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Technical results summary for the

Anadromous Fish Floor spatial analysis

Gus Seixas
on behalf of the AFF Project Team
6/27/2022

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The Anadromous Fish Floor Project Team:

PIs: Lisa Belleveau, Brian Fransen, Jamie Glasgow, Gus Seixas

Workgroup: Caprise Fasano, John Heimburg, Doug Martin, Chris Mendoza, Don Nauer, Brian McTeague, Sarah Zaniewski

Project administrators: Marc Ratcliff, Ash Roorbach

Consultants: Dan Miller and the TerrainWorks team

The technical report and addendum reflect a wide range in technical perspectives with a lot of compromise to reach consensus on the interpretations and presentation. It is difficult to summarize those elements in a high-level presentation. However, we have done our best to distill this down to only the essential elements that we could agree on. Please ask questions.

What is the Anadromous Fish Floor?

'…physical stream characteristics downstream from which all streams can be presumed to have anadromous fish use.'

Would constitute the place to start electrofishing during a water typing survey.
Goals: reduce e-fishing in the highest quality salmon habitats, reduce the risk of 'missing' salmon during fish presence-based surveys, reduce survey effort requirements for landowners by providing a place to start.

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Alternative A4 (5, 7, 10%):

'…all waters included in the SWIFD GIS database of documented (observed) and presumed anadromy, plus upstream associated waters occurring below a sustained gradient of X% or a permanent natural barrier, whichever comes first.'

First I'm going to define the two main alternatives that have received recommendations from the policy reps of the workgroup. These are quotations from the AFF technical report.
[read A4 definition]
Additionally, A4 includes waters connected to saltwater up to the gradient threshold or permanent natural barrier but which do not have SWIFD coverage.

Alternative D:

'…waters included in the SWIFD GIS database of known and presumed anadromy including tributaries lacking a 5% gradient increase or permanent natural obstacle at the junction with the main stem SWIFD stream.'

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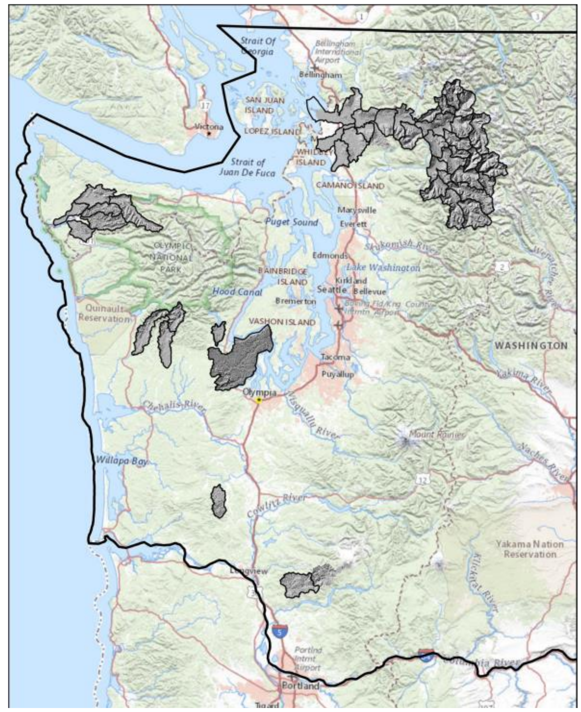
- Approach: create GIS models of the AFF alternatives and compare them against field data.



Working with TerrainWorks, we developed a GIS-based spatial analysis to test modeled versions of the proposed AFF alternatives.

