



Meeting Handouts

June 18, 2019

1. Funding updates and balances
2. WSDOT work plan update
3. Presentation: Climate Adapted Culverts
4. Presentation: Pilchuck Watershed
5. Presentation: North of Falcon

2017-19 FBRB PROJECTS (March 18, 2019)

Rank	Project Name	WDFW / RCO	Amt. in enacted 2017-19 Capital Budget	Total Agreement Amt.	RCO Share	Real Match	PRISM App ID	Comment
1	Chico Cr	Piazza / Caudill	\$3,785,000	\$3,922,000	\$3,472,000	\$450,000	17-1417	
2	Johnson Cr	Piazza / Caudill	\$3,008,000	\$2,256,632	\$2,158,432	\$98,200	17-1418	Bid for entire project came in under (incl. creosote removal), so not expecting cost increase request
3	Buford Cr	Collins / Lambert	\$4,721,000	\$4,409,284	\$4,160,031	\$249,253	17-1419	Total agreement amount is after adjustment approved on May 25, 2018 (clerical error). Hold \$250,000 for anticipated cost increase.
4	MF Newaukum	Roler / Lambert	\$572,000	\$1,016,993	\$1,016,993	\$0	17-1420	491,993\$ cost increase request approved
5	Trib to Arkansas Cr	Roler	\$285,000	\$0	\$0		17-1421	funded by FEMA—application withdrawn
6	Coleman Cr	Collins / Caudill	\$771,000	\$606,762	\$606,762	\$0	17-1422	
7	Catherine Cr	Piazza / Lambert	\$566,000	\$316,389	\$307,427	\$8,962	17-1423	Cost increase anticipated
8	Trib to Coffee Cr	Piazza / Caudill	\$327,000	\$704,343	\$300,000	\$404,343	17-1424	404,343\$ provided by Puget Sound Acq./Rest., bringing total RCO agreement amt. to 704,343\$
9	Johnson Cr	Collins / Caudill	\$544,000	\$499,000	\$499,000	\$0	17-1425	
10	Baxter Cr	Roler / Lambert	\$2,181,000	\$2,354,118	\$2,001,000	\$353,118	17-1426	
11	Turner Cr	Roler / Lambert	\$1,090,000	\$1,347,500	\$1,000,000	\$200,000	17-1427	Anticipating 147,500\$ cost increase request; WDFW reviewed prelim designs and new cost estimate, sent comments to sponsor
12	Cottonwood Cr	Collins / Lambert	\$62,000	\$101,700	\$83,200	\$18,500	17-1428	26,000\$ cost increase approved
13	Trib to Johnson Cr	Piazza / Caudill	\$1,835,000	\$1,980,000	\$1,683,000	\$297,000	17-1429	If a bridge is req'd and cost increases above RCO Share amt. (1.68M\$), County will cover the overrun.
ALT 1	MF Newaukum	Roler / Lambert	\$0	\$97,730	\$97,730	\$0	18-2602	Approved for design-only funding by FBRB (Nov 2018) - previously Alternate #1 on LEAP List
ALT 3	Coleman Cr	Collins/Caudill	\$0	\$195,000	\$195,000	\$0	Pending	Approved for design-only funding by FBRB (May 2019) - previously Alternate #3 on LEAP List
			\$19,747,000	\$19,807,451	\$17,580,575	\$2,079,376		

Budget Summary for \$19,747,000 in Capital Budget	
Item	Amount
Tot. Grant Awards for Implementation of Top 13 Projects	\$17,580,575
Facilitation Contract	\$68,500
RCO Administration and Project Management	\$813,576
WDFW Administration and Program Implementation	\$798,233
Total	\$19,260,884
<i>Remainder</i>	\$486,116

\$250,000 hold for Buford Cr not included
 Cost Increase for Catherine Cr not included

LEAP List Alternates					
Rank	Project	Cost Estimate in 'Binder'	2019-21 Funding Request / Scope	WDFW TRT BIO	Comment
ALT 1	MF Newaukum	\$850,500	\$97,730 / Planning	Roler	Funded by FBRB for Design
ALT 2	Dayton Cr	\$460,000	\$420,304 / Restoration	Piazza	
ALT 3	Coleman Cr	\$1,560,734	\$1,306,080 / Restoration	Collins	Funded by FBRB for Design
ALT 4	Catherine Cr	\$400,000	\$89,611 / Planning	Piazza	
ALT 5	Johnson Cr	\$550,951	\$489,673 / Restoration	Collins	
ALT 6	Thorndyke Cr	\$1,412,000	\$198,313 / Planning	Roler	

DRAFT Schedule For Next FBRB RFP:

Task:	Date:	Description:	Notes:
-------	-------	--------------	--------

Request for Draft Proposals	1-Nov-19	Publication of FBRB Coordinated Pathway Request for Proposals	Earlier start to allow for more application review and an earlier list to RCO.
-----------------------------	----------	---	--

DRAFT

Draft Proposals Due	15-Jan-20	Submit complete Draft Proposal material to FBRB@dfw.wa.gov	These will go into initial review by DFW
---------------------	-----------	--	--

FBRB Reviews Draft Proposals	January - March 2020	Initial review of projects by TRT and FBRB for eligibility and potential benefits to anadromous salmonids.	Note: This gives us an extra two weeks. **Inventory crews will be out confirming barrier status and starting habitat surveys on obvious high ranking projects. Run two crews from here to the end of Final Proposal Review.
------------------------------	----------------------	--	---

Invitation to Submit Final Proposal	1-Apr-20	Proponents of high priority projects are invited to submit a Final Proposal	Note: continue two crews completing habitat surveys
-------------------------------------	----------	---	---

Final Proposals Due	15-May-20	Complete all sections and submit all attachments. Submit to PRISM (instead of the FBRB email like last round)	Note: This will speed up RCO's schedule for developing agreements and Cultural Resources. DFW and RCO will be reviewing Final Proposals in PRISM at the same time to expedite the process.
---------------------	-----------	---	--

FBRB Reviews Final Proposals	15 May - July 2020	Projects reviewed, ranked, and approved by TRT. Try to get the list approved at the FBRB meeting in July.	Note: This is a super busy time of year with construction for scoping bios. Might need extra help here from Inventory Section Staff.
------------------------------	--------------------	---	--

DRAFT

FBRB Project Request Submitted	1-Aug-20	Ranked project list and funding recommendations published and submitted to the Legislature. List approved at the August FBRB Meeting if it wasn't approved during the July meeting.	Note: One month earlier than last round
--------------------------------	----------	---	---

Funding Notification	TBD	Funding notification dependent upon final state budget. Funds expected to be available 01 JUL 2021	Will RCO then delete unfunded projects from PRISM? Hoping for a ~50 million dollar ask again potentially will lead to a lot of unfunded projects in PRISM.
----------------------	-----	--	--

WSDOT Stand-alone Fish Passage Projects planned for Design and Construction 19-21 within the Culvert Case Area

This plan is subject to change due to significant project issues and/or new information. This list does not include fish passage projects outside of the case area or projects within larger transportation projects; we're currently compiling information on those other projects and will share that information when available.

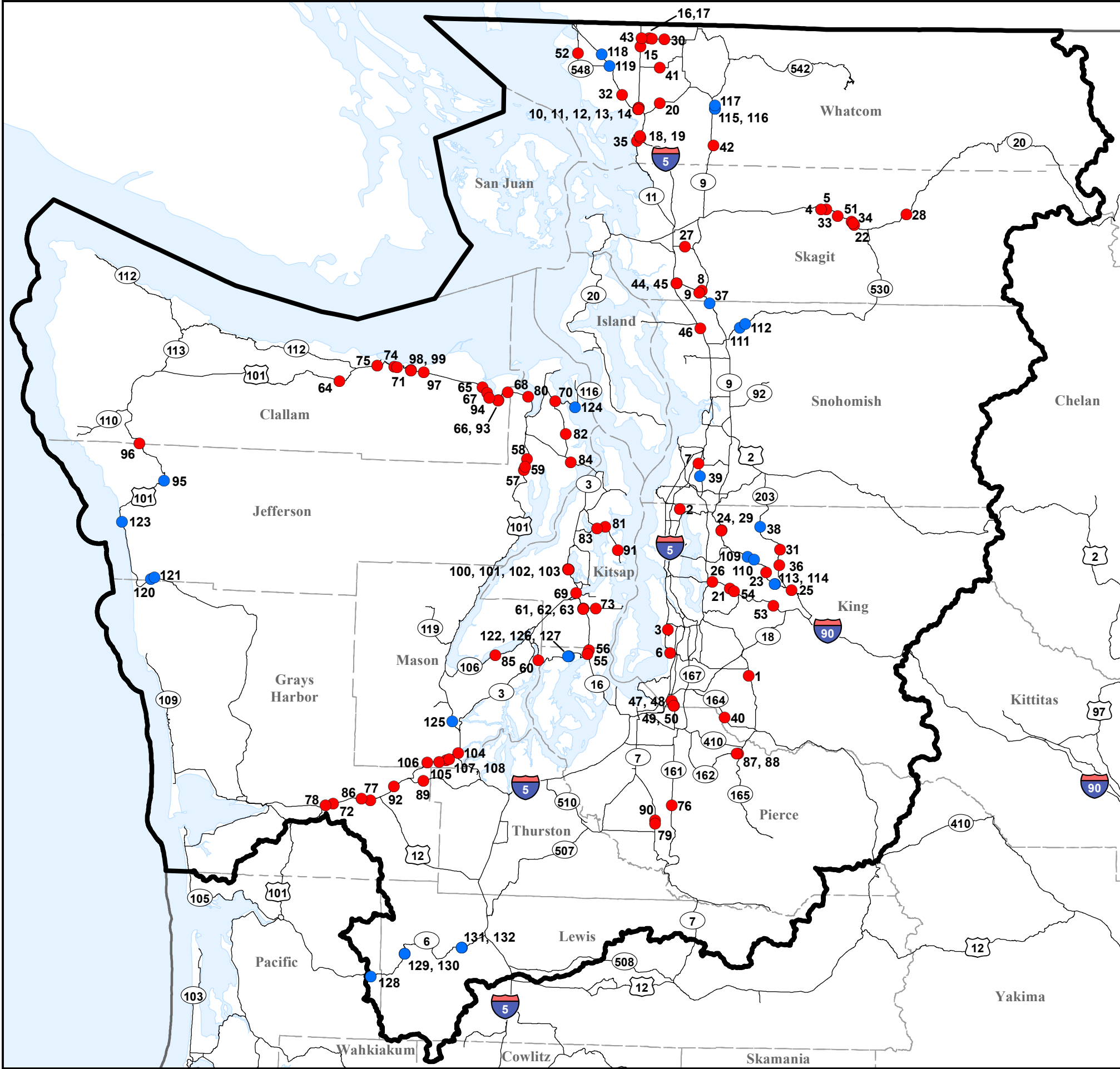
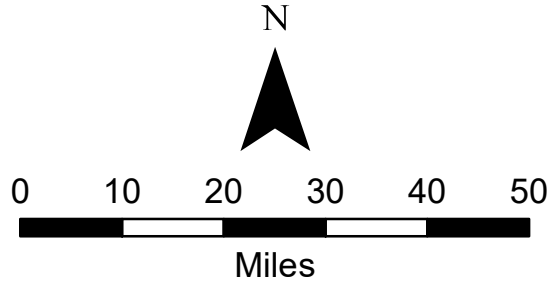
If you have questions about this document, and/or prior to making plans based on this document, please contact:

Kim Mueller
Fish Passage Delivery Program Manager
360-705-7404
kim.mueller@wsdot.wa.gov

Paul Wagner
Biology Branch Manager
360-705-7406
paul.wagner@wsdot.wa.gov

Legend

- Construction 19/21
- Design 19/21
- US v. WA Case Area Boundary



WSDOT Stand-alone Fish WSDOT Stand-alone Fish Passage Projects planned for Design and/or Construction 19-21 within the Culvert Case Area

This plan is subject to change due to significant project issues and/or new information. This list does not include fish passage projects outside of the case area or projects within larger transportation projects; we're currently compiling information on those other projects and will share that information when available. If you have questions about this document, and/or prior to making plans based on this document, please contact:

Kim Mueller

Fish Passage Delivery Program Manager

360-705-7404

kim.mueller@wsdot.wa.gov

Paul Wagner

Biology Branch Manager

360-705-7406

paul.wagner@wsdot.wa.gov

List sorted by WRIA, Road, Milepost. Map ID is not a priority number; it's meant to help locate sites on the enclosed map.

Map ID	Site ID	Stream	Tributary to	County	WRIA	WSDOT Region	Highway	Milepost	Activity
19	994233	Padden Cr	Bellingham Bay	Whatcom	1	NW	I-5	250.55	Design 19/21
10	990022	Baker Cr	Squalicum Cr	Whatcom	1	NW	I-5	256.28	Design 19/21
118	995715	unnamed	California Cr	Whatcom	1	NW	I-5	268.63	Construction 19/21
32	995723	unnamed	Silver Cr	Whatcom	1	NW	I-5; NB Ext 260	260.00	Design 19/21
11	992003	Spring Cr	Baker Cr	Whatcom	1	NW	I-5; NB on-ramp	256.00	Design 19/21
35	990581	unnamed	Chuckanut Cr	Whatcom	1	NW	SR 11	18.65	Design 19/21
18	994386	Padden Cr	Bellingham Bay	Whatcom	1	NW	SR 11	21.08	Design 19/21
14	992987	Baker Cr	Squalicum Cr	Whatcom	1	NW	SR 539	0.04	Design 19/21
12	991973	WF Spring Cr	Spring Cr	Whatcom	1	NW	SR 539	0.30	Design 19/21
13	990015	Spring Cr	Baker Cr	Whatcom	1	NW	SR 539	0.30	Design 19/21
15	991473	Duffner Ditch	Bertrand Cr	Whatcom	1	NW	SR 539	11.08	Design 19/21
20	990014	Squalicum Cr	Bellingham Bay	Whatcom	1	NW	SR 542	3.50	Design 19/21
41	996168	unnamed	Four Mile Cr	Whatcom	1	NW	SR 544	3.51	Design 19/21
43	931144	Duffner Ditch	Bertrand Cr	Whatcom	1	NW	SR 546	0.17	Design 19/21
16	996163	unnamed	Fishtrap Cr	Whatcom	1	NW	SR 546	1.47	Design 19/21
17	996164	unnamed	Fishtrap Cr	Whatcom	1	NW	SR 546	2.01	Design 19/21
30	990223	Kamm Cr	Nooksack R	Whatcom	1	NW	SR 546	4.21	Design 19/21
119	996003	unnamed	California Cr	Whatcom	1	NW	SR 548	0.29	Construction 19/21
52	996149	unnamed	Terrell Cr	Whatcom	1	NW	SR 548	8.11	Design 19/21
42	991106	unnamed	Landingstrip Cr	Whatcom	1	NW	SR 9	70.60	Design 19/21
115	992349	unnamed	Tawes Cr	Whatcom	1	NW	SR 9	77.36	Construction 19/21
116	992350	unnamed	Tawes Cr	Whatcom	1	NW	SR 9	77.43	Construction 19/21

WSDOT Stand-alone Fish WSDOT Stand-alone Fish Passage Projects planned for Design and/or Construction 19-21 within the Culvert Case Area

