuation through increases in floodplain roughness -Improved resiliency to high summer stream temperatures through increased shading of floodplain waterbodies	Reduction in open space may not be well received by dog park users?
10	Meadowbrook Reach	Relocate powerlines and convert to forested buffer. If powerlines cannot be moved, convert blackberry acreage to native shrub community and plant trees along riverbank.	Low - minimal bank length effected	High (Initiates restored self sustaining forest processes)	-This action will have low influence on climate resiliency because of the small bank length and area affected	
11	City Reach	Add more wood to LB timber revetment to increase structural integrity and improve fish habitat along bank	Low to Medium (improved aquatic habitat (cover/pools) but processes not restored)	None (actions will not impact terrestrial habitat)	-Minor influence on flood attenuation through increases in roughness -Minor influence on temperature through increased pool frequency	Potential risk to recreation due to added wood in heavily used area
12	City Reach	Build mid-channel ELJ on bar adjacent to Sandy Cove park to establish flow split, increase shade, and increase pool frequency and complex cover. Enhance side channel habitat along right bank floodplain to increase channel length and shade, provide slow velocity habitat, increase cover, and potentially add additional flood storage.	Medium (increased cover, pool formation, floodplain area)	Medium (increased quantity and quality of riparian forest)	-Minor improvements to flood attenuation through increases in roughness -Minor improvements to summer drought resiliency by creating narrower and deeper channel segments and increasing shade	Potential risk to recreation due to ELJs being constructed in heavily used area Potential increases in flooding due to added roughness and obstructions

Upper Snoqualmie Resilient River Corridor Management Plan  
List of Restoration Opportunities and Actions.

Action Number (see Map)	Reach/Zone	Opportunity/Description	Aquatic Habitat Benefit (Low to High)	Terrestrial Habitat Benefit (Low to High)	How will this action affect climate change resiliency benefits?	Risks/Issues?
13	City Reach	Vegetation - inside of 100' riparian buffer, control invasives (knotweed, blackberry), plant conifers, willow, dogwood, plant 2 currently unvegetated bars	Low = Improves aquatic habitat conditions (i.e. increases available cover) but does not initiate restored river and floodplain processes;	Low = Improves terrestrial habitat conditions (i.e. increases forest cover) but does not initiate regenerative forest processes;	Low = little effect on human impact of increased peak flows	Some conflict with current uses?
			Medium = Initiates some restoration of river and floodplain processes but primarily focused on short term benefits such as improved cover or pools;	Medium = Initiates some restoration of forest processes but primarily focused on short term benefits such as improved stem density;	Medium = some effect on human impact of increased peak flows	
14	City Reach	Conduct Mill Pond water quality, environmental cleanup, recreational and river connectivity assessment to evaluate potential risks to environmental quality and develop solutions to improve conditions. Consider road removal or enhancing side channel connectivity under road. Wetland restoration opportunities.	High = Initiates restored self sustaining river and floodplain processes	High = Initiates restored self sustaining forest processes	High = significant effect on human impact of increased peak flows	
15	City Reach	Improve tribal access to top and bottom of Snoqualmie Falls.	Low	High	-Minor improvements to flood attenuation through increases in bank roughness and cohesion -Increased resiliency to high summer stream temperatures through increased shading	
16	Kimball Creek Reach	Initiate development of protection strategy and implement to protect Coal and Fisher Creeks, which are providing colder, higher DO water to mainstem Kimball Creek. Much of these watersheds is currently forested, but with extensive private property ownership there could be clearing and development actions. Start with plan for property acquisition.	High (restoration of floodplain processes and reconnection to historical floodplain landform)	High (improve water quality and environmental conditions at Mill Pond site through remediation actions)	-Improve flood attenuation by re-connecting historical floodplain landform -Potential positive impacts to late summer temperature and stream flow through increased connectivity with Mill Pond	
17	Kimball Creek Reach	Improve tribal access to top and bottom of Snoqualmie Falls.	N/A	N/A	N/A	No obvious risks but it will take many conversations to achieve well.
18	Kimball Creek Reach	Initiate development of protection strategy and implement to protect Coal and Fisher Creeks, which are providing colder, higher DO water to mainstem Kimball Creek. Much of these watersheds is currently forested, but with extensive private property ownership there could be clearing and development actions. Start with plan for property acquisition.	High	High	-Increased resiliency to summer drought through protection of forested tributary areas	Sensitivity to private property rights.
19	Kimball Creek Reach	Possible riparian reforestation around Coal Creek where it avulsed into an unforested channel at a location referenced in Baerwalde (2011, p. 10). Exact location and current riparian status need to be assessed. Start with assessment.	Low. The main benefit is to water temperature with secondary benefits related to having forested banks (e.g., root cohesion, organic matter)	Low	-Increased resiliency to high summer temperatures through increased shading	Need to assess current status first.
20	Kimball Creek Reach	Riparian reforestation along the Meadowbrook reach of Kimball Creek, see maps showing low canopy cover and high reed canarygrass grass, and description in Baerwalde (2011, p. 11).	Low. The main benefit is to water temperature with secondary benefits related to having forested banks (e.g., root cohesion, organic matter)	Low.	-Increased peak flow attenuation through increases in roughness -Increased resiliency to high summer temperatures through increased shading	Much of this reach is wetland with open water and wide channel areas, which makes riparian shading less effective. Private buildings are located very close to Kimball Creek at the Williams Addition (i.e., along 381st Place SE)
21	Kimball Creek Reach	Stream restoration in previously dredged section of Kimball Creek, which could include regrading over-steepened banks, instream wood placements to add complexity and retain gravels that are coming in from Coal and Fisher Creeks.	Medium.	Low.	-Minor benefits to peak flow attenuation -Increased resiliency to high summer stream temperatures through increased roughness and sinuosity which will encourage hyporheic function	Raising WSE may be unwelcome in this highly developed area; could also attract more beaver usage. What is the community perception of the existing beaver populations?
22	Kimball Creek Reach	If not already implemented, use best management practices (BMPs) recommended in Baerwalde (2011) at Casino detention pond and in application of salts to road. Casino detention pond was identified as a source of high pH and warm effluent to tributary "KT", which ultimately flows into Kimball Creek.	Low.	None.	N/A	What is the current status of implementation and effectiveness since Baerwalde (2011)?
23	Project Area	Create Forest Stewardship Program	High	High	-Increased resiliency to peak flows through improvement of floodplain forest -Increased resiliency to summer drought through improved forest function	Needs public and political support, patience, and money.
24	Project Area	Flood and erosion risk analysis with climate change and river resiliency actions	n/a	n/a	-Increased resiliency to peak flows through identifying and addressing high risk areas and infrastructure.	Needs public and political support, patience, and money.
Key Assumptions and Notes						
Note 1. Costs which are based off of a percentage of the construction costs may be c						