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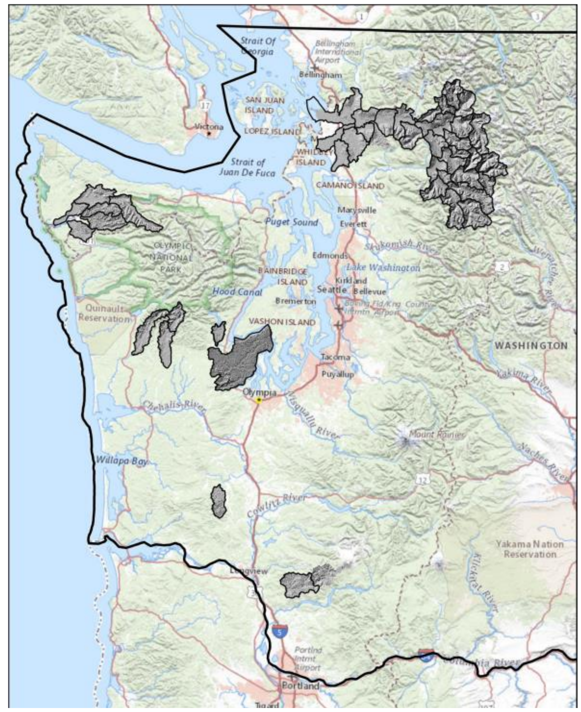
- Approach: create GIS models of the AFF alternatives and compare them against field data.
- Used high-resolution lidar topography in basins distributed throughout western WA.



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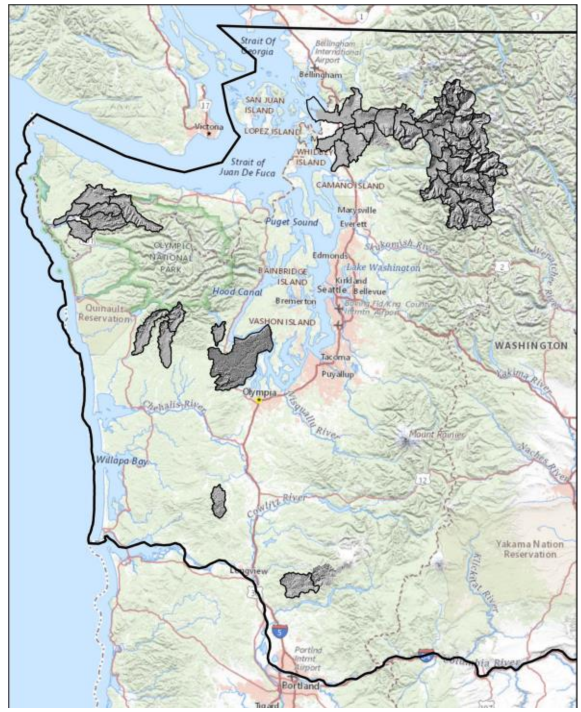

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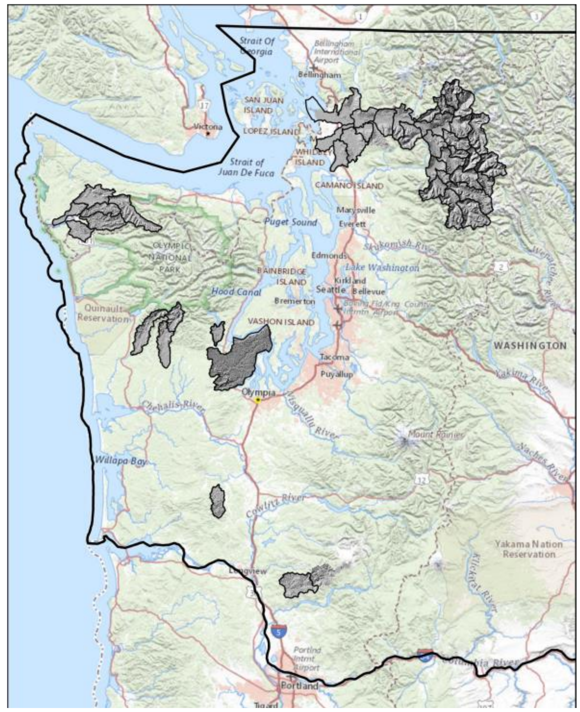
- GIS programs extracted elevations along each 'synthetic stream', calculated channel gradient, width and barrier dimensions.