Map ID	Site ID	Stream	Tributary to	County	WRIA	WSDOT Region	Highway	Milepost	Activity
117	992356	Tawes Cr	SF Nooksack R	Whatcom	1	NW	SR 9	77.94	Construction 19/21
44	CR2	unnamed	Carpenter Cr	Skagit	3	NW	SR 534	0.53	Design 19/21
45	995265	unnamed	Carpenter Cr	Skagit	3	NW	SR 534	0.60	Design 19/21
27	NC129	Logan Cr	Nookachamps Cr	Skagit	3	NW	SR 538	2.18	Design 19/21
9	990641	unnamed	Lk McMurray	Skagit	3	NW	SR 9	40.09	Design 19/21
8	990091	Norway Park Cr	Lk Mc Murray	Skagit	3	NW	SR 9	41.04	Design 19/21
4	GR9	Fish Cr	Lorenzan Cr	Skagit	4	NW	SR 20	87.70	Design 19/21
5	GR23	Lorenzan Cr	Skagit R	Skagit	4	NW	SR 20	88.82	Design 19/21
33	JK2	unnamed	Skagit R	Skagit	4	NW	SR 20	91.30	Design 19/21
51	991711	unnamed	Skagit R	Skagit	4	NW	SR 20	94.10	Design 19/21
34	994308	unnamed	Skagit R	Skagit	4	NW	SR 20	94.47	Design 19/21
22	991126	unnamed	Skagit R	Skagit	4	NW	SR 20	94.82	Design 19/21
28	CD18	Olson Cr	Skagit R	Skagit	4	NW	SR 20	105.42	Design 19/21
46	990623	Secret Cr	Pilchuck Cr	Snohomish	5	NW	I-5	211.70	Design 19/21
111	991159	Trafton Cr	NF Stillaguamish R	Snohomish	5	NW	SR 530	24.65	Construction 19/21
112	991160	Schoolyard Cr	NF Stillaguamish R	Snohomish	5	NW	SR 530	25.94	Construction 19/21
37	LP19	unnamed	unnamed Pilchuck Cr trib	Snohomish	5	NW	SR 9	37.26	Construction 19/21
53	994410	Soderman Cr	Raging R	King	7	NW	I-90	23.13	Design 19/21
110	990325	Patterson Cr	Snoqualmie R	King	7	NW	SR 202	13.22	Construction 19/21
23	995194	unnamed	Patterson Cr	King	7	NW	SR 202	16.79	Design 19/21
114	991174	unnamed	Patterson Cr	King	7	NW	SR 202	19.69	Construction 19/21
113	991173	unnamed	Patterson Cr	King	7	NW	SR 202	19.76	Construction 19/21
25	101SA-06	Skunk Cr	Snoqualmie R	King	7	NW	SR 202	23.18	Design 19/21
36	991720	unnamed	Snoqualmie R	King	7	NW	SR 203	4.37	Design 19/21
31	995167	unnamed	Horseshoe Lk	King	7	NW	SR 203	7.26	Design 19/21
38	991716	Loutsis Cr	Snoqualmie R	King	7	NW	SR 203	13.60	Construction 19/21
26	996251	Sunset Cr	Richards Cr	King	8	NW	I-90	10.52	Design 19/21
21	992798	Lewis Cr	Lk Sammamish	King	8	NW	I-90	13.83	Design 19/21
54	994415	W Village Park Cr	Lake Sammamish	King	8	NW	I-90	14.83	Design 19/21
2	990253	Lyon Cr	Lake Washington	King	8	NW	SR 104	31.30	Design 19/21
24	996921	unnamed	Sammamish R	King	8	NW	SR 202	4.17	Design 19/21
29	996925	unnamed	unnamed	King	8	NW	SR 202	4.25	Design 19/21
109	990142	Evans Cr	Bear Cr	King	8	NW	SR 202	11.96	Construction 19/21
39	08.0077 0.20	Penny Cr	North Cr	Snohomish	8	NW	SR 527	6.57	Construction 19/21

WSDOT Stand-alone Fish WSDOT Stand-alone Fish Passage Projects planned for Design and/or Construction 19-21 within the Culvert Case Area

Map ID	Site ID	Stream	Tributary to	County	WRIA	WSDOT Region	Highway	Milepost	Activity
7	102 N183	North Cr	Sammamish R	Snohomish	8	NW	SR 96	0.47	Design 19/21
1	997695	Ravensdale Cr	Sawyer Lk	King	9	NW	SR 169	9.95	Design 19/21
3	997679	Miller Cr	Puget Sound	King	9	NW	SR 509	24.42	Design 19/21
6	991191	Barnes Cr	Massey Cr	King	9	NW	SR 516	0.41	Design 19/21
50	105 S011918a	unnamed	Hylebos Cr	King	10	NW	SR 161	32.78	Design 19/21
49	997974	unnamed	unnamed Hylebos Cr trib	King	10	NW	SR 161	32.90	Design 19/21
48	992062	unnamed	Hylebos Cr	King	10	NW	SR 161	33.48	Design 19/21
47	992064	unnamed	EF Hylebos Cr	King	10	NW	SR 161	33.79	Design 19/21
87	996343	Spiketon Cr	S Prairie Cr	Pierce	10	OL	SR 162	19.70	Design 19/21
40	105 R042117a	Pussyfoot Cr	White R	King	10	NW	SR 164	8.24	Design 19/21
88	105 R033018B	Spiketon Cr	S Prairie Cr	Pierce	10	OL	SR 165	19.76	Design 19/21
76	995475	unnamed	South Cr	Pierce	11	OL	SR 161	14.89	Design 19/21
79	991225	unnamed	South Cr	Pierce	11	OL	SR 7	37.50	Design 19/21
90	990688	unnamed	South Cr	Pierce	11	OL	SR 7	38.12	Design 19/21
85	990450	Twanoh Cr	Hood Canal	Mason	14	OL	SR 106	12.30	Design 19/21
106	991237	unnamed	Skookum Cr	Mason	14	OL	SR 108	5.50	Design 19/21
105	991672	unnamed	Skookum Cr	Mason	14	OL	SR 108	7.62	Design 19/21
108	990278	McDonald Cr	Skookum Cr	Mason	14	OL	SR 108	8.89	Design 19/21
107	997225	Kamilche Cr	Skookum Cr	Mason	14	OL	SR 108	9.47	Design 19/21
125	115 MC093	Coffee Cr	Goldsborough Cr	Mason	14	OL	US 101	346.95	Construction 19/21
104	997158	unnamed	Skookum Cr	Mason	14	OL	US 101	354.01	Design 19/21
56	15.0060 1.00	Purdy Cr	Burley Lagoon	Pierce	15	OL	SR 16	17.80	Design 19/21
62	990038	Blackjack Cr	Sinclair Inlet	Kitsap	15	OL	SR 16	25.30	Design 19/21
61	996755	Blackjack Cr	Sinclair Inlet	Kitsap	15	OL	SR 16; EB on-ramp	25.24	Design 19/21
63	996756	Blackjack Cr	Sinclair Inlet	Kitsap	15	OL	SR 16; WB off-ramp	25.30	Design 19/21
73	990366	Salmonberry Cr	Long Lk	Kitsap	15	OL	SR 160	2.29	Design 19/21
69	991995	Wright Cr	Sinclair Inlet	Kitsap	15	OL	SR 3	36.10	Design 19/21
100	15.0229 0.10	Chico Cr	Dyes Inlet	Kitsap	15	OL	SR 3	40.96	Design 19/21
101	991907	unnamed	Chico Cr	Kitsap	15	OL	SR 3; Access Rd	40.97	Design 19/21
103	996794	unnamed	Chico Cr	Kitsap	15	OL	SR 3; SB off-ramp	41.08	Design 19/21

WSDOT Stand-alone Fish WSDOT Stand-alone Fish Passage Projects planned for Design and/or Construction 19-21 within the Culvert Case Area

Map ID	Site ID	Stream	Tributary to	County	WRIA	WSDOT Region	Highway	Milepost	Activity
102	996795	unnamed	Chico Cr	Kitsap	15	OL	SR 3; SB on-ramp	40.99	Design 19/21
60	991525	Victor Cr	Case Inlet	Mason	15	OL	SR 302	4.20	Design 19/21
122	990286	Minter Cr	Henderson Bay	Pierce	15	OL	SR 302	11.30	Construction 19/21
126	15.0051 0.10	Little Minter Cr	Minter Cr	Pierce	15	OL	SR 302	11.36	Construction 19/21
127	15.0051 0.20	Little Minter Cr	Minter Cr	Pierce	15	OL	SR 302	11.42	Construction 19/21
55	990345	Purdy Cr	Burley Lagoon	Pierce	15	OL	SR 302; SPPURDY	16.04	Design 19/21
91	994325	unnamed	Murden Cove	Kitsap	15	OL	SR 305	2.44	Design 19/21
81	991958	Klebeal Cr	Agate Passage	Kitsap	15	OL	SR 305	7.28	Design 19/21
83	994327	unnamed	Liberty Bay	Kitsap	15	OL	SR 305	8.94	Design 19/21
84	990375	Shine Cr	Hood Canal	Jefferson	17	OL	SR 104	10.36	Design 19/21
70	990077	Chimacum Cr	Port Townsend Bay	Jefferson	17	OL	SR 116	0.22	Design 19/21
124	990943	Kilisut Harbor	Oak Harbor	Jefferson	17	OL	SR 116	4.67	Construction 19/21
82	990711	Swansonville Cr	EF Chimacum Cr	Jefferson	17	OL	SR 19	4.30	Design 19/21
65	990219	Johnson Cr	Sequim Bay	Clallam	17	OL	US 101	267.18	Design 19/21
67	991667	unnamed	Sequim Bay	Clallam	17	OL	US 101	268.54	Design 19/21
94	994464	unnamed	Sequim Bay	Clallam	17	OL	US 101	269.45	Design 19/21
93	991850	unnamed	Sequim Bay	Clallam	17	OL	US 101	271.83	Design 19/21
66	990075	Chicken Coop Cr	Sequim Bay	Clallam	17	OL	US 101	271.98	Design 19/21
68	990134	Eagle Cr	Strait of Juan de Fuca	Clallam	17	OL	US 101	274.25	Design 19/21
80	990090	Contractors Cr	Discovery Bay	Jefferson	17	OL	US 101	277.90	Design 19/21
58	990896	unnamed	Leland Cr	Jefferson	17	OL	US 101	290.35	Design 19/21
59	995502	unnamed	Leland Cr	Jefferson	17	OL	US 101	291.79	Design 19/21
57	990241	Leland Cr	L Quilcene R	Jefferson	17	OL	US 101	292.52	Design 19/21
64	18.0283 2.00	Indian Cr	Elwha R	Clallam	18	OL	US 101	238.35	Design 19/21
75	990448	Tumwater Cr	Port Angeles Harbor	Clallam	18	OL	US 101	246.40	Design 19/21
74	18.0234 1.10	Ennis Cr	Strait of Juan de Fuca	Clallam	18	OL	US 101	250.00	Design 19/21
71	990240	Lees Cr	Strait of Juan de Fuca	Clallam	18	OL	US 101	250.50	Design 19/21
98	990021	Bagley Cr	Strait of Juan de Fuca	Clallam	18	OL	US 101	253.85	Design 19/21

WSDOT Stand-alone Fish WSDOT Stand-alone Fish Passage Projects planned for Design and/or Construction 19-21 within the Culvert Case Area

Map ID	Site ID	Stream	Tributary to	County	WRIA	WSDOT Region	Highway	Milepost	Activity
97	18.0173 2.40	Siebert Cr	Strait of Juan de Fuca	Clallam	18	OL	US 101	256.10	Design 19/21
99	934250	unnamed	Bagley Cr	Clallam	18	OL	US 101 ROW	253.84	Design 19/21
123	990400	Steamboat Cr	Pacific Ocean	Jefferson	20	OL	US 101	162.60	Construction 19/21
95	991647	unnamed	Hoh R	Jefferson	20	OL	US 101	175.45	Construction 19/21
96	990269	May Cr	Bogachiel R	Clallam	20	OL	US 101	184.66	Design 19/21
121	990178	Harlow Cr	Queets R	Jefferson	21	OL	US 101	146.85	Construction 19/21
120	990148	Fisher Cr	Queets R	Jefferson	21	OL	US 101	147.49	Construction 19/21
92	993724	unnamed	Wildcat Cr	Grays Harbor	22	OL	SR 8	3.16	Design 19/21
89	990773	unnamed	Mox Chehalis Cr	Grays Harbor	22	OL	SR 8	9.10	Design 19/21
72	22.0349 0.70	Camp Cr	Metcalf Sl	Grays Harbor	22	OL	US 12	12.36	Design 19/21
86	933616	unnamed	Wenzel Sl	Grays Harbor	22	OL	US 12	17.56	Design 19/21
77	125 1806W34G	unnamed	Vance Cr	Grays Harbor	22	OL	US 12	19.17	Design 19/21
128	990735	Salmon Cr	Rock Cr	Pacific	23	SW	SR 6	22.64	Construction 19/21
129	990744	SB Fronia Cr	Fronia Cr	Lewis	23	SW	SR 6	31.04	Construction 19/21
130	990746	SB Fronia Cr	Fronia Cr	Lewis	23	SW	SR 6	31.06	Construction 19/21
131	991544	unnamed	Chehalis R	Lewis	23	SW	SR 6	46.39	Construction 19/21
132	991757	unnamed	Chehalis R	Lewis	23	SW	SR 6	46.50	Construction 19/21
78	991528	unnamed	unnamed to Chehalis trib	Lewis	23	OL	US 12	11.01	Design 19/21

Incorporating Climate Change into Culvert Design

June 18, 2019



Project Team (Phase 1)

Timothy Quinn
Jane Atha
George Wilhere
Don Ponder
Kevin Lautz
Lynn Helbrecht
Dan Dulan
Ingrid Tohver

This project was partially funded by the U.S. Fish and Wildlife Service.

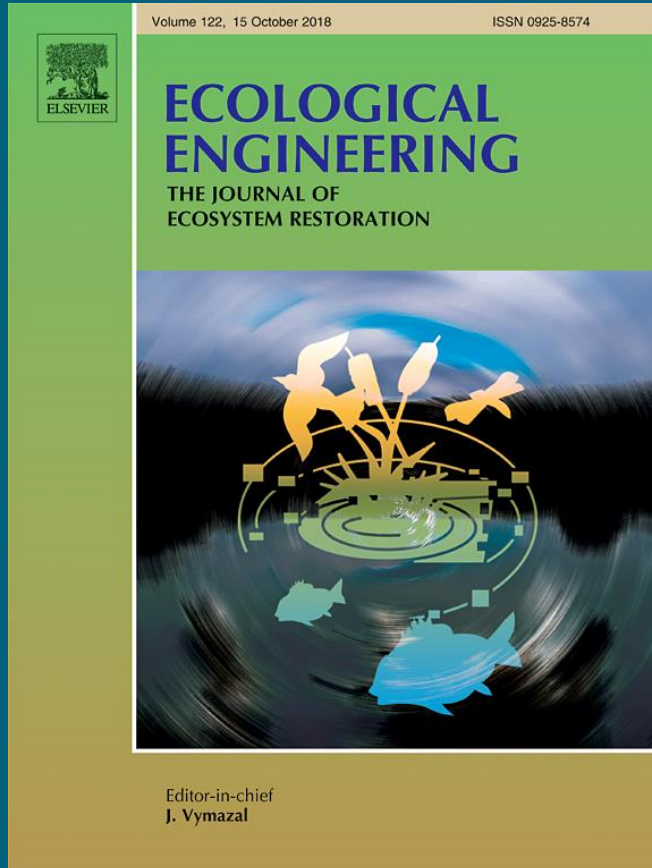
Research paper

Incorporating climate change into culvert design in Washington State, USA

George F. Wilhere^{a,*}, Jane B. Atha^a, Timothy Quinn^a, Ingrid Tohver^b, Lynn Helbrecht^a

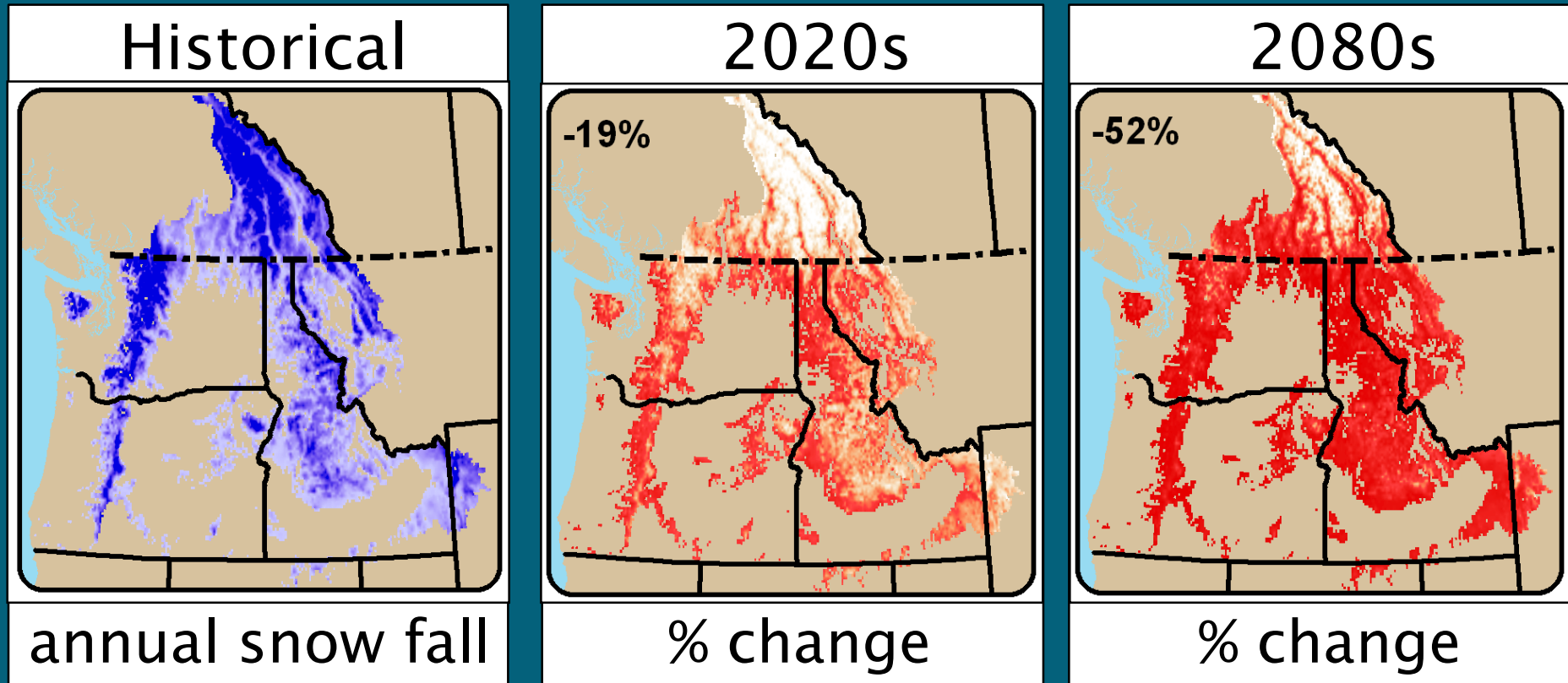
^a Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA, 98501, USA

