North Fork Skokomish River Sockeye Salmon Program: Beginnings...

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Natural Resources
Tacoma Power

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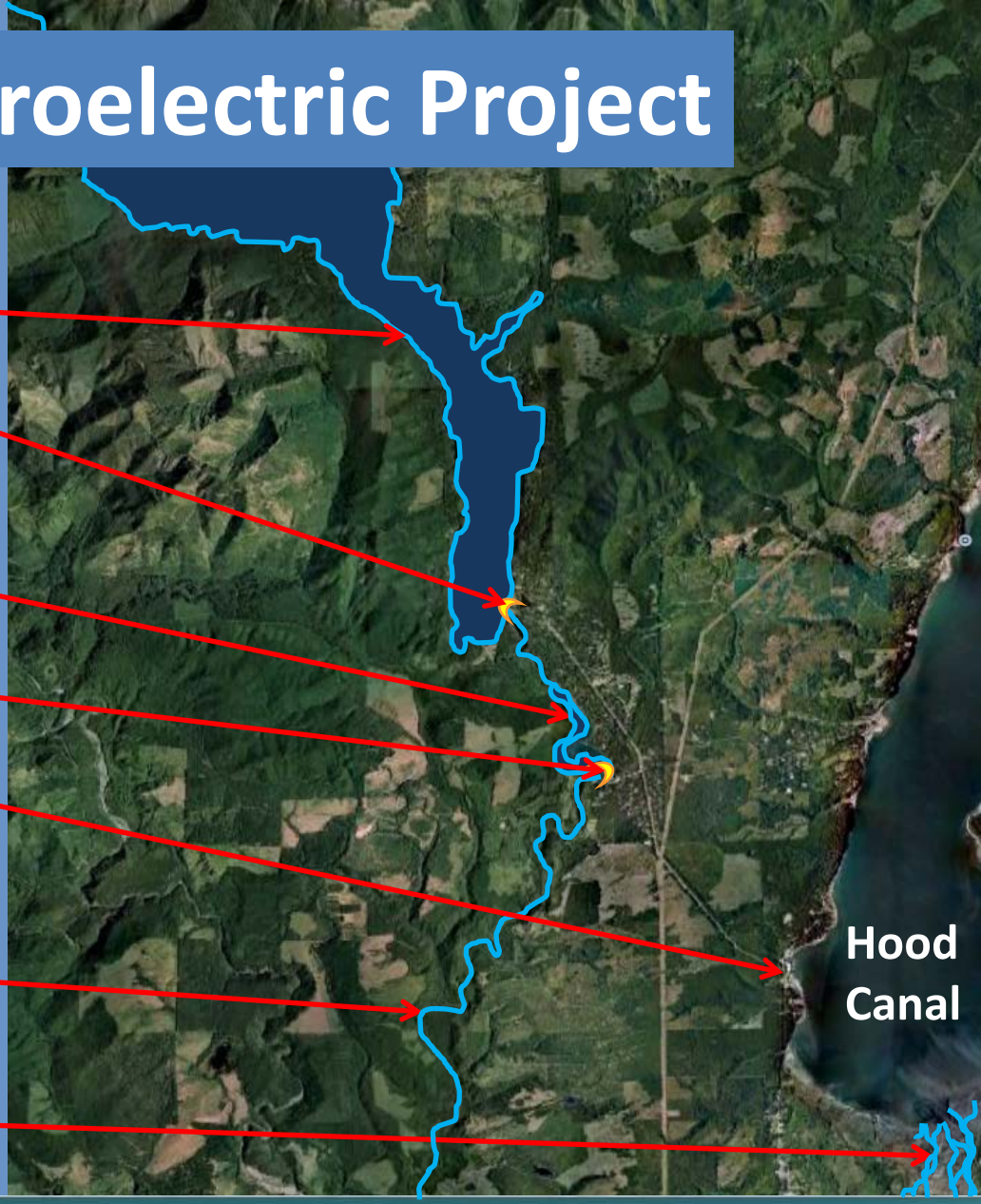
Cushman Hydroelectric Project



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Resident Salmonids

Native

- Sockeye Salmon - extirpated
- Chinook Salmon
  - Spring - extirpated
  - Fall - extirpated.....or not?
- Coho Salmon - extirpated above dams
- Winter Steelhead - extirpated above dams
- Bull Trout - separated by dams
- Cutthroat Trout - separated by dams
- Chum Salmon
- Pink Salmon