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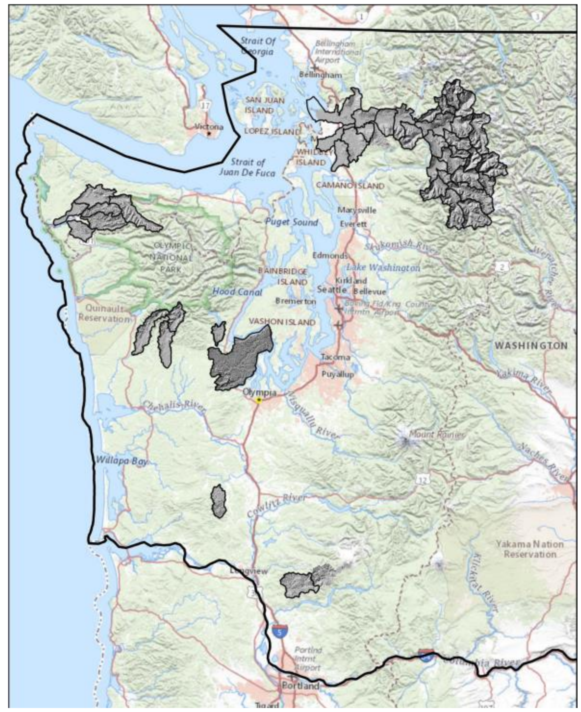

Slide 11

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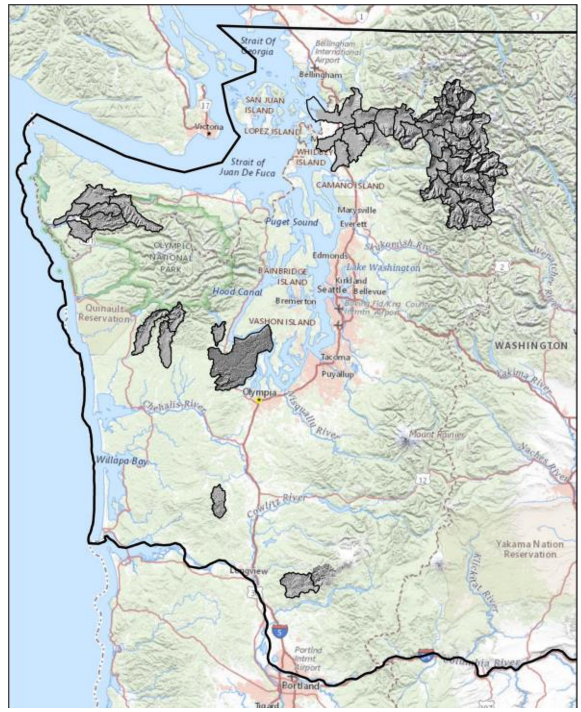
- These methods are subject to error/uncertainty. The results are not a map of the actual AFF that may be eventually implemented in rule.



Slide 12

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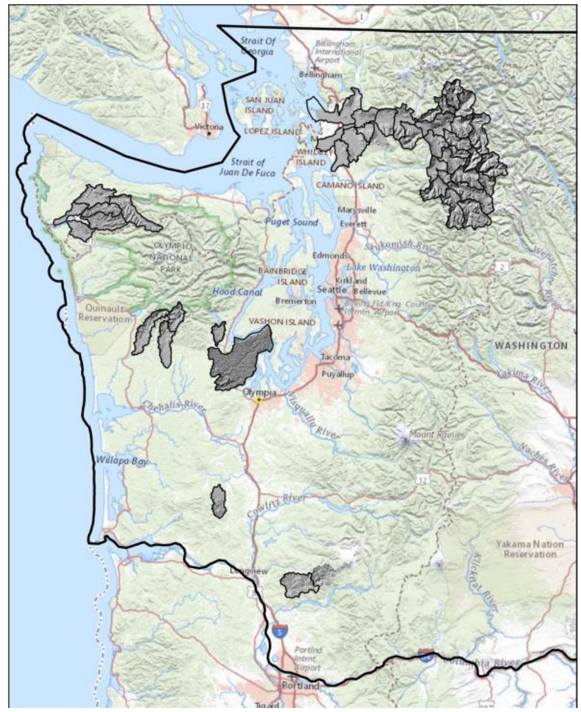
- Relative distances between alternatives should be robust even if absolute distances are subject to error.



Fish reference field data

- SWIFD
  - Observations of anadromous fish presence
  - Large number (623 points)
  - Widely distributed in test basins
  - Form baseline for all AFF alternatives now being considered

These are the data we used to test the modeled AFF alternatives against.
SWIFD is maintained and updated by WDFW and NWIFC and is easily accessible online or as GIS files.