^b Climate Impacts Group, University of Washington, John Wallace Hall, 3737 Brooklyn Ave. NE, Seattle, WA, 98105, USA



Ecological Engineering (2017)
vol. 104, pp. 67-79

Climate Change in PNW: Less Snow and More Rain



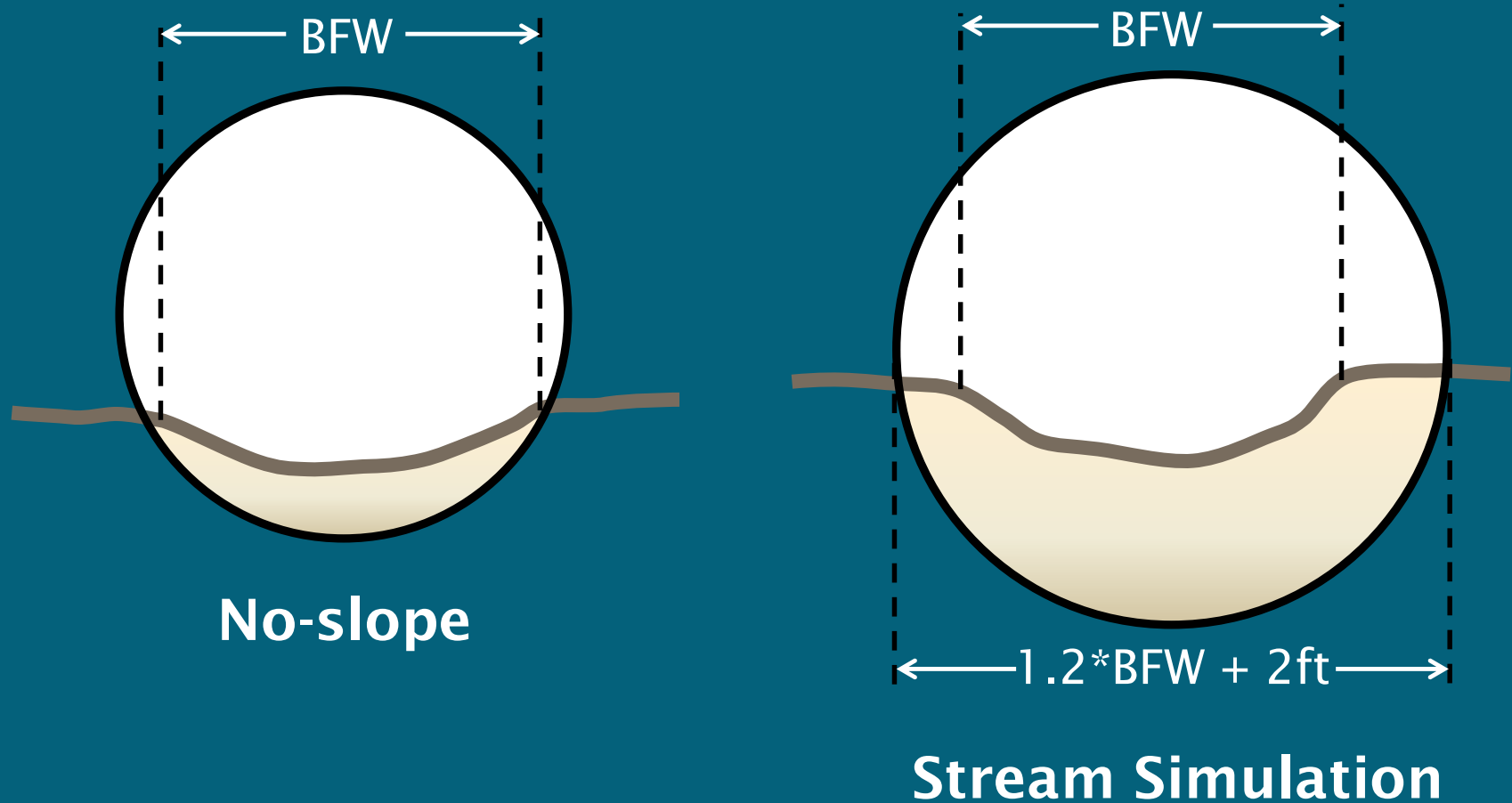
- Same amount of precipitation but as rain
- Higher peak flows

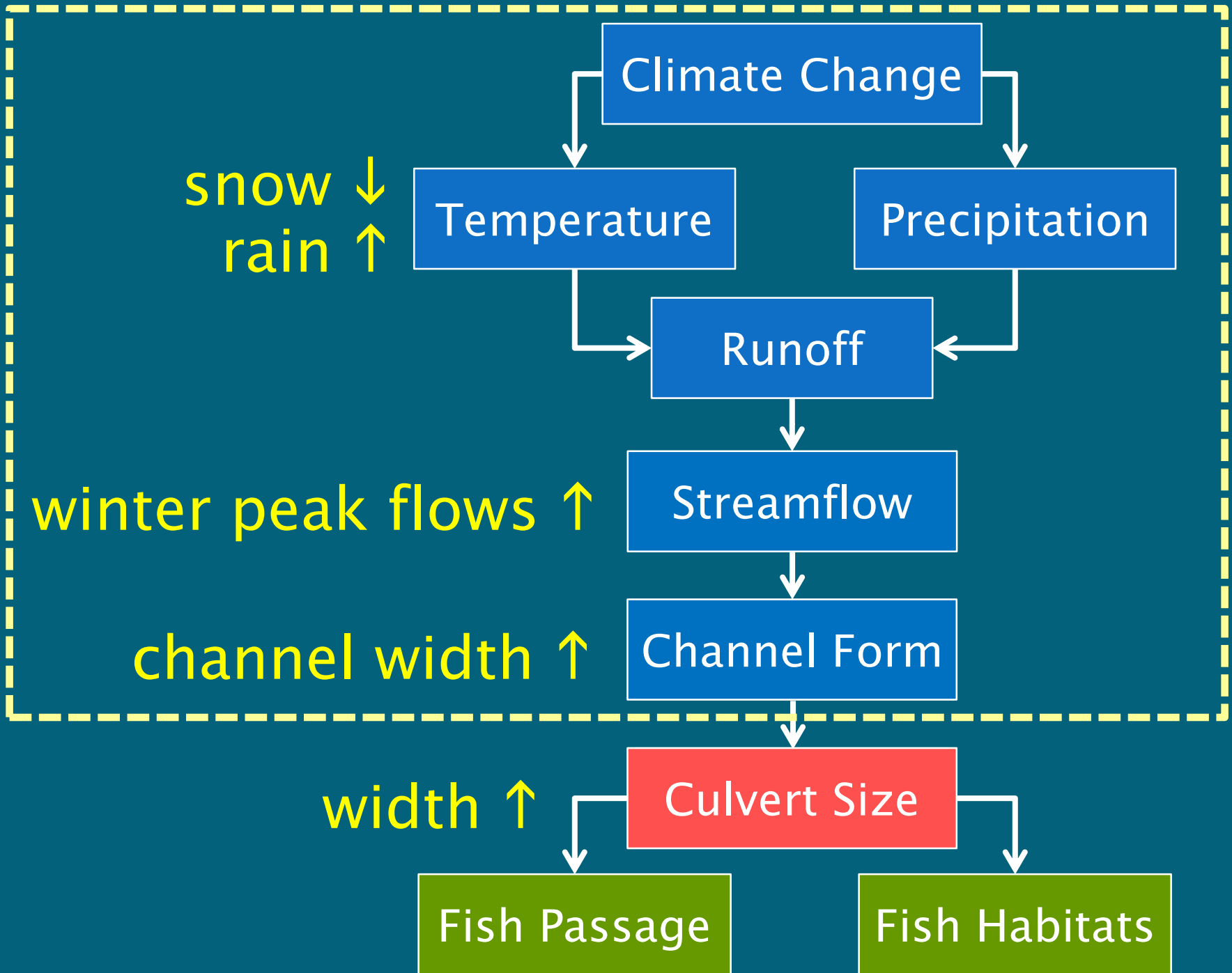
Why this Project?

- Climate change is expected to cause larger peak stream flows.
- Culverts too small for high flows often result in barriers to fish movement.
- Growing awareness of potential climate change impacts to public infrastructure.
- **Purpose:** explore how WDFW might use climate change projections to inform culvert design.

Culvert Design

Bankfull width (BFW) is a key parameter





Climate Change

snow ↓
rain ↑

Temperature

Precipitation

Runoff

winter peak flows ↑

Streamflow

channel width ↑

Channel Form

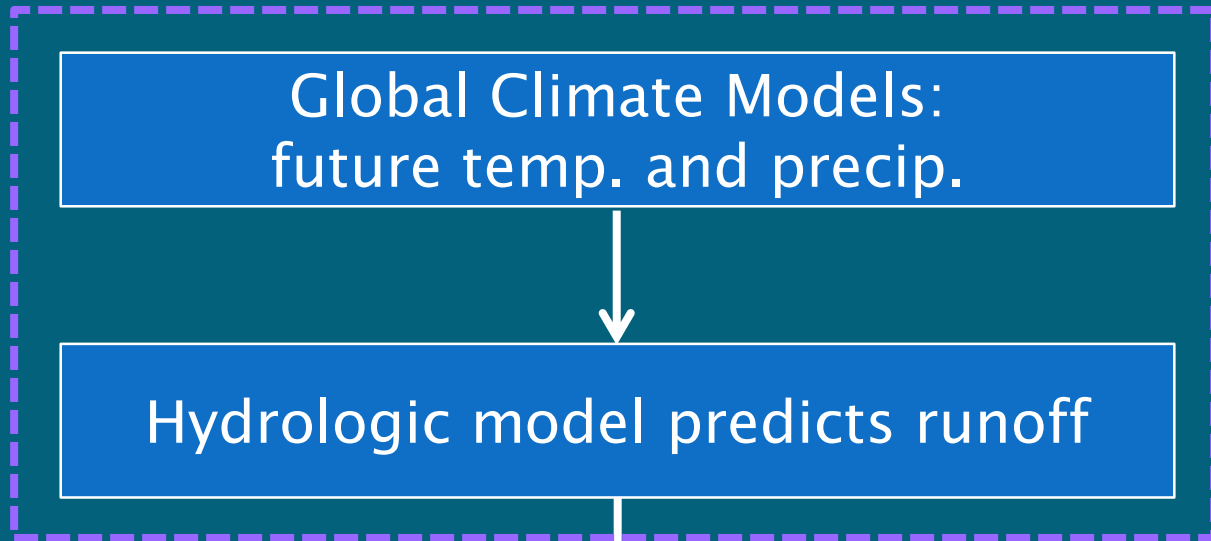
width ↑

Culvert Size

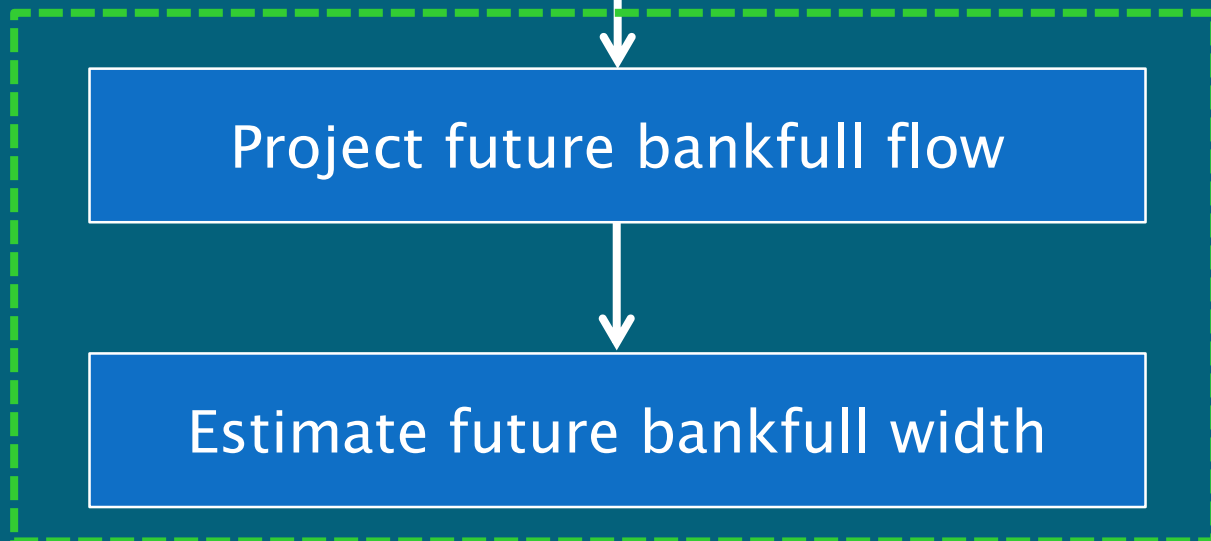
Fish Passage

Fish Habitats

Analytical Process

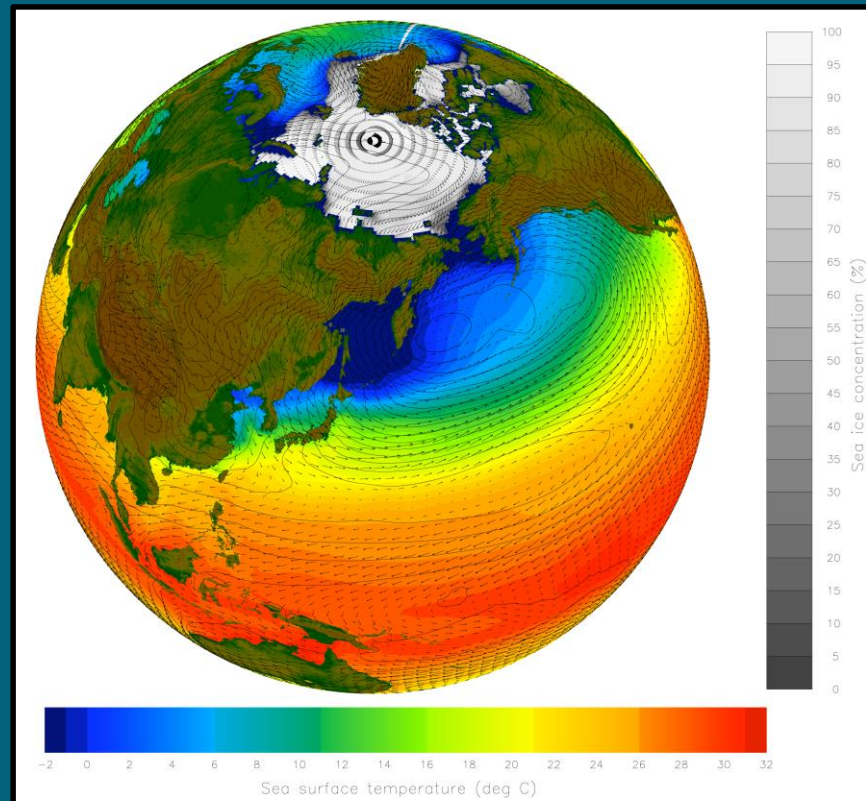


WDFW



Global Climate Models

- Projections from **10** independent models
- 1 global emission scenario: **moderate A1B**
- Climate projections for **2040s** and **2080s**