Introduced

- Kokanee - non-native Lake Whatcom stock
- Rainbow Trout - Skamania stock above Cushman Dam

Relicensing - 2010

Settlement Agreement

- 22 Articles
- 8 Articles directly address fish topics:
  - Article 417 - "The objectives of the Fish Supplementation Program are to:
    1) Support the reintroduction, restoration, and long-term maintenance of anadromous populations in the North Fork Skokomish watershed;
    2) Provide harvest opportunities to treaty Indian and non-treaty fishers; and
    3) Provide recreational fishing opportunities.“

Settlement Agreement

License Article 417 - Fish Supplementation

- Tacoma Power to develop four restoration/supplementation hatchery programs in the North Fork Skokomish River:
  - North Fork Salmon Hatchery:
    - Spring Chinook Salmon
    - Coho Salmon
    - Winter Steelhead
  - Saltwater Park Sockeye Hatchery:
    - Sockeye Salmon

Sockeye Salmon Program

Beginnings...

- Production goal: 2,000,000 fry
- Source population: Baker River, Washington
- Managed as a Mitigation/Restoration program
- Operated as a Segregated program but transition to an Integrated program as quickly as possible
- Mature Sockeye Salmon
    - Hatchery broodstock
    - Released above dams to spawn in nature
    - pNOB > pHOS so that PNI > 0.5

Sockeye Salmon Program

License Article 417

Type	Number Released	Mean Weight (g)	Total Weight (kg)	Survival to Smolt	Smolts	SAR	Mature Salmon
Fed fry (MAY)	200,000	0.18	36	2.5%	5,000	4%	200
Fed fry (JUN)	1,000,000	0.57	570	15%	150,000	4%	6,000
Fall fry (SEP)	800,000	3.0	2,421	50%	400,000	4%	16,000
Totals	2,000,000		3,027		555,000		22,200

- "The licensee shall transport and release juvenile sockeye into Lake Cushman or in the North Fork Skokomish River as determined by the Fisheries and Habitat Committee.“
- "The production quantities and release strategies for those facilities may be adjusted by the Fisheries and Habitat Committee within the design production capacity of those facilities."

Sockeye Salmon Program

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Totals	2,000,000		3,027		555,000		22,200

- Appendix A. Section E.1: "This number of fry can be expected to produce an estimated adult return to the North Fork Skokomish River of approximately 22,200 sockeye adults...Tacoma will take reasonable steps, as determined by the FHC, to achieve the adult return objective."

Sockeye Salmon Program

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Totals	2,000,000		3,027		555,000		22,200