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  - Independent of proposed alternatives
  - Not widely distributed (103 points)

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  - Form baseline for all AFF alternatives now being considered
- 'Other anadromy'
  - Observations of anadromous fish presence
  - Independent of proposed alternatives
  - Not widely distributed (103 points)
- Fish/No fish break points
  - Closest approximation to end of (resident) fish habitat
  - Not widely distributed (447 points) due to uncertainty in spatial placement of points on synthetic stream network

All data were compiled from preexisting sources. Not collected for the purpose we used them for in this study. Have limitations of interpretation.
May have errors in both the upstream and downstream directions.
For the anadromous datasets, the errors are likely to be larger in the upstream direction due to these being 'presence' data, not presence-absence data.
~20% of the anadromous data are 'presumed'. The rest are 'observed'.
The 447 F/N breaks are heavily concentrated in the Stillman and Kalama basins. This is because we had to remove many of the candidate F/N breaks due to misplacement on the synthetic stream network.

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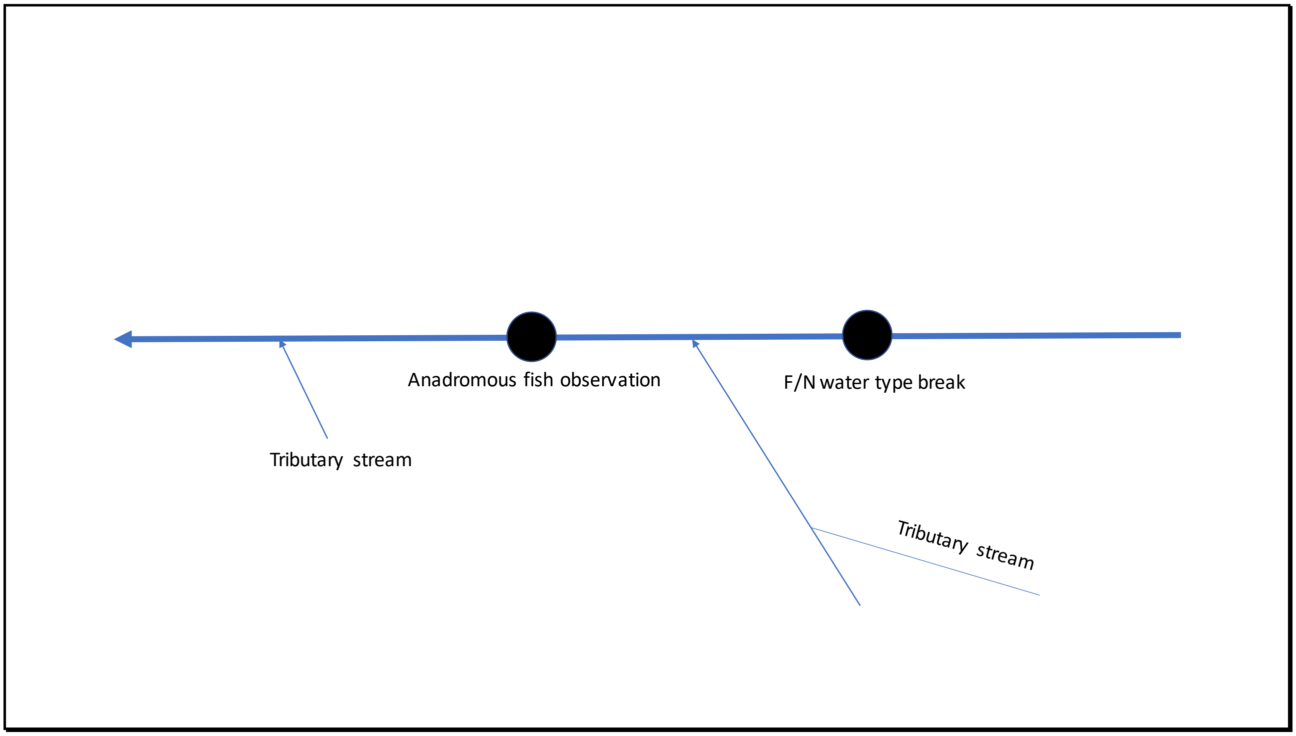

Now I'm going to show how we compare modeled AFF alternatives against the fish reference data.
Zooming in on a hypothetical stream in the GIS model. These are not real streams, they are pictures to illustrate the modeling process and interpretation.
Flow is downstream to the left.
Anadromous fish observation: could be SWIFD or 'other anadromy'
F/N water type break.
Tributary streams.