Hydrological Model

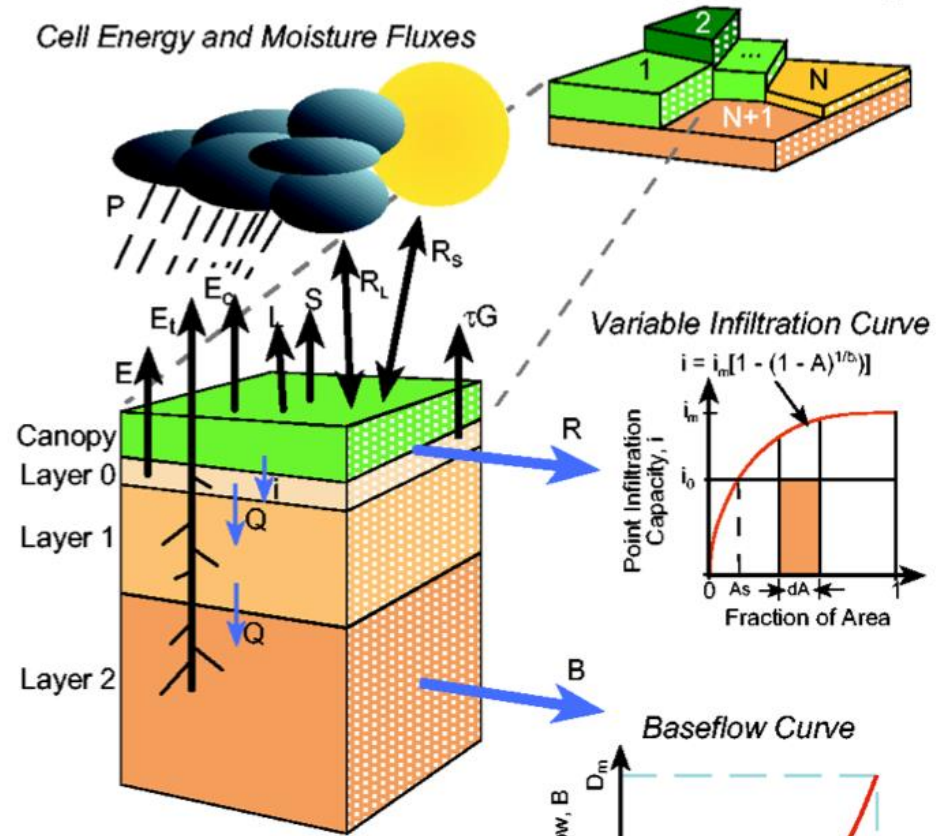
Temperature 

Precipitation 

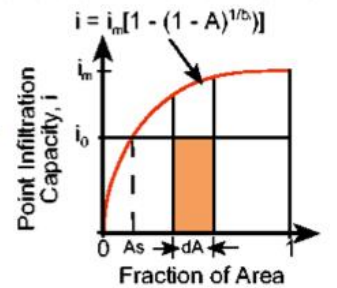
Mean Daily Flow 

Variable Infiltration Capacity Model (VIC)

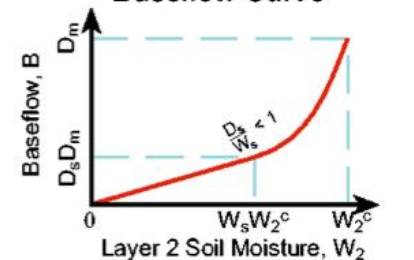
Cell Energy and Moisture Fluxes



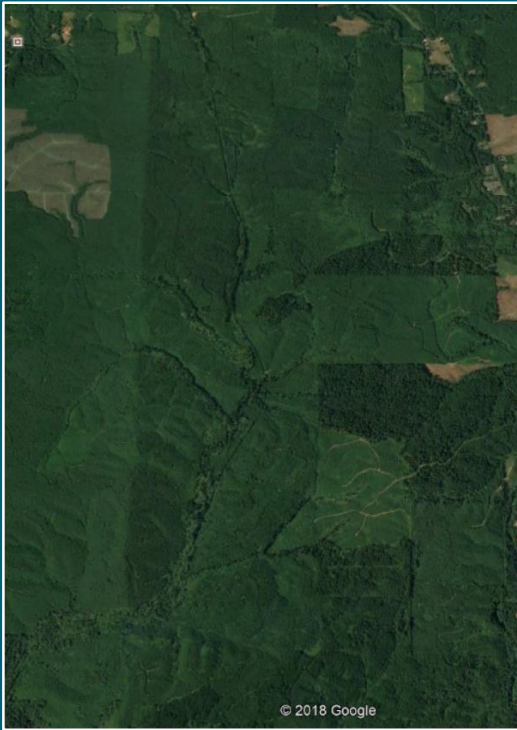
Variable Infiltration Curve



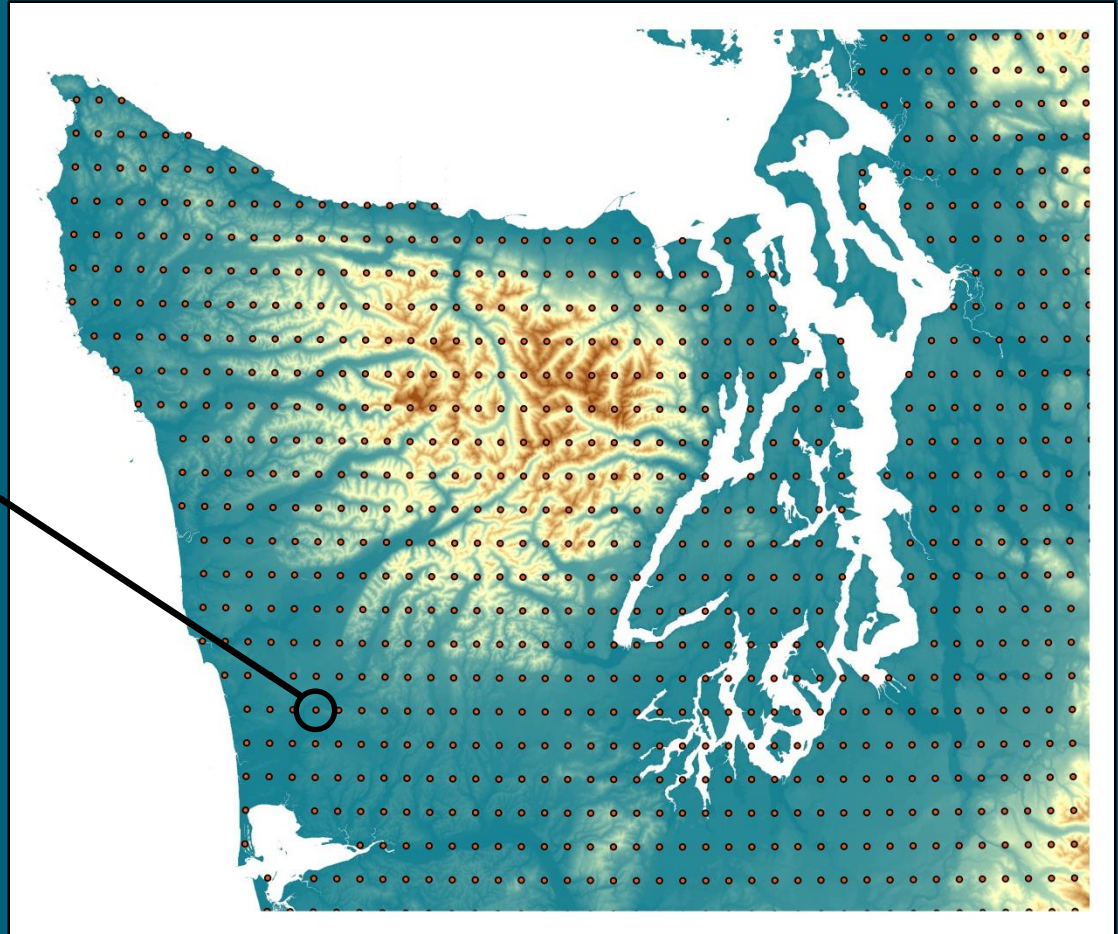
Baseflow Curve



Grid Covering Washington

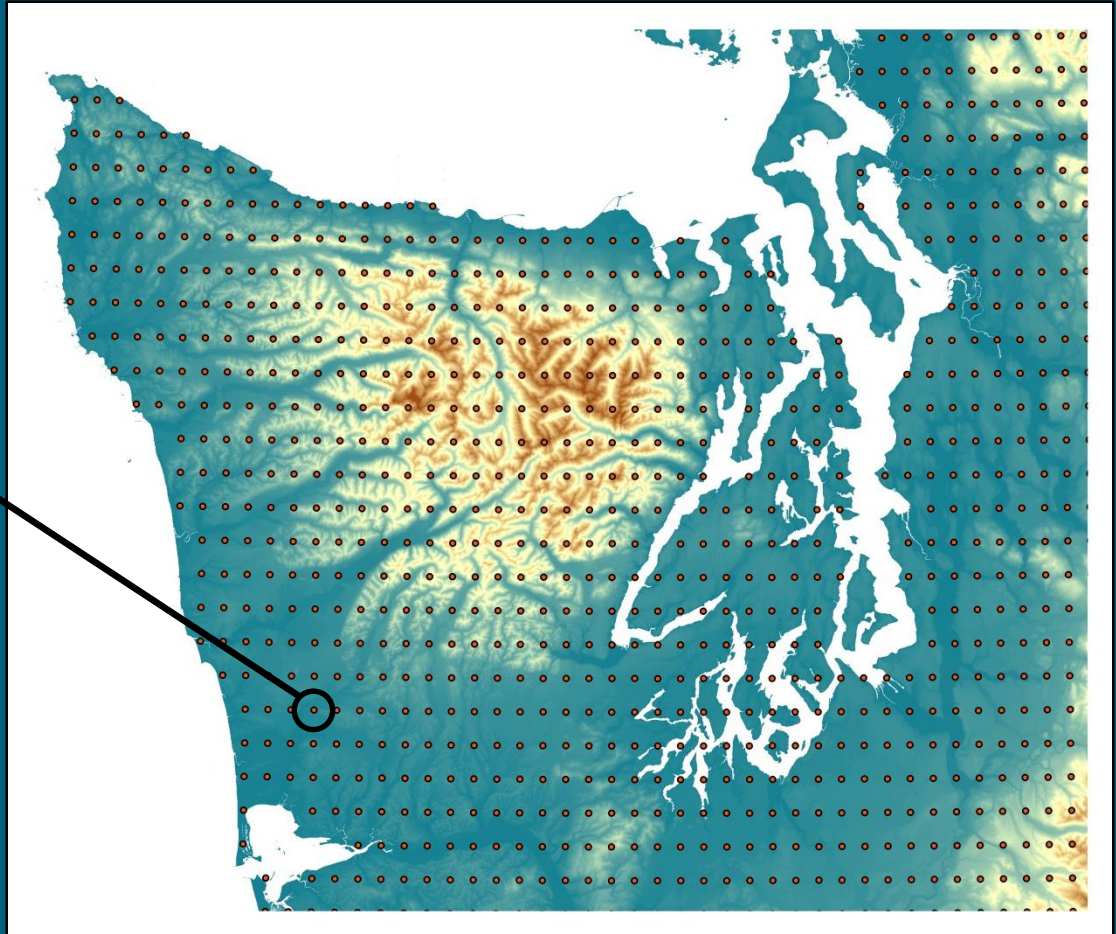
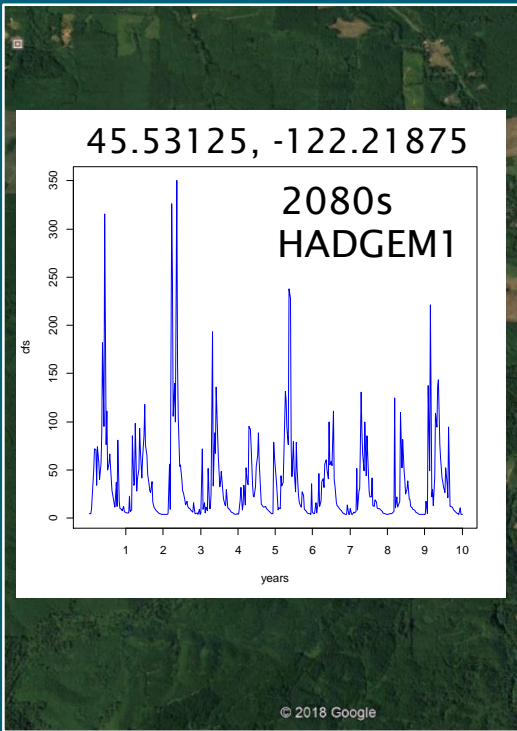