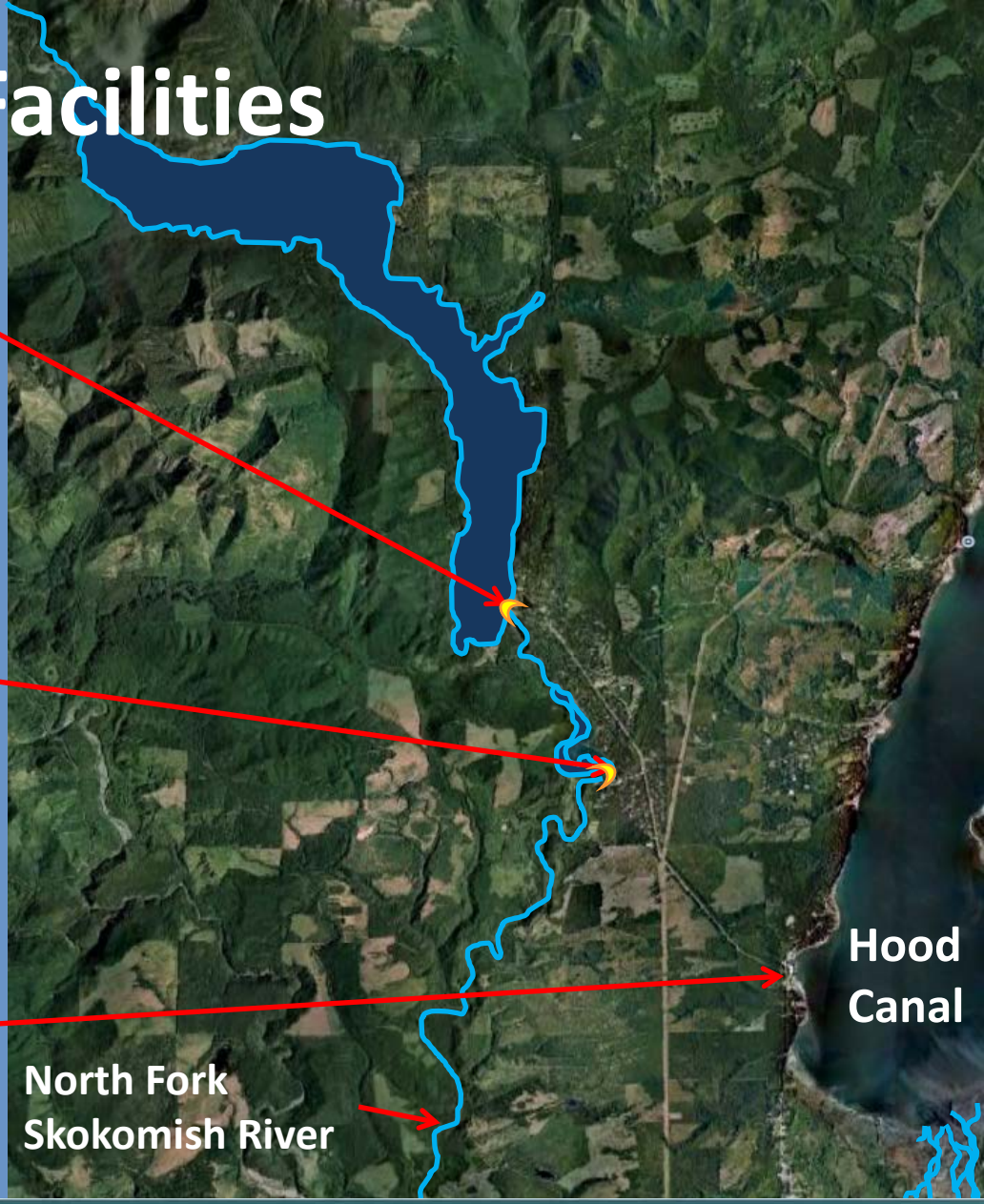
- Survival to smolt of juveniles released into Lake Cushman is a guess
  - Doesn't seem to account for ability to collect smolts at Cushman Dam
- SAR assumption may be conservative
  - Baker River mean (1990-2013 BYs) = 8.5% (1.6-27.6%)
  - Also didn't consider kokanee smolts

Sockeye Salmon Facilities

Juvenile Fish Collector at Cushman Dam

Sorting and Release Facility & Adult Collection Site at Cushman No. 2 Dam

Saltwater Park Sockeye Hatchery



Saltwater Park Sockeye Hatchery

Water

- Groundwater from springs on hill next to Powerhouse
- Surface water from Powerhouse

Tanks

- 6 outdoor circular mature holding ponds
- 120 incubation jars
- 24 rectangular indoor early rearing troughs
- 24 outdoor circular final rearing ponds

Juvenile Fish Collector

System Survival

- "Percentage of a marked group of smolts released near the upstream end of Lake Cushman that is successfully collected by the JFC and safely passed downstream of the Cushman Project."
- Minimum Compliance Standard = 75%
- Goal = 95%

Fish Collection Efficiency

- "Percentage of acoustic-tagged smolts detected at the log boom (approximately 110 m upstream of the dam) and are successfully collected in the JFC and safely passed downstream of the Cushman Project."
- Standard = 95%

Facilities - Juvenile Fish Collector

- Tested using Coho Salmon in 2015-2017.
- Being tested with Coho and Sockeye salmon in 2018.

Year	System Survival		Fish Collection Efficiency
	$Year_1$	$Year_2$	
2015	18.1%	25.5%	28.5%
2016	18.6%	27.0%	36.5%
2017	31.2%	TBD 2018	54.0%

- Kokanee Collections:

Year	Fry/ Parr	Smolts	Sub-adults
2015	1	367	14
2016	495	11,689	79
2017	5,382	17,297	43

Sorting and Transportation Facility

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Release & Adult Collection Sites

Broodstock and Eyed Eggs

Brood Year	Date Received	Eyed Eggs	
		Total	Live
2016	December 2016	255,000	252,000
2017	December 2017	515,700	509,000

Metric	Rate	Number	Units
Matures collected (both sexes)		1,858	Mature salmon collected
Prespawn mortality	5%	1,765	Total adults spawned
Sex Ratio	50%	883	Females spawned
Female IHN rate	1%	874	Clean females spawned
Fecundity	2,770	2,420,217	Green eggs
Fertility rate	94%	2,275,004	Eyed eggs
Survival to fry	88%	2,002,003	Fry