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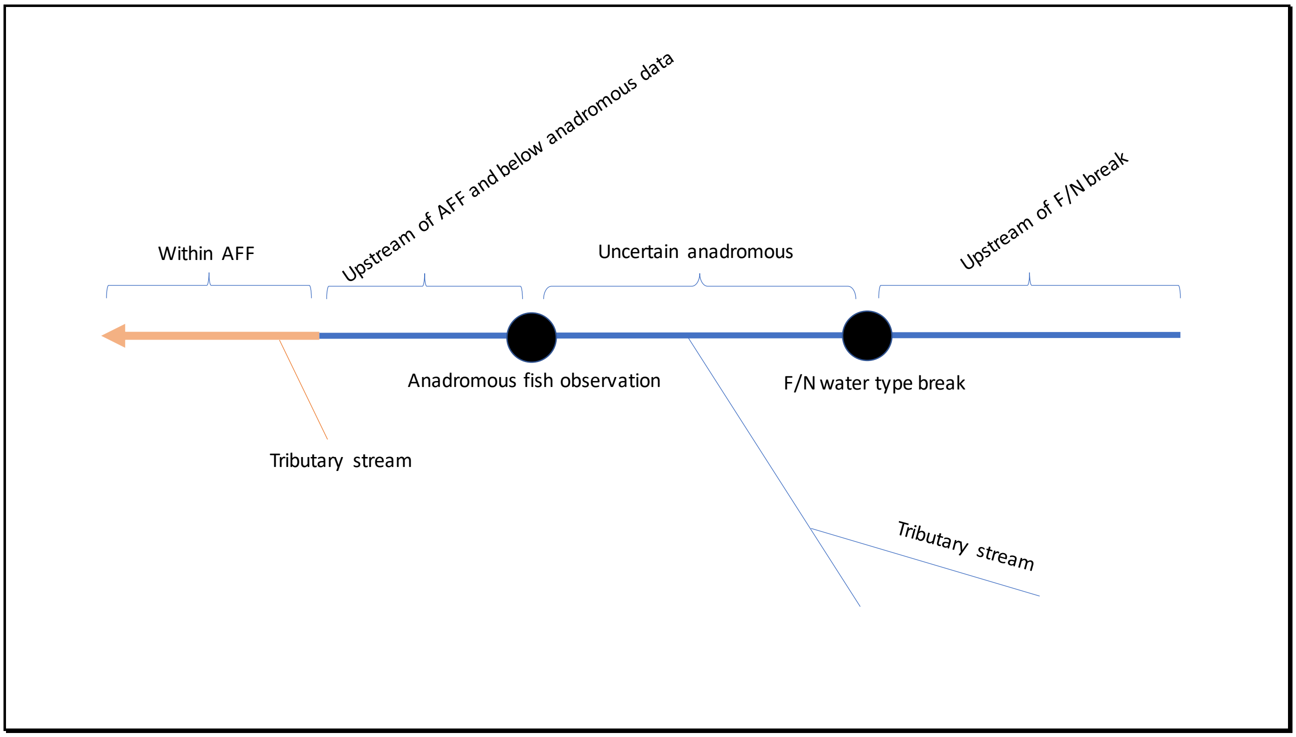

Now we can add a modeled AFF to this hypothetical stream. This could be any AFF alternative. These are the important reach types we can use to understand the relative performance of the AFF alternatives.