1/16 degree
 $\approx 5 \times 7 \text{ km}$
 $\approx 12.6 \text{ mi}^2$



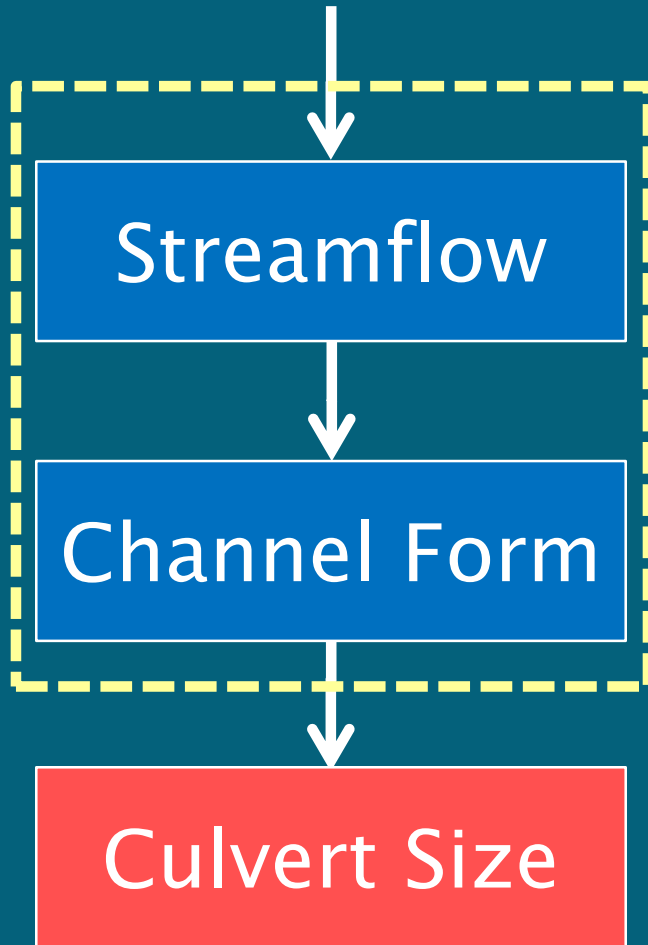
5,270 grid cells
in Washington

Projecting Future Streamflow



- 10 projections
- 2 future periods (2040s, 2080s)
- historical period

Estimating Future Channel Width



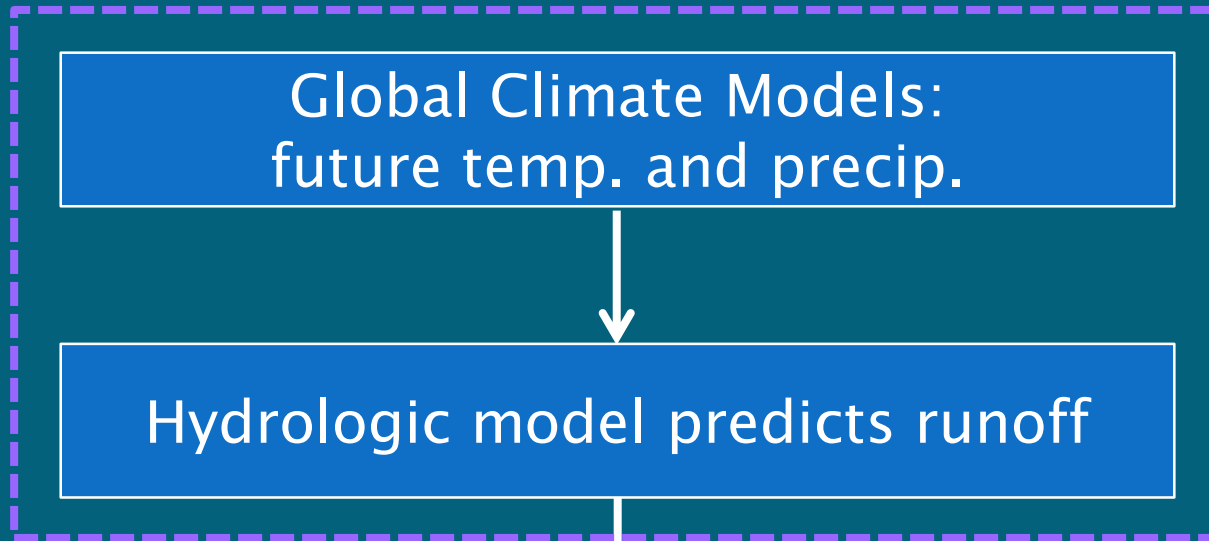
$$w = a \cdot Q^b$$

Q = stream flow

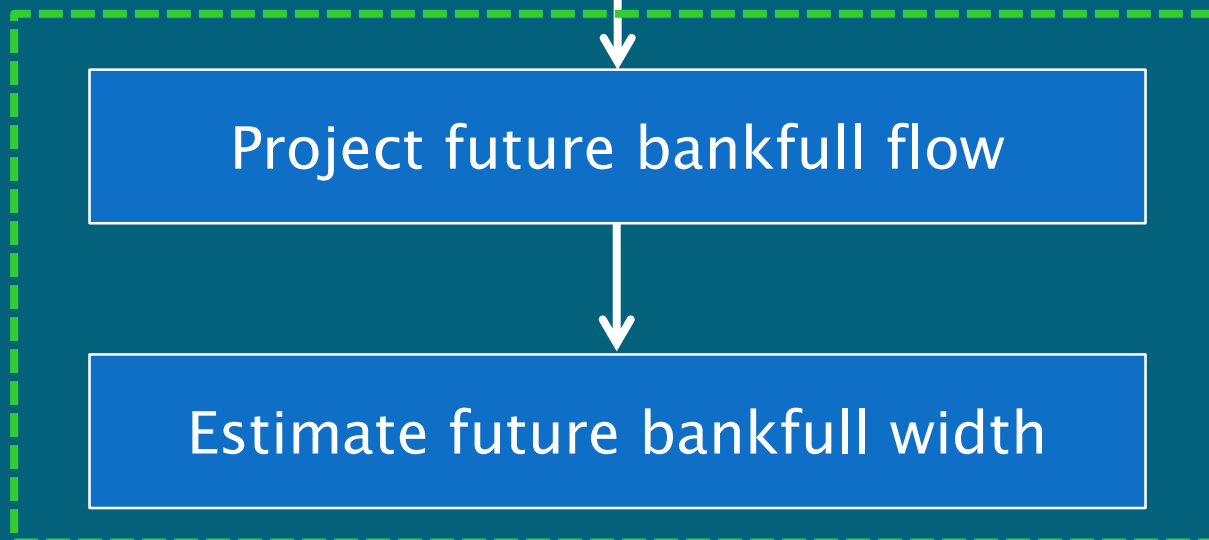
w = channel width

a and b estimated
for each ecoregion

Analytical Process



WDFW

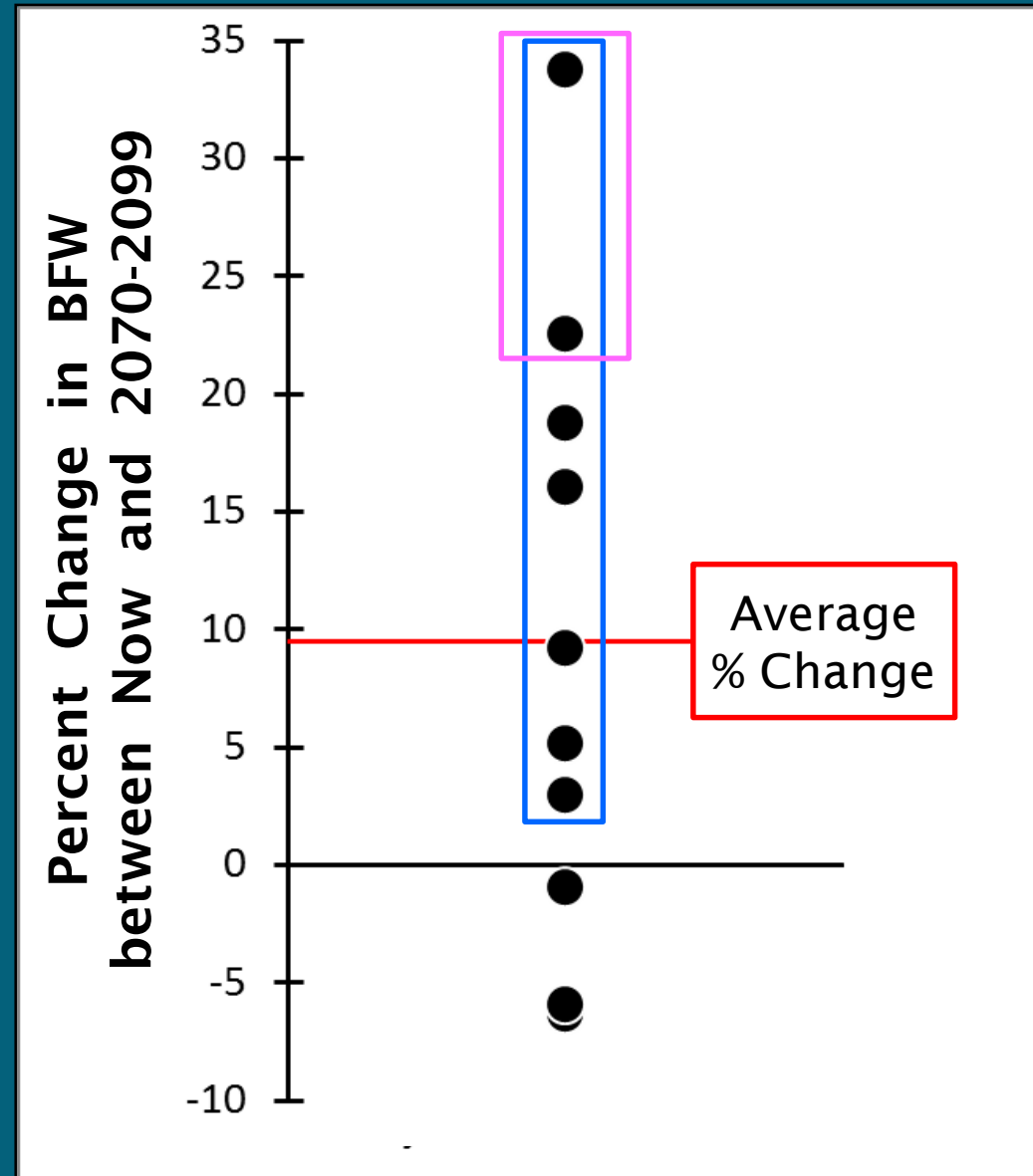


Project % Change in Channel Width

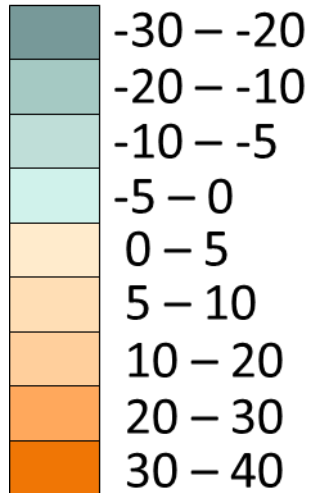
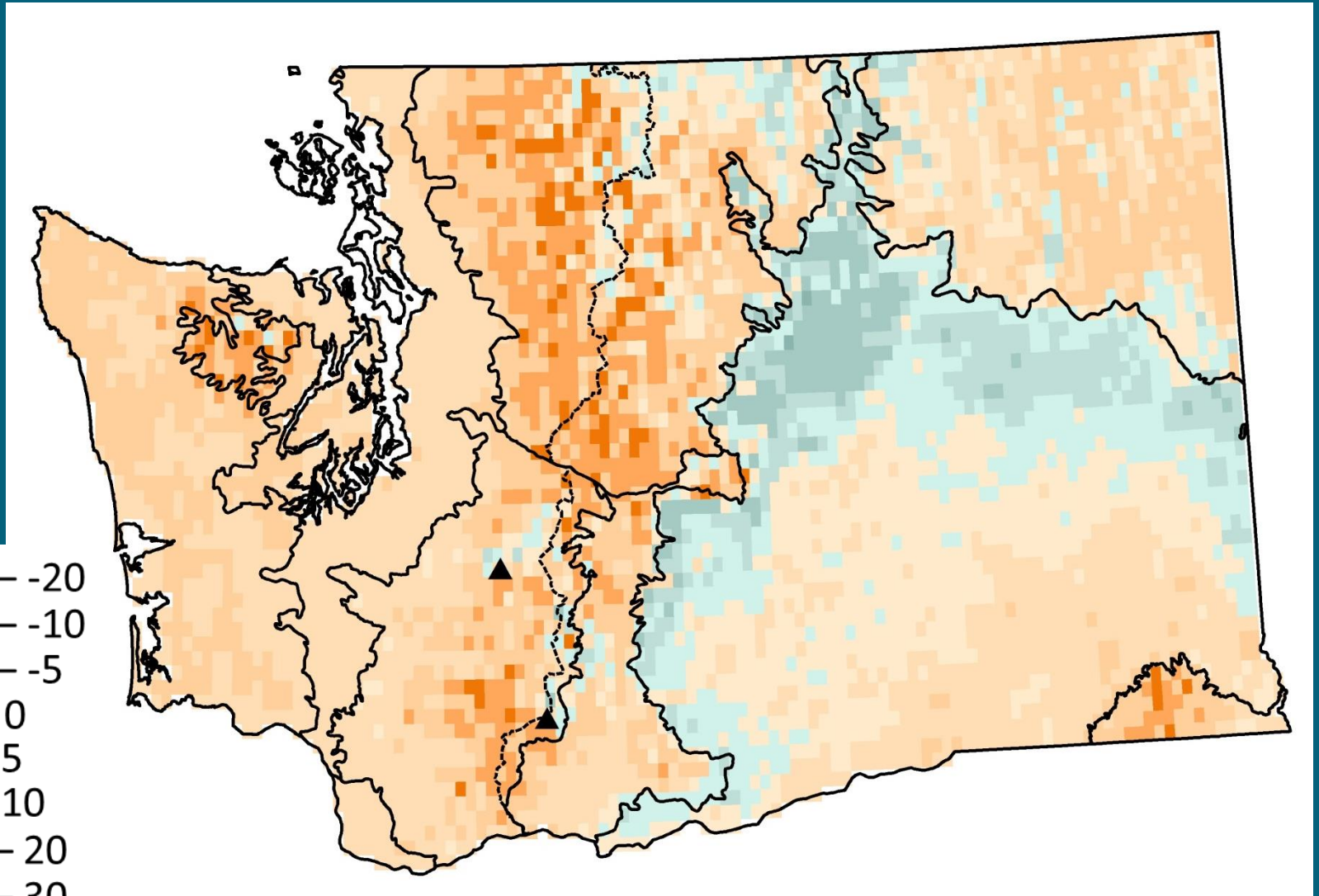
- How large?
- How likely?
- Where?

% Change at a Single Grid Cell

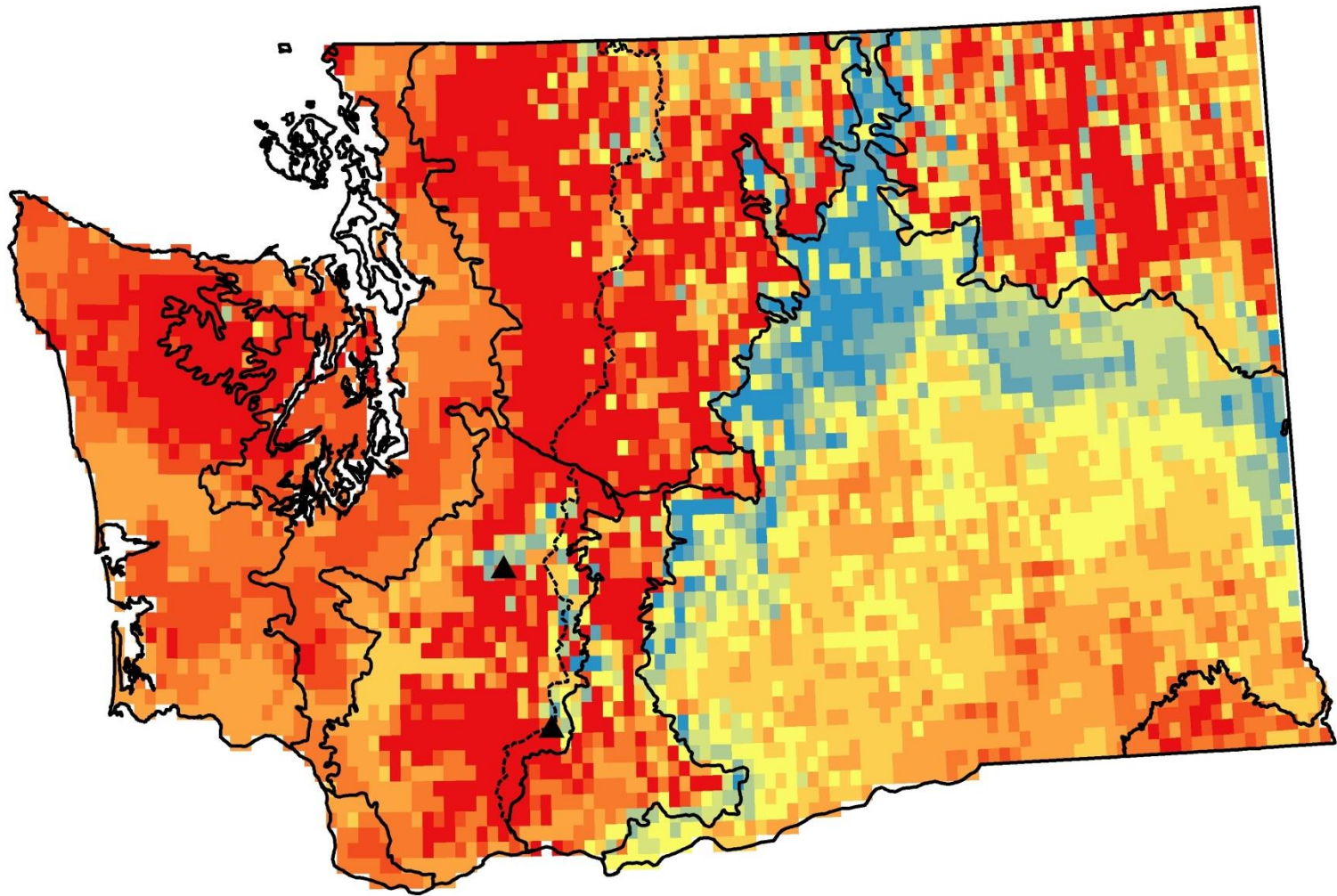
- How large?
average of 10
projections:
 % change in
 BFW = +9.5%
- How likely?
model agreement:
 7 of 10 models
 project an increase
 in BFW
- Uncertainty and Risk



Average % Change BFW



Model Agreement



Number of models
projecting BFW \uparrow :



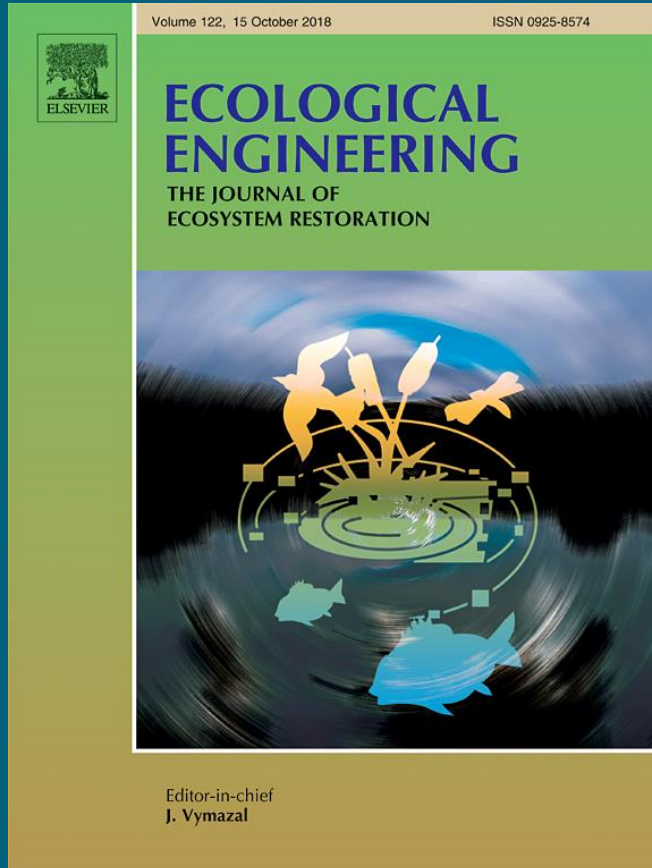
Research paper

Incorporating climate change into culvert design in Washington State, USA

George F. Wilhere^{a,*}, Jane B. Atha^a, Timothy Quinn^a, Ingrid Tohver^b, Lynn Helbrecht^a

^a Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA, 98501, USA

^b Climate Impacts Group, University of Washington, John Wallace Hall, 3737 Brooklyn Ave. NE, Seattle, WA, 98105, USA

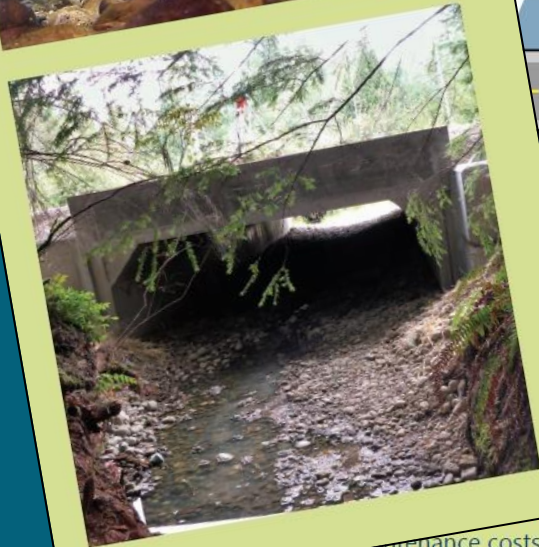


Ecological Engineering (2017)
vol. 104, pp. 67-79

Real-World Application



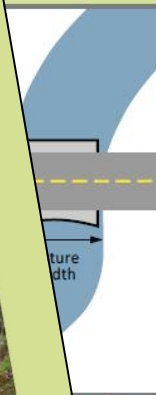
Culvert Design: Planning for Climate Change



Design affects fish passage

designed to last however, culverts designed for current conditions.

ected to and channel. This may to fail and



ase in

lem

at

aintenance costs

How to design your project for the future

Climate change will affect each stream differently. We can estimate channel width for your project site in 2045 and 2085 and explain how this may affect your project.