Survival, Growth & Release

- Mean monthly survival at Saltwater Park Sockeye Hatchery has been 99.5%.
- <u>Releases:</u>

Month	Age	Life Stage	BY 2016	BY 2017
May	5 months	Parr	36,300	150,000*
June	6 months	Parr	0	0
September	9 months	Parr	167,000	250,000*
April	16 months	Smolt	19,000*	50,000*
May	17 months	Smolt	19,000*	50,000*

*Expected

Survival, Growth & Release

	License Release Plan			BY 2016	Proposed Release Plan		
Release Month	Life Stage	Percent Released	Mean Weight (g)	Mean Weight (g)	Life Stage	Percent Released	Mean Weight (g)
MAY	Fed fry	20%	0.18	2.62	Parr	30%	2.0
JUN	Fed fry	50%	0.57	4.6		0%	
SEP	Fed fry	30%	3.0	15	Parr	50%	12
APR				50?	Smolts	10%	40
MAY				55?	Smolts	10%	40

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Estimates of Survival in Lake Kokanee

Settlement Agreement Release Plan

Release Stage, Date, Location	Number Released	Release-to-Smolt Survival in Lake Cushman					
		Low Survival		Medium Survival		High Survival	
		Survival Rate	Smolts in lake	Survival Rate	Smolts in lake	Survival Rate	Smolts in lake
MAY, Fed Fry, LC	200,000	0.63%	1,247	1.25%	2,475	2.5%	4,950
JUN, Fed Fry, LC	1,000,000	3.75%	36,000	7.5%	72,000	15%	144,000
SEP, Fed Fry, LC	800,000	12.5%	95,000	25%	190,000	50%	380,000
Total	2,000,000		132,247		264,475		528,950
% of Total Released			6.7%		13.2%		26.4%

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Estimates of Survival in Lake Kokanee

Proposed Release Plan

Release Stage, Date, Location	Number Released	Release-to-Smolt Survival in Lake Cushman					
		Low Survival		Medium Survival		High Survival	
		Survival Rate	Smolts in lake/ hatchery	Survival Rate	Smolts in lake/ hatchery	Survival Rate	Smolts in lake/ hatchery
MAY, Parr, LC	600,000	0.63%	3,780	1.25%	7,500	2.5%	15,000
JUN, Fed Fry, LC	0	N/A	0	N/A	0	N/A	0
SEP, Parr, LC	1,000,000	12.5%	125,000	25%	250,000	50%	500,000
APR, Smolts, LC	200,000	25%	50,000	50%	100,000	75%	150,000
MAY, Smolts, NFSR	200,000	N/A	200,000	N/A	200,000	N/A	200,000
Total	2,000,000		378,780		557,500		865,000
% of Total Released			19%		28%		43%

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Smolts to North Fork Skokomish River

Proposed Release Plan

Release Stage, Date, Location	Number Released	Low Survival		Medium Survival		High Survival	
		Survival Rate	Smolts in lake/ hatchery	Survival Rate	Smolts in lake/ hatchery	Survival Rate	Smolts in lake/ hatchery
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MAY, Smolts, NFSR	200,000	N/A	200,000	N/A	200,000	N/A	200,000
Total	2,000,000		378,780		557,500		865,000
% of Total Released			19%		28%		43%
Smolts in NFSR (26% SS)			**246,483**		**292,950**		**372,900**
% of Total Released			**12%**		**15%**		**19%**

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Potential Mature Returns

Fry Production/ Lake Cushman Survival	Smolts in NFSR	SAR			
		Baker River Min (1.6%)	Settlement Agreement (4.0%)	Baker River Mean (8.5%)	Baker River Max (27.6%)
500,000 Fry					
Low Survival	61,621	986	2,465	5,238	17,007
Medium Survival	73,238	1,172	2,930	6,225	20,214
High Survival	93,225	1,492	3,729	7,924	25,730
2,000,000 Fry					
Low Survival	246,483	3,944	9,859	20,951	68,029
Medium Survival	292,950	4,687	11,718	24,901	80,854
High Survival	372,900	5,966	14,916	31,697	102,920

Settlement Agreement plan: 22,200

Estimate: 1,150-18,400

Potential Mature Returns

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Kokanee returns will add 240-4,140 matures