This slide shows a scenario where the modeled AFF ends downstream of all fish reference data. [step through each label one at a time]

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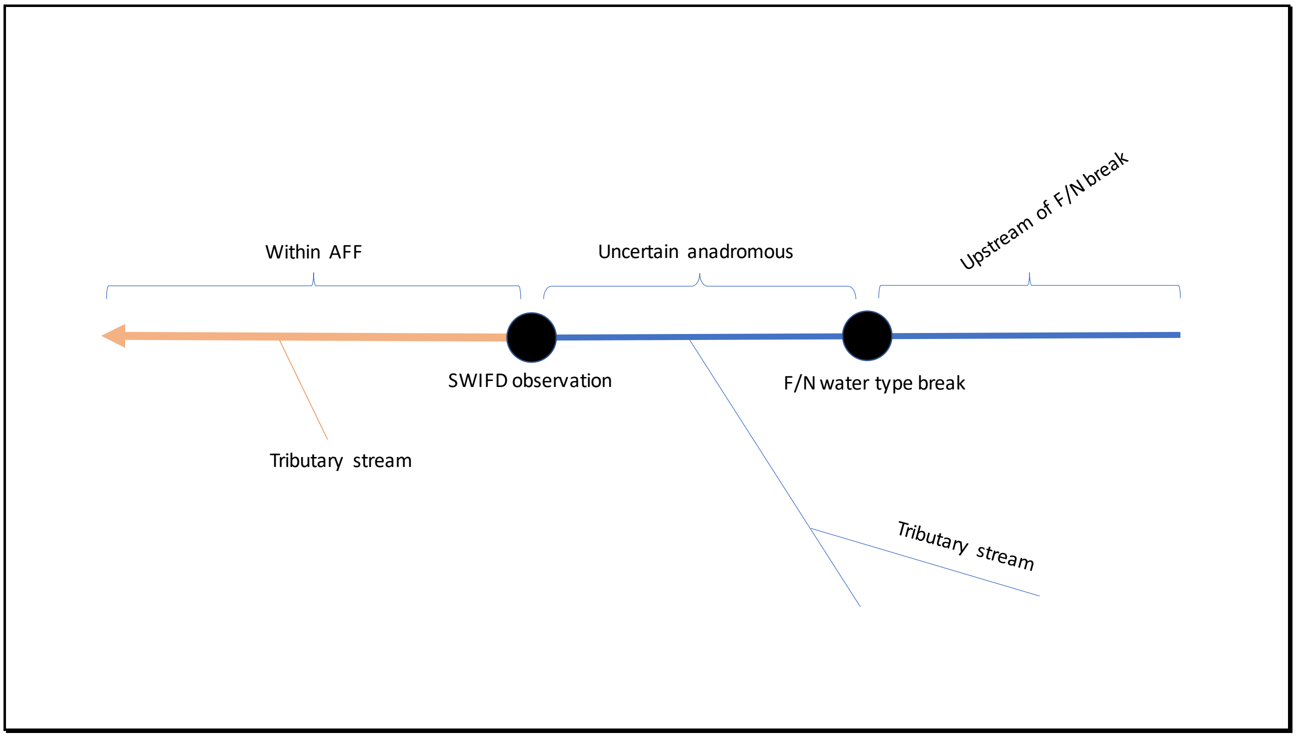

In this slide, the anadromous data point is now specifically a SWIFD data point. All alternatives extend at least up to SWIFD.
Therefore, there are no downstream error distances below SWIFD.