How do we predict channel width?



WDFW can assess the likelihood of stream channel changes at your project site by predicting future stream flow above your site.

With this information, you can make an informed decision about your project design. This may include installing a wider culvert or bridge.

Learn more about culverts and climate change at www.wdfw.wa.gov.

Benefits of planning ahead

It is possible to consider climate change in project design to ensure natural stream conditions will continue into the future.

The benefits of building culverts and bridges to accommodate higher stream flows begin immediately.

Reduced flood risk - culvert passes flood flows and large debris

Fish passage - allows passage of all fish and aquatic organisms

Healthy habitat - maintains natural stream processes

Cost savings - reduces future maintenance and repair costs



Intranet Site

http://culverts-dev.dfw.wa.lcl/

Culverts and Climate Change

Generate Watershed Upload watershed(s) Upload culvert(s) Calculate Clear

Map Layers

- Dams
- Misc_Barriers
- Road Crossings
- Percent_change_BFW_2080s
- Cities
- Counties

Basemaps

- Topographic
- Dark Gray Canvas
- Light Gray Canvas
- National Geographic
- Terrain with Labels
- Oceans
- OpenStreetMap
- USA Topo Maps
- USGS National Map

Grid

Latitude: 47.15625
Longitude: -123.84375
Ecoregion: PM
Percent Change in BFW: 10.312909
Model Agreement: 7
[Zoom to](#)

esri

<http://culverts-dev.dfw.wa.lcl/>

Current Intranet Site Output

Future Projections for Climate-Adapted Culvert Design

Project Name:
 Stream Name:
 Drainage Area: 269 ac

Projected mean percent change in bankfull flow:

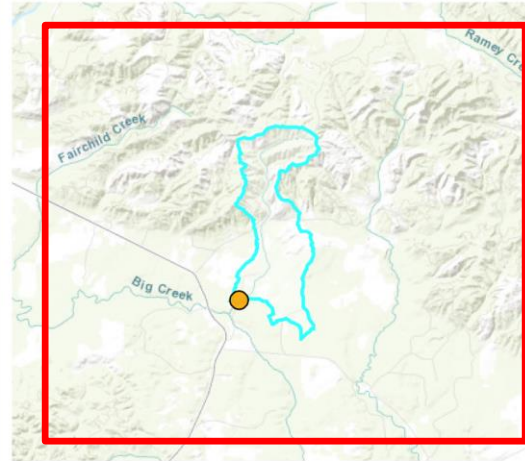
2040s: 16.1%
 2080s: 21.4%

Projected mean percent change in bankfull width:

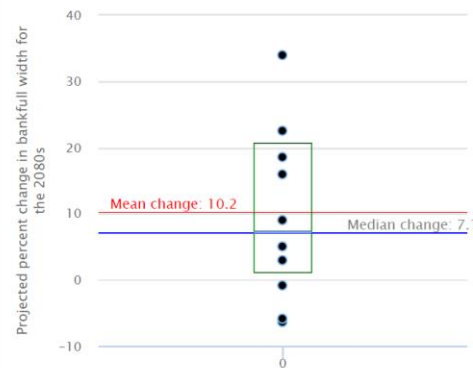
2040s: 7.8%
 2080s: 10.2%

Projected mean percent change in 100-year flood:

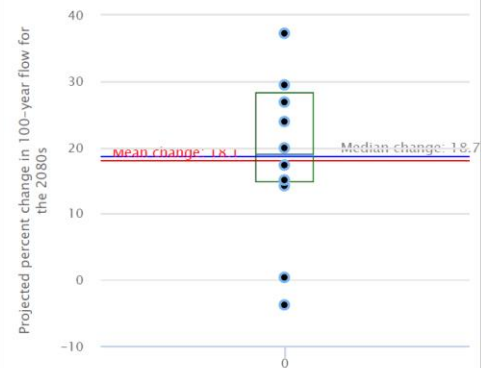
2040s: 9.8%
 2080s: 18.1%



Projected percent change in bankfull width



Projected percent change in 100-year flow



Black dots are projections from 10 separate models

The Washington Department of Fish and Wildlife makes no guarantee concerning the data's content, accuracy, precision, or completeness. WDFW makes no warranty of fitness for a particular purpose and assumes no liability for the data represented here.

Next Steps (Phase 2)

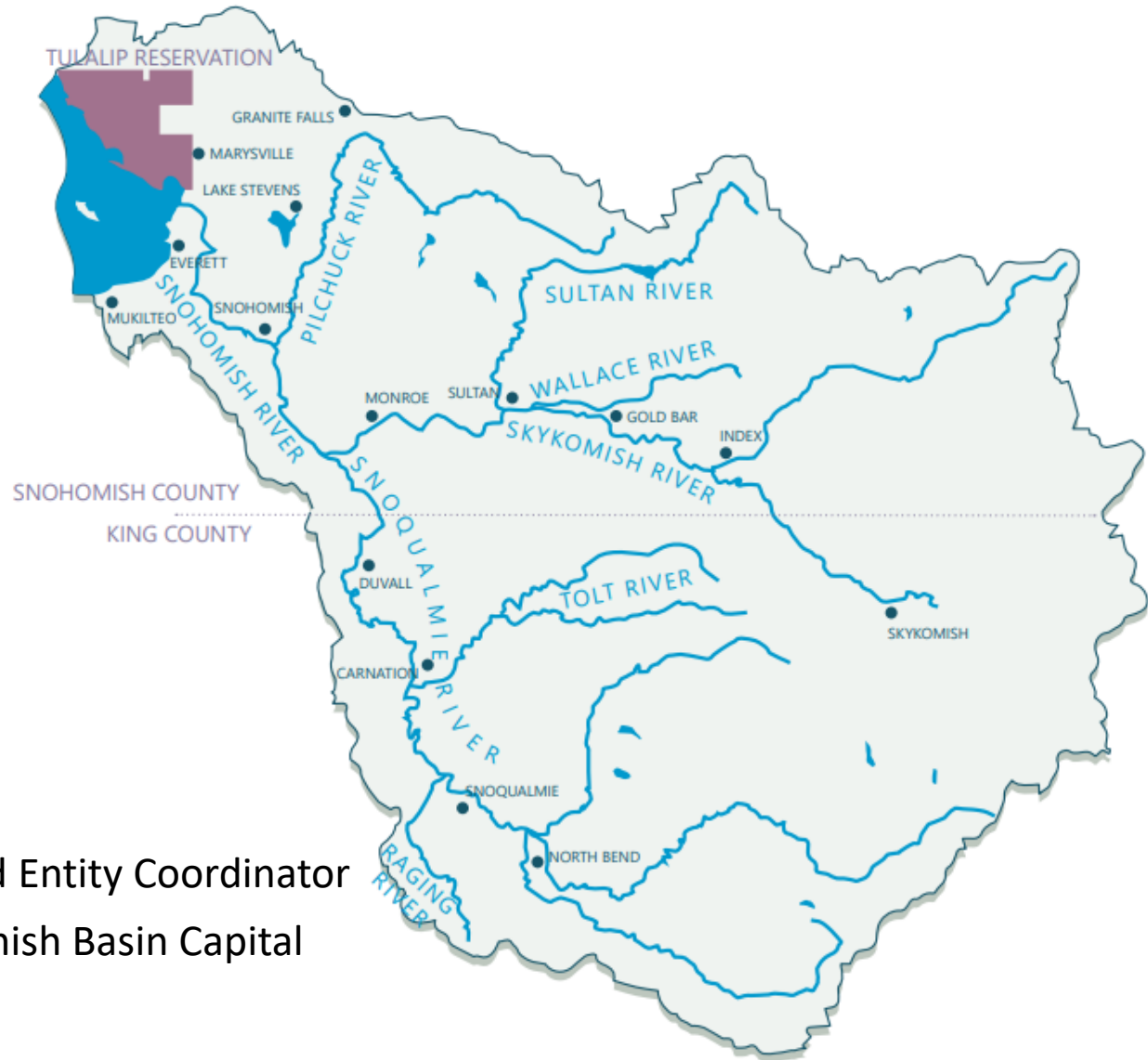
- Update streamflow projections using more recent climate change projections.
- Update % change in bankfull width projections.
- Move intranet site to the internet.
- Create internet site that is user-friendly that provides useful information for practitioners.
- And, work with user groups to make that happen.

The Bottom Line

- Bankfull width is projected to increase in many watersheds due to climate change.
- Many culverts are at risk of being undersized.
- We now have a state-wide, spatially-explicit assessment of the magnitude and “likelihood” of change in bankfull width.
- We have an web-based application which we are taking to the internet.
- And, we need your help.

Thank You





Snohomish Basin

- Gretchen Glaub, Lead Entity Coordinator
- Morgan Ruff, Snohomish Basin Capital Projects Coordinator