Potential Mature Returns

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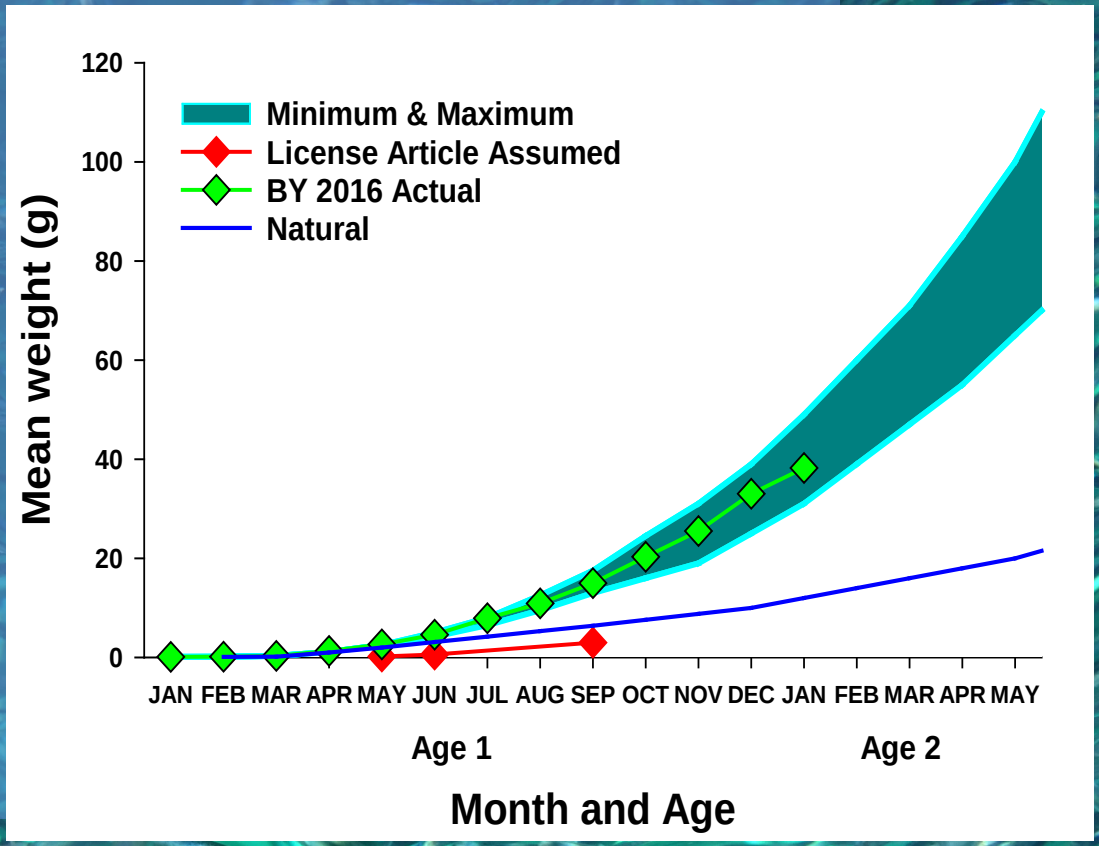
Modeled JFC Collection Efficiency = 26%;
Minimum Compliance Standard = 75%; Goal = 95%

Issues

Rearing & Release Strategies

- Growth rate at Saltwater Park hatchery is too fast.
- Size is constrained by our egg source:
- Eyed eggs from Baker River
  - from early spawns
  - incubated in warm water
- Hatch early and we have to feed them

When we start spawning broodstock, we can chill the incubation water to slow hatching, growth, and subsequent size at release.



Issues

Rearing & Release Strategies

- Large Sockeye Salmon smolts = high residualism
- Age composition of returns
    - Large Sockeye Salmon smolts = high early maturation
- June release is unrealistic