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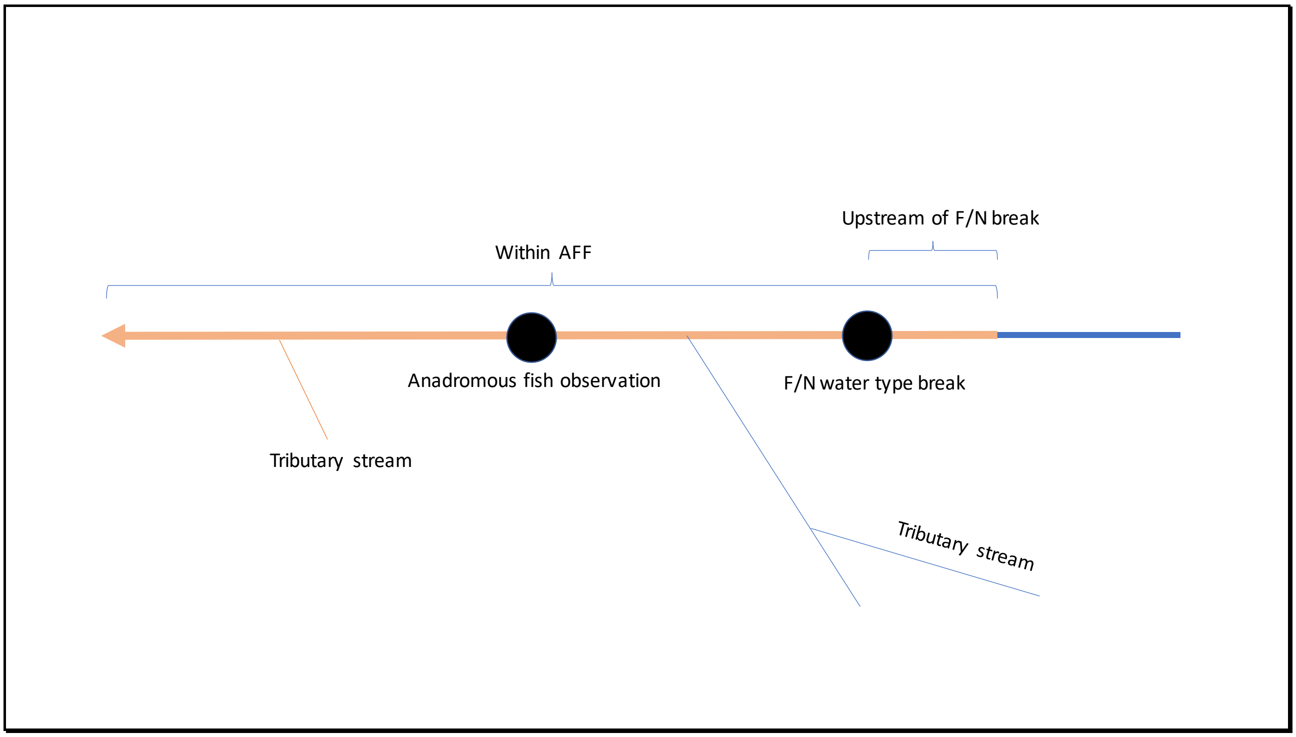

This slide shows a different hypothetical stream that has different gradient and/or barrier/obstacle features. In this case the AFF extends beyond the fish observation data. Again, this could be any AFF alternative.
We use these lengths of modeled AFF alternatives above and below the fish reference data to compare the alternatives against each other.
In this way, we can estimate how the AFF alternatives may perform and we can compare possible performance. These are just estimates and may not reflect the actual AFF once implemented in a field-based rule.

Now we will look at some real results.

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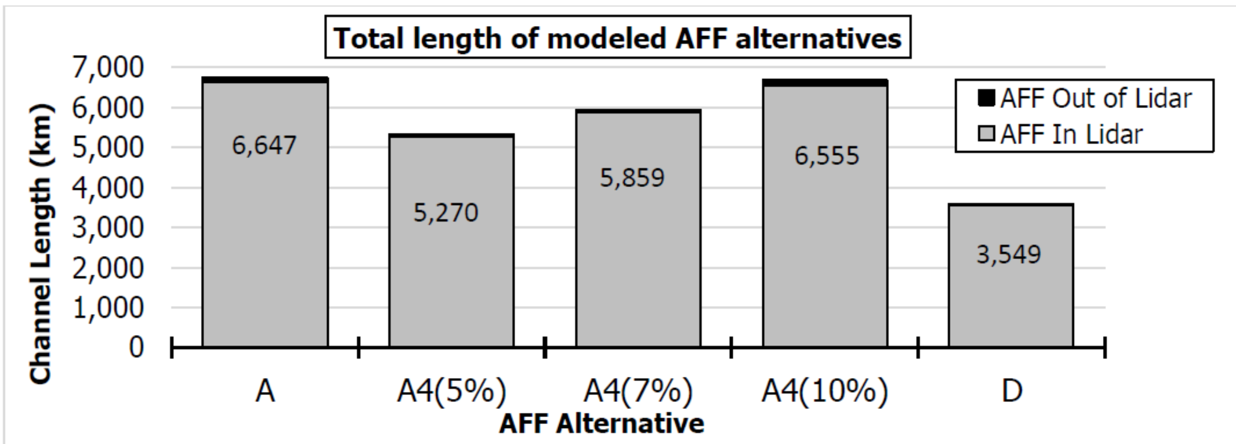