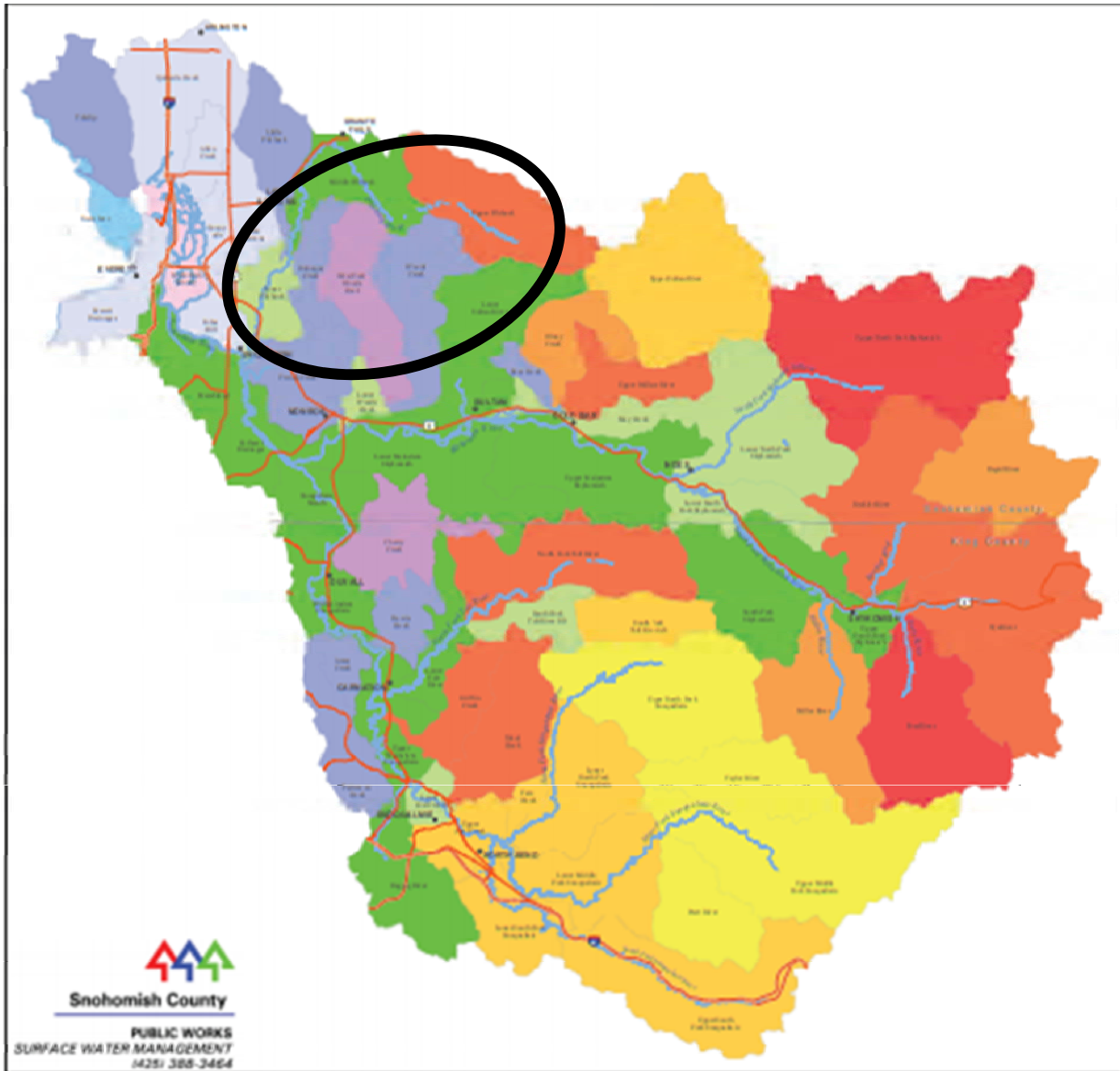
OUR COMMITTEES

**Snohomish Basin Salmon
Recovery Forum**

**Snohomish
Basin Salmonid
Recovery
Technical
Committee**

**Project Review
Group**

**Policy Development
Committee**



SNOHOMISH RIVER BASIN

Sub-basin Strategy Groups

Nearshore

 Nearshore Restoration

Estuary

 Estuary Restoration

Mainstem

 Primary Restoration

 Secondary Restoration

Rural Streams

 Primary Restoration

 Secondary Restoration

Urban Streams

 Restoration

Headwaters

 Primary Protection

 Secondary Restoration

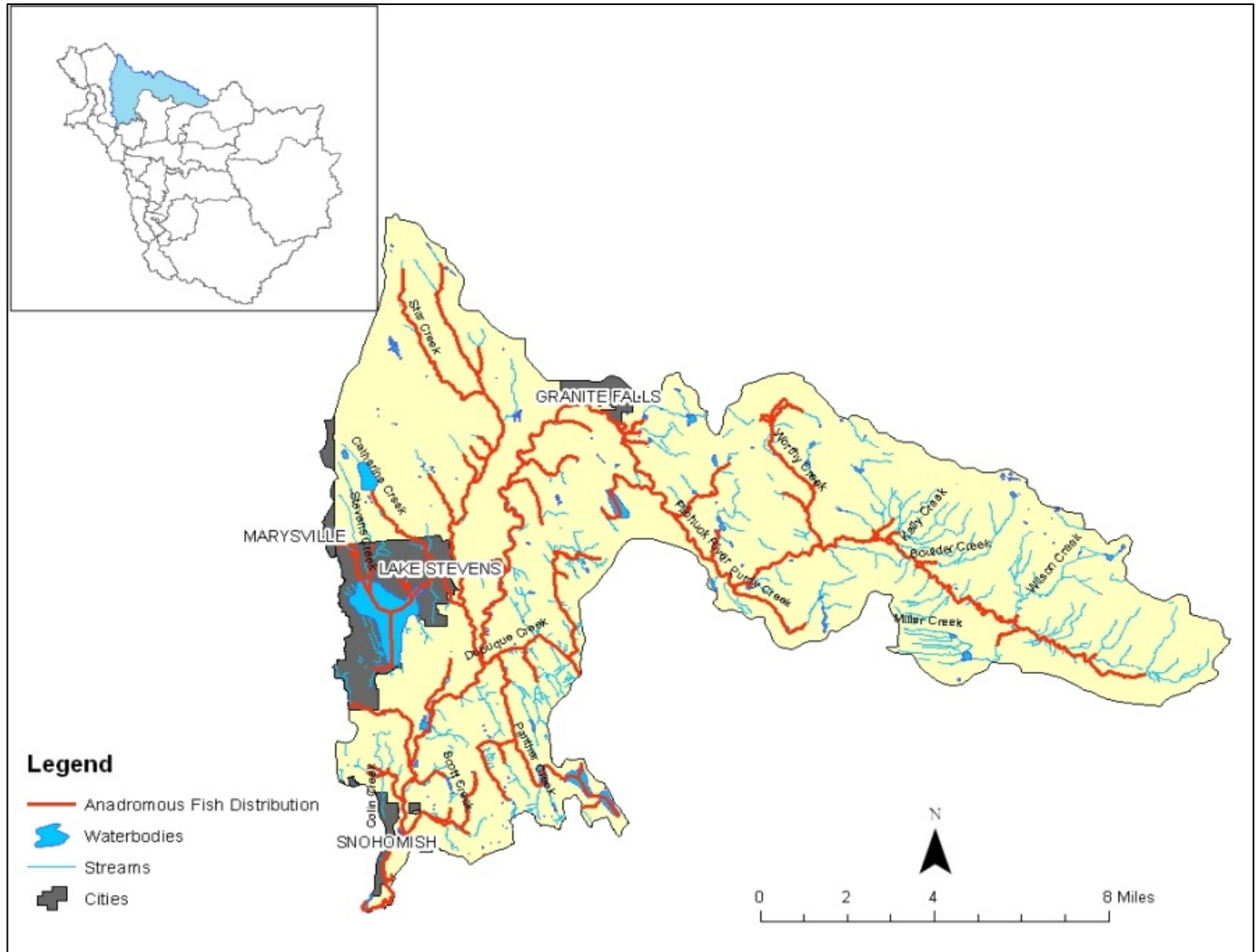
 Secondary Protection

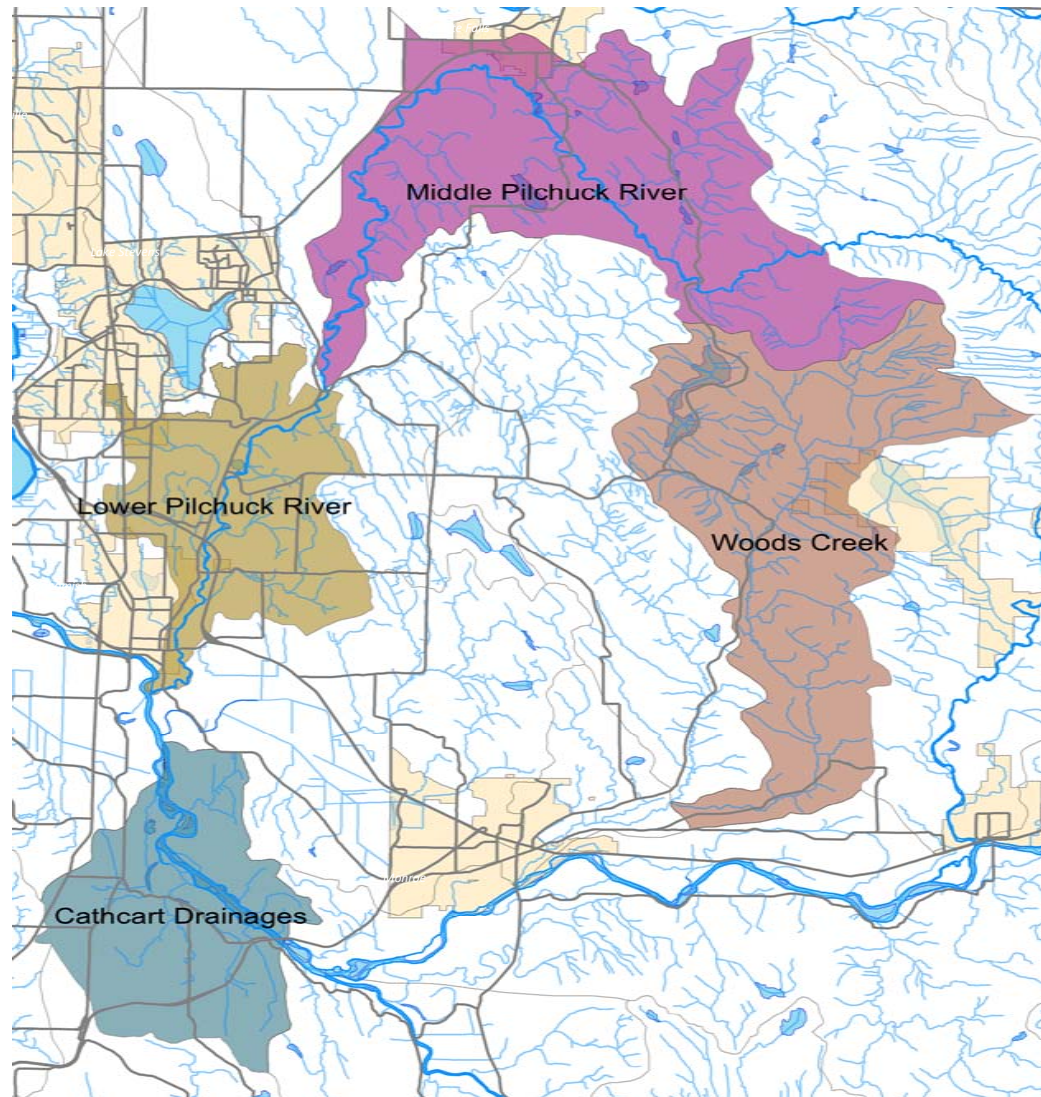
 Restoration Above Falls and Dam

 Protection Above Natural Barriers

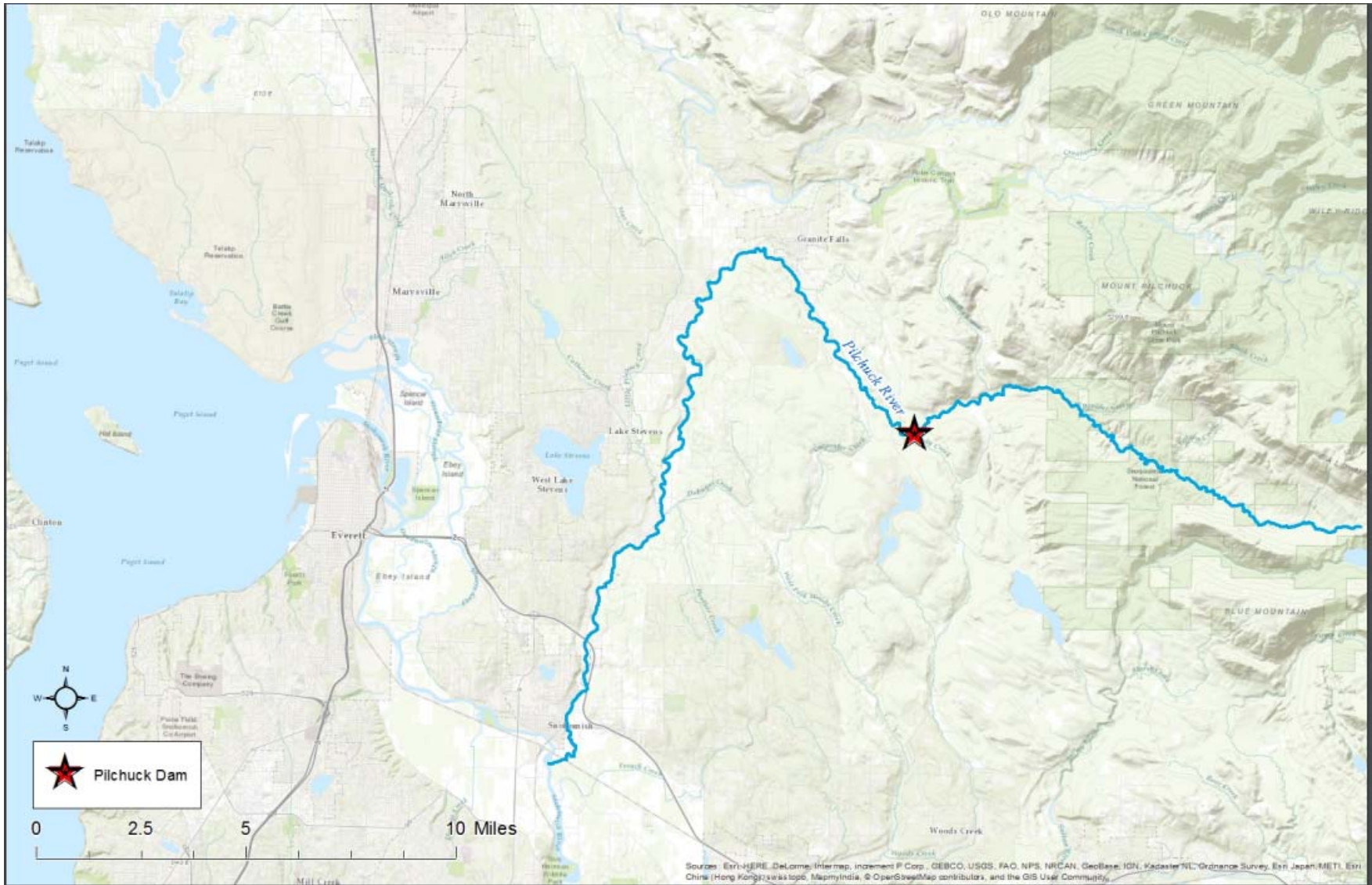


Pilchuck River





Snohomish Watershed



Pilchuck River

LOCHSLOY PROJECT

North of Falcon Update

Kyle Adicks, Intergovernmental Salmon Manager

May 21, 2019

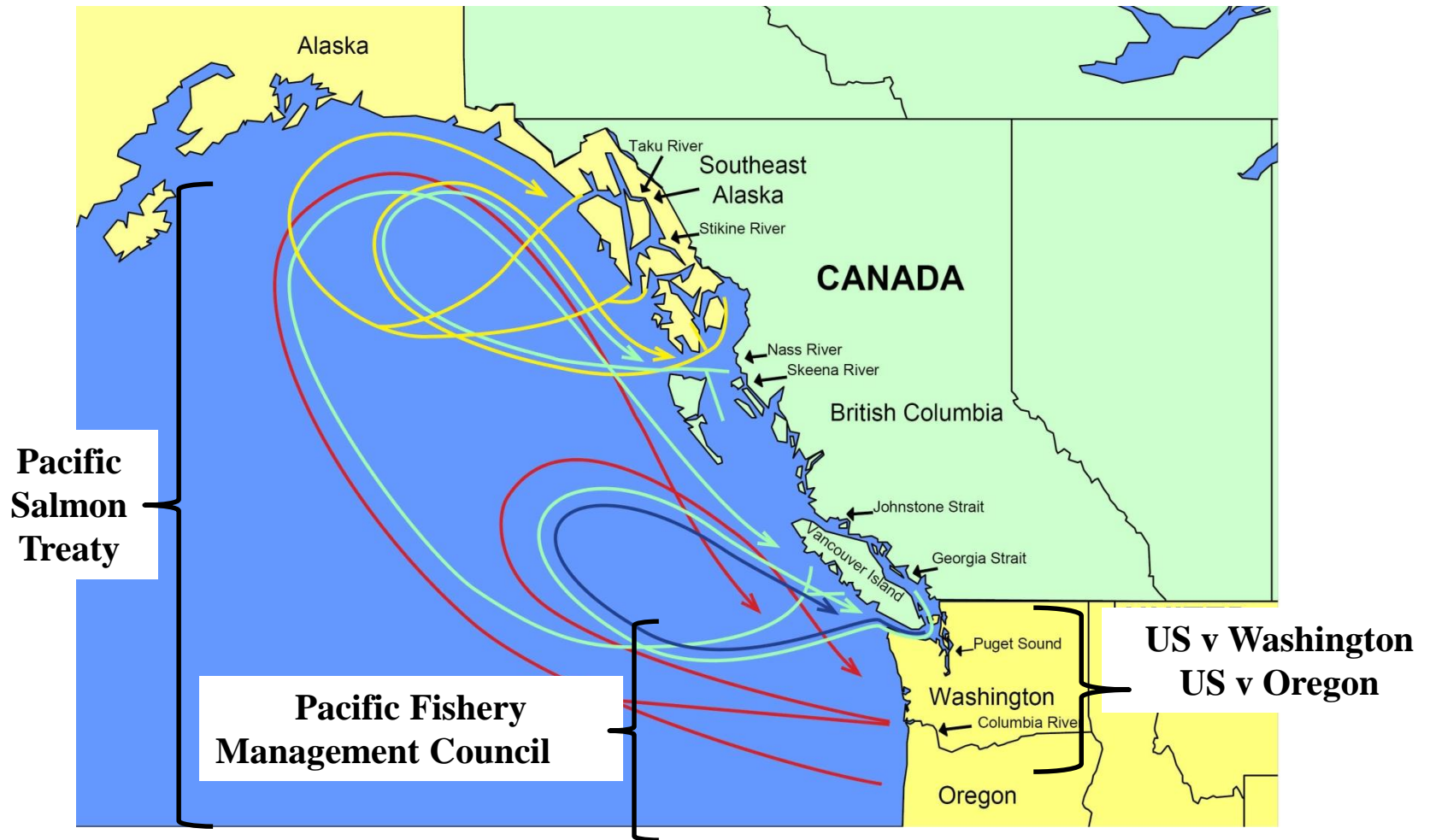


Presentation Overview

- Salmon Management Landscape
- North of Falcon Process
- 2019 Challenges and Outcomes



Management landscape

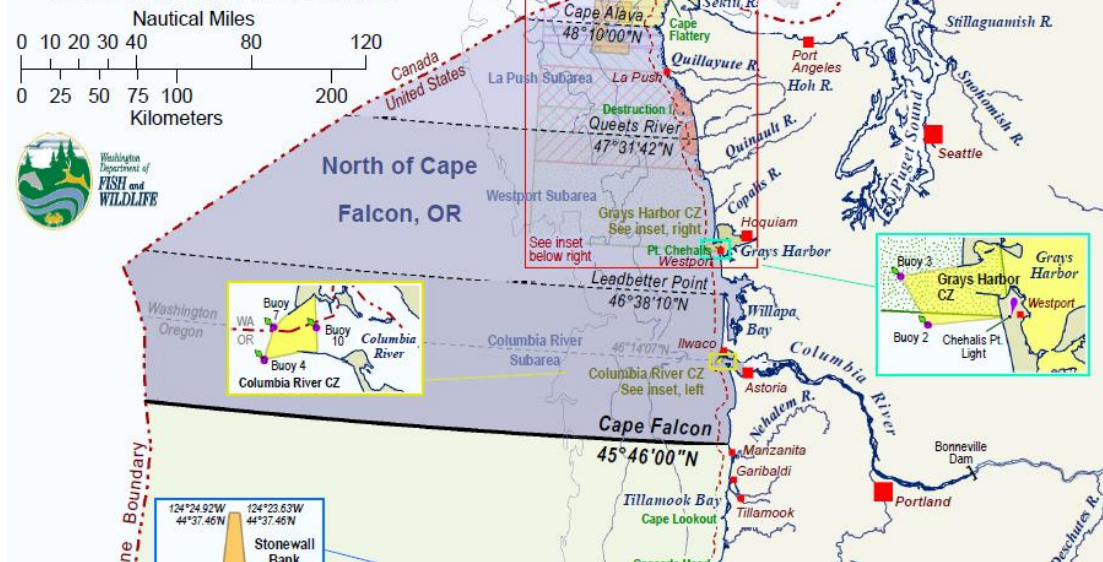


North of Falcon process

An intensive 7-week process to set salmon fishing seasons in the area north of Cape Falcon, OR

- 5 species
- >25 tribes
- Pacific Salmon Treaty
- Magnuson-Stevens Act
- Federal Court Decisions
- ESA Requirements
- FWC Policies
- State Law

Pacific Fisheries Management Council
Commercial Salmon Fishing Zones,
Control Zones, Tribal Areas, and
Conservation and Closure Areas



North of Falcon process

Pre-season planning of salmon fisheries:

- Forecasts and conservation objectives
- Public and co-manager meetings
- Develop fisheries that meet all objectives