Cushman No. 2 Dam Release Site

- Pool has lots of predators
    - Cutthroat Trout
    - Bull Trout

Issues

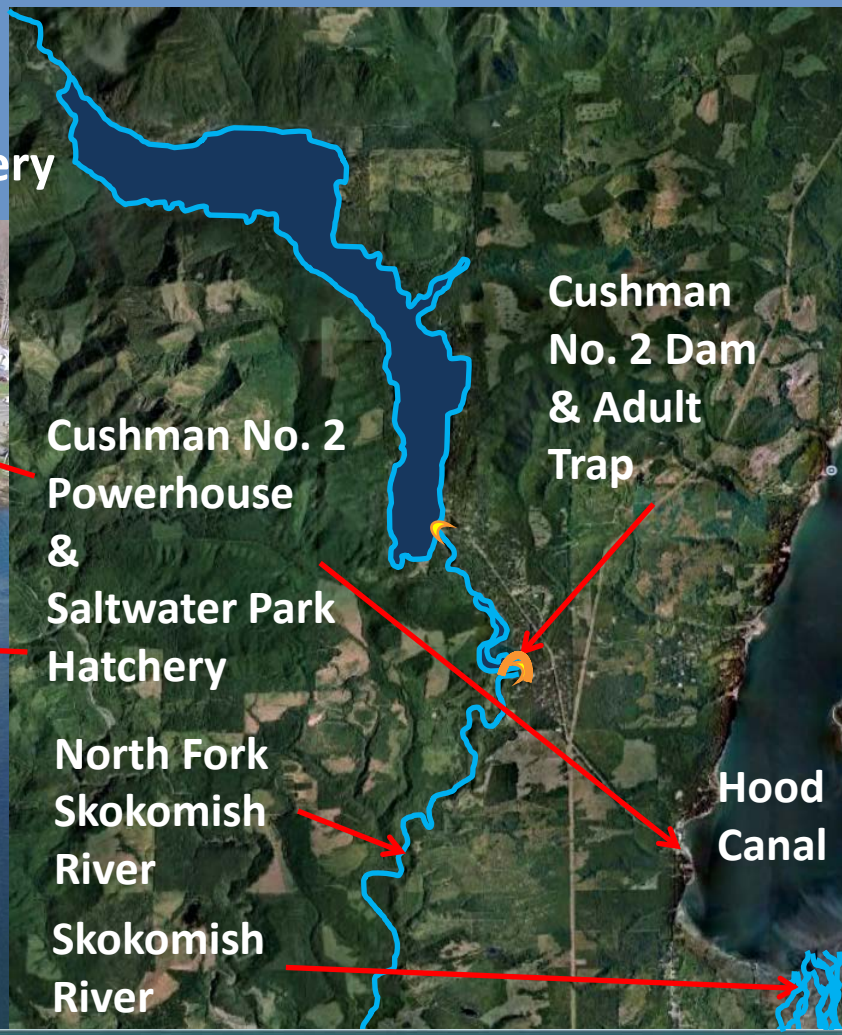
Juvenile Fish Collector

- Low System Survival and Collection Efficiency
  - Not even close to expectations
  - If we capture <50% of the *O. nerka* smolts, then a lot of Sockeye Salmon will residualize in Lake Cushman, even if they didn't want to.
- JFC may not be able to handle the number of smolts that may want to leave Lake Cushman
  - Kokanee in 2017: 17,297 smolts
  - Settlement Agreement estimate: 7,476 - 119,600 smolts
  - Proposed Plan estimate: 46,529 - 169,293 smolts
  - Proposed Plan & 75-95% Collection Efficiency: 500,000 - 620,000?

Issues

Collection of Mature Salmon

- Location of Saltwater Park Sockeye Hatchery



Issues

Collection of Mature Salmon

- Location of Saltwater Park Sockeye Hatchery
  - Matures are likely to return to SWP or the Cushman No. 2 Powerhouse , not Cushman No. 2 Dam.
  - Appendix A, Section E.1:
    - SWP “discharge will be monitored for evidence of false attraction of sockeye adults....It should be noted that sockeye might home to the tailrace, regardless of the influence of the hatchery outfall due to the attraction to reservoir water being discharged at the powerhouse.“
    - “If substantial false attraction is documented, as determined by the FHC, contingency measures to correct the situation will be developed.”

Issues

Releases into Lake Cushman - Juveniles and Matures

- Effect on Other Species
  - Kokanee
    - How will they affect program?
    - How will program affect them?
  - Listed species
    - Bull Trout
    - Chinook Salmon
    - Winter Steelhead
- Diseases
  - IHN
  - Others?

Future

TRADITION

JUST BECAUSE YOU'VE ALWAYS DONE IT THAT WAY
DOESN'T MEAN IT'S NOT INCREDIBLY STUPID.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Questions?
FORESIGHT
THOSE WHO SAY IT CANNOT BE DONE
SHOULD NOT INTERRUPT THOSE BUSY PROVING THEM RIGHT.