2019 Timeline

February 27

2019 Salmon Forecasts and Fishing Opportunities

March 7-12

Pacific Fishery Management Council Meeting

March 18

Columbia River Fisheries Discussion

March 19

First North of Falcon Meeting

March 21

Puget Sound Recreational Fisheries Discussion

March 25

Public Hearing on Ocean Salmon Management Options

March 26

**Grays Harbor Fisheries Discussion
Upper Columbia River Fisheries Discussion**

March 27

**Puget Sound Recreational Fisheries Discussion
Willapa Bay Fisheries Discussion
Mid-Columbia River Public Meeting**

March 28

Snake River Fisheries Discussion

April 2

Columbia River and Ocean Fisheries Discussion

April 3

North of Falcon Meeting

April 11-15

Final Pacific Fishery Management Council Meeting

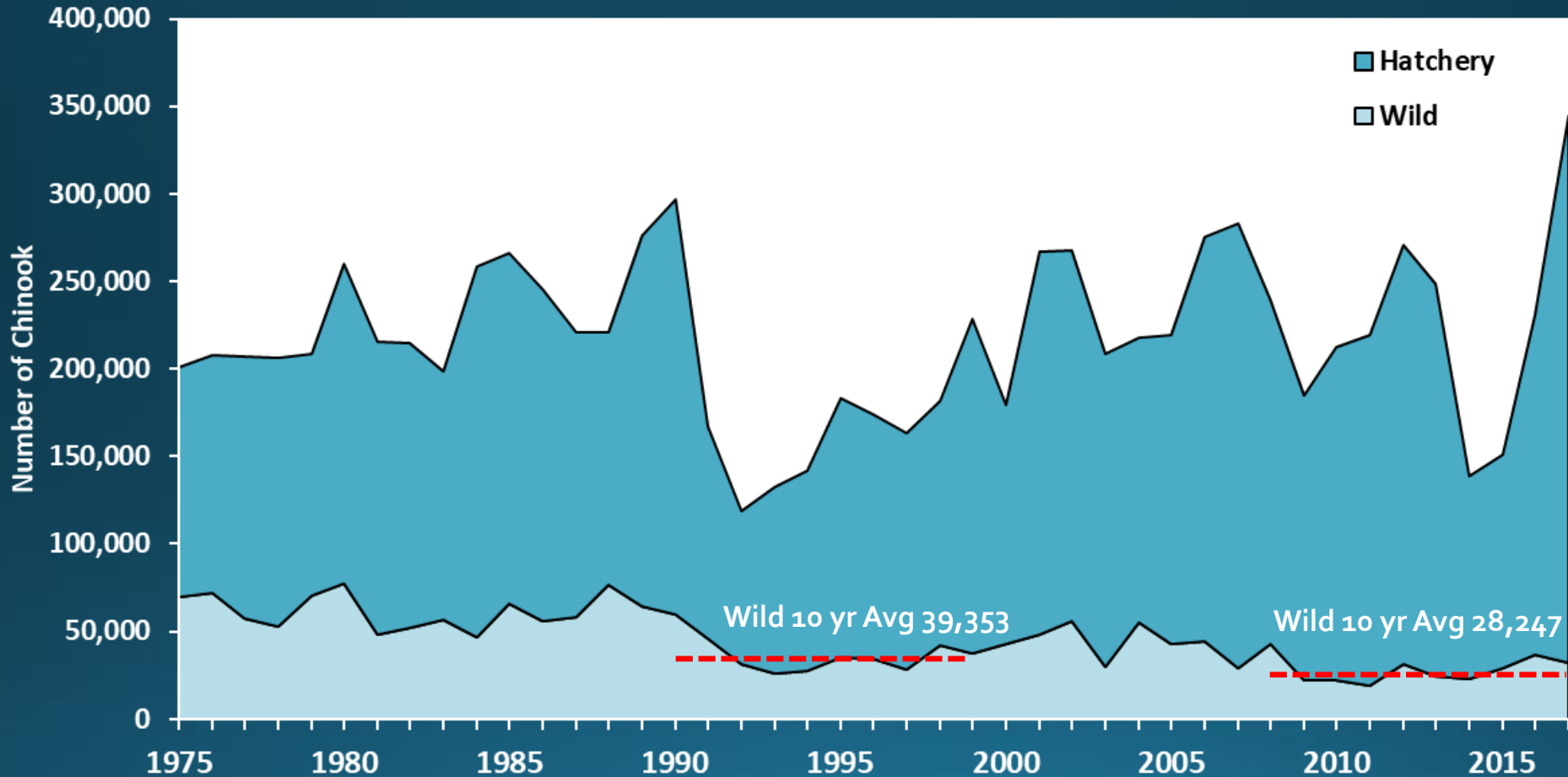


2019 Challenges – Puget Sound

- Puget Sound Chinook abundance has not improved since time of ESA listing
- Reach state-tribal agreement on fisheries that meet conservation objectives for all stocks and obtain ESA authorization
 - ESA limits for Stillaguamish, Nooksack and Mid Hood Canal Chinook
 - Rebuilding Strait of Juan de Fuca and Snohomish coho
 - Thompson River coho – PST obligation
- Continue to consider potential effects of fisheries on SRKW
 - Prey availability effects
 - Vessel interaction effects
- Puget Sound chum salmon management strategy



Chinook Historical Runsize – Puget Sound

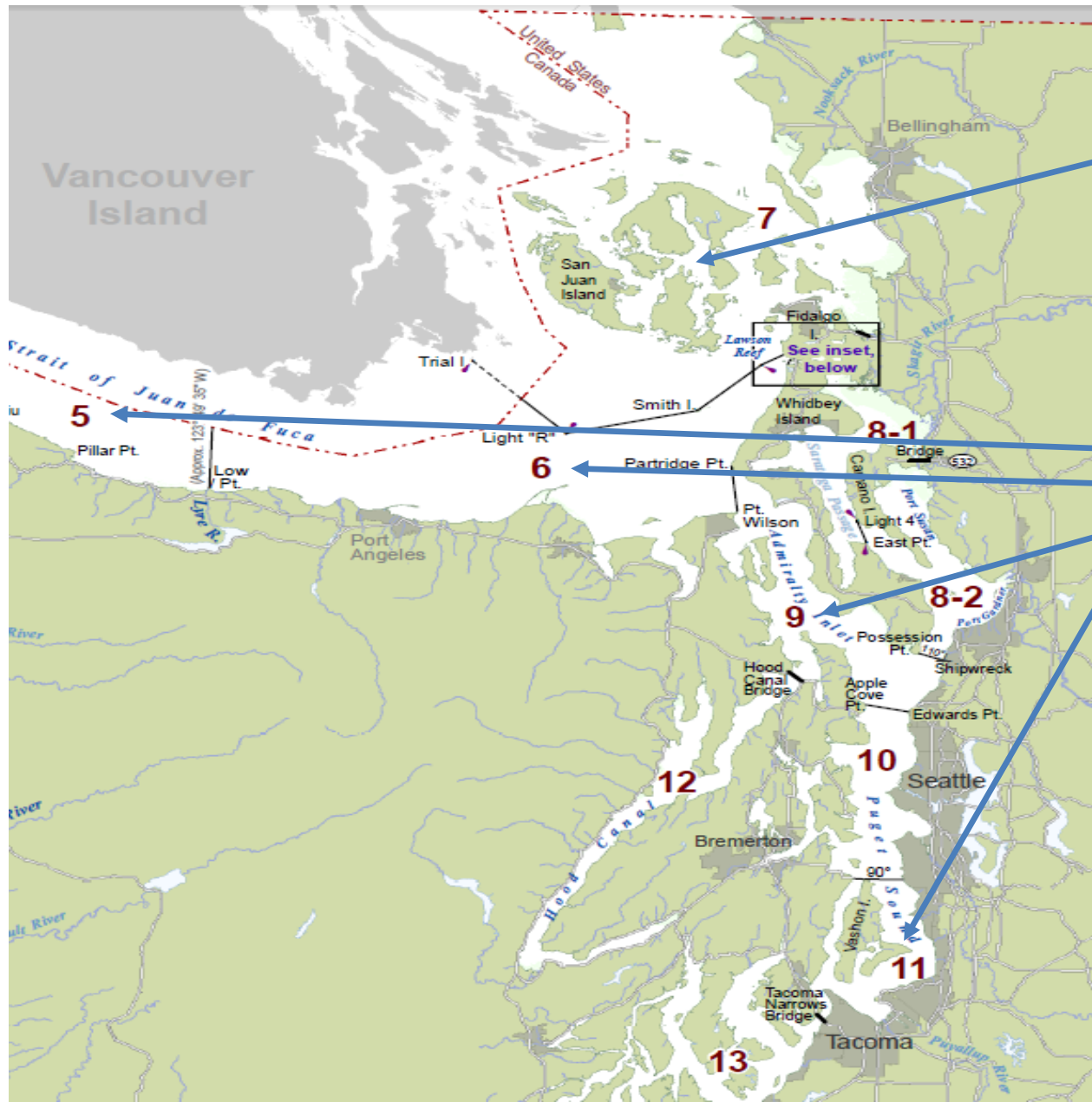


Wild Chinook ↓ ~28% since 10yr avg. prior to listing under ESA in 1999

2019 Puget Sound season development

- Starting point for planning fisheries was modeling of 2018 fisheries with 2019 forecasts
- The impact rate on Stillaguamish Chinook was more than double the allowable rate when 2018 fisheries were modeled – fisheries needed reductions to meet ESA limits

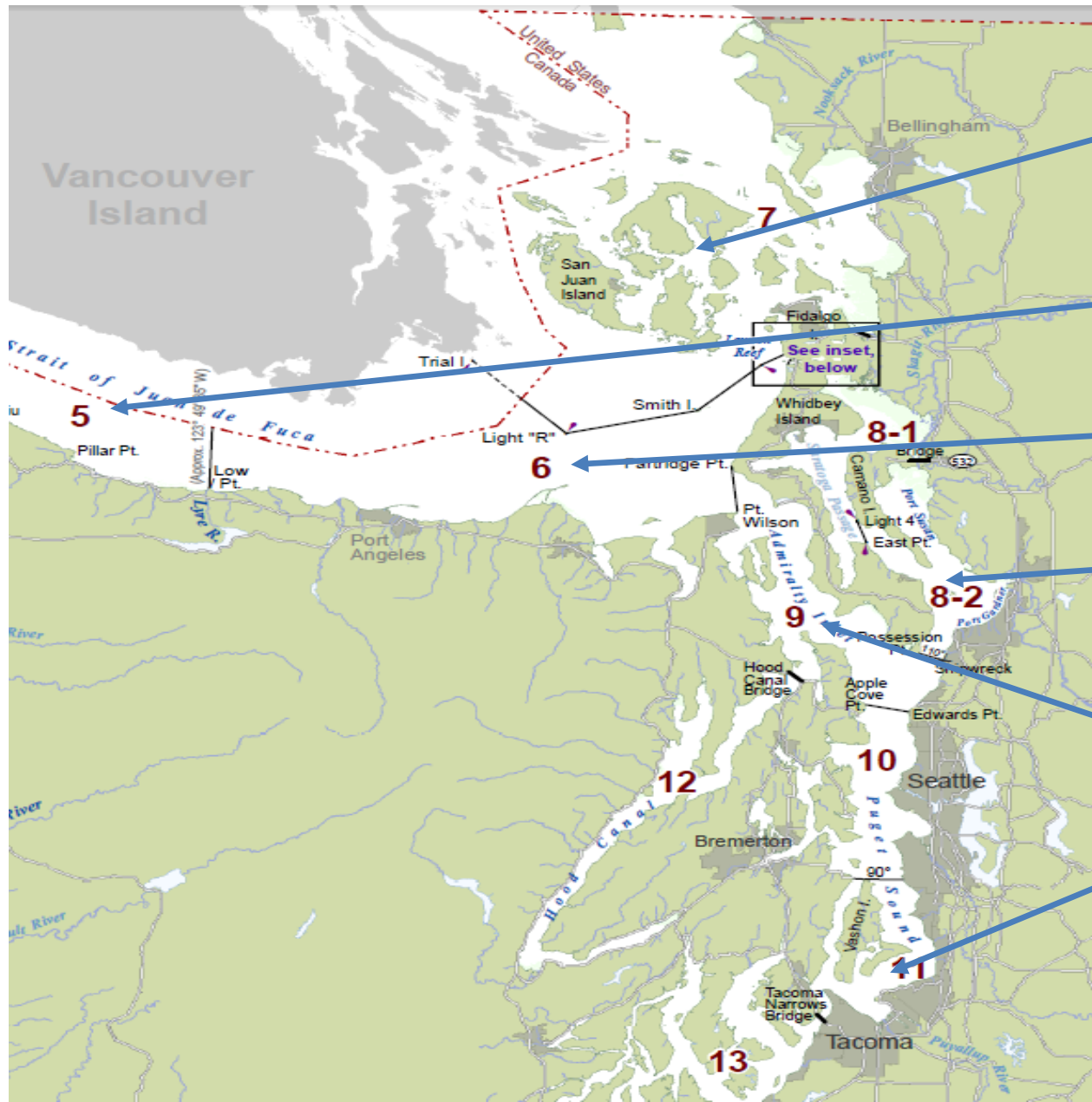




Area 7 August = 0.7% Stilly ER
 ~10,000 angler trips

Area 5 July – Sept
 Area 6 July – Sept
 Area 9 July – Sept
 Area 11 July
 =.7% Stilly ER
 ~160,000 angler trips





Area 7 – Closed August and January

Area 5 – Closed 2 weeks in February

Area 6 – Closed February

Areas 8.1 & 8.2 – Closed December and January

Area 9 – Closed July 16-25 and January

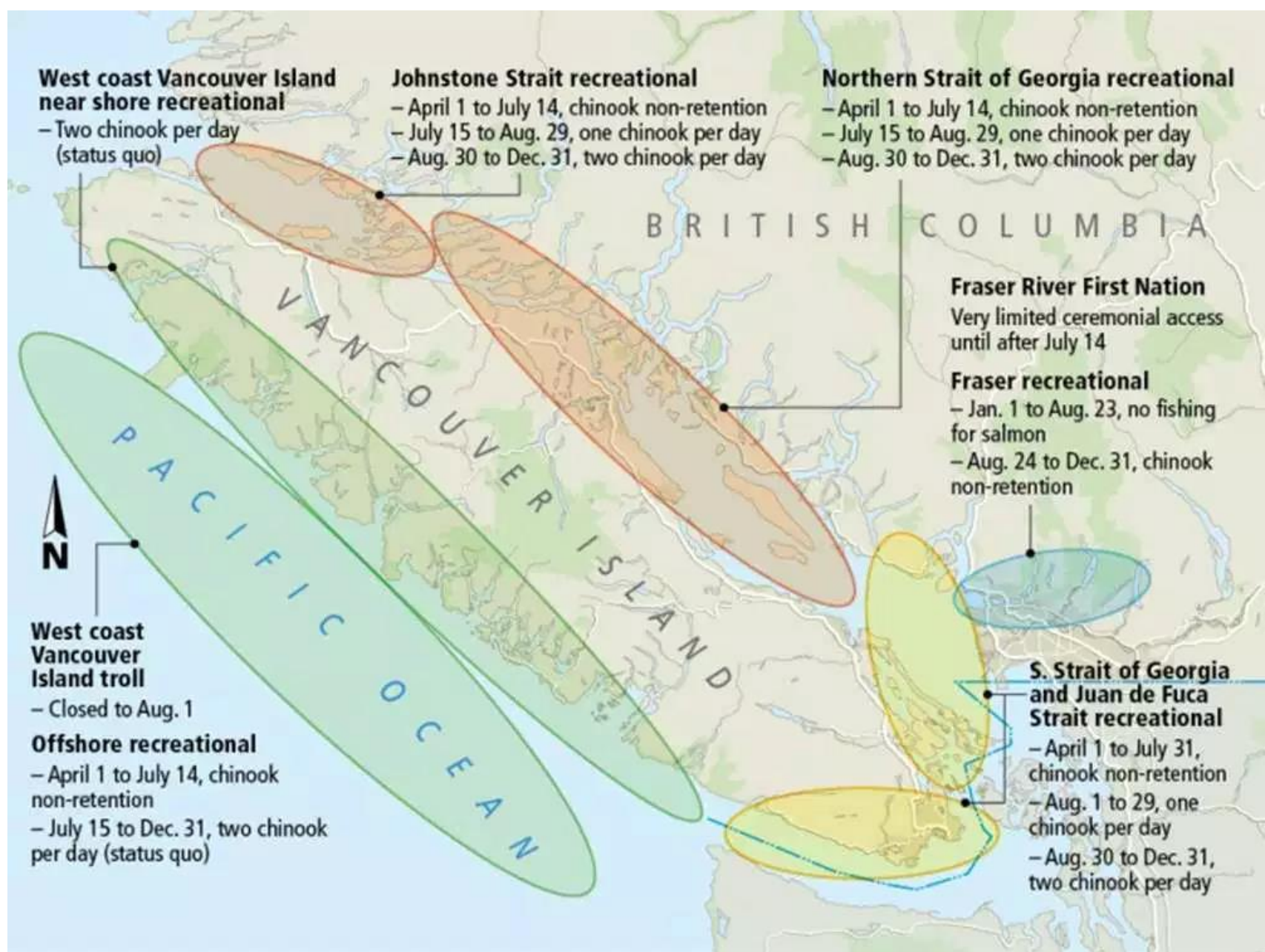
Area 11 – Closed June, October-December



Puget Sound Recreational Chinook Seasons 2019-20

Area	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
5			M M M	NR NR NR							M M M M	
6			M M M	NR NR NR							M M M M	
7			M M		NR NR						M M M M	
81				NR NR NR NR	NR NR						M M M M M M	
82				NR NR							M M M M M M	
9			M*	M NR NR NR							M M M M M M	
10		NR NR NR	M M M	M NR NR NR	NR NR NR						M M M M M M	
11			M M M M	M M M							M M M M M M M M	
12 NoA				NR NR NR NR	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M
12 SoA			M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M
13	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M





Key Outcomes for 2019

- Provide fishing opportunities consistent with expected abundances and conservation goals for all species
- State & Tribal agreement for all salmon fisheries
- ESA authorization for Puget Sound fisheries
 - Chinook
 - SRKW



North of Falcon