Total length of modeled AFF alternatives
Channel Length (km)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
6,647
5,270
5,859
6,555
3,549
AFF Out of Lidar
AFF In Lidar
A
A4(5%)
A4(7%)
A4(10%)
D
AFF Alternative

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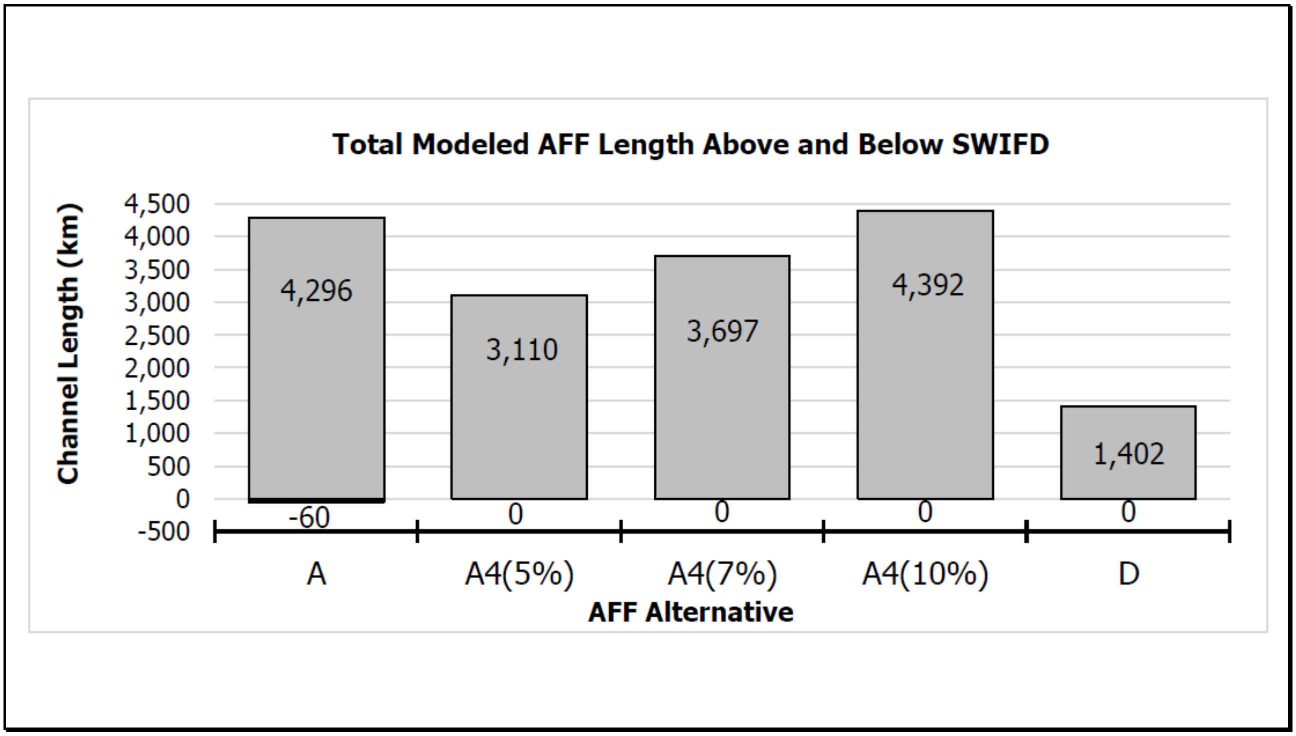

Modeled AFF upstream and downstream of SWIFD reference data
[define axes]
No downstream errors in A4 or D due to using SWIFD in their definitions.
Suggestive that all of the proposed alternatives are functioning to capture a large proportion of anadromous waters.
We cannot say with certainty how much of the anadromous waters are captured by each alternative because the SWIFD dataset are observations of presence with no guarantee of absence upstream.
Therefore, the grey bars are not true ‘overshoot’ errors. They are distances within the ‘uncertain anadromous’ category.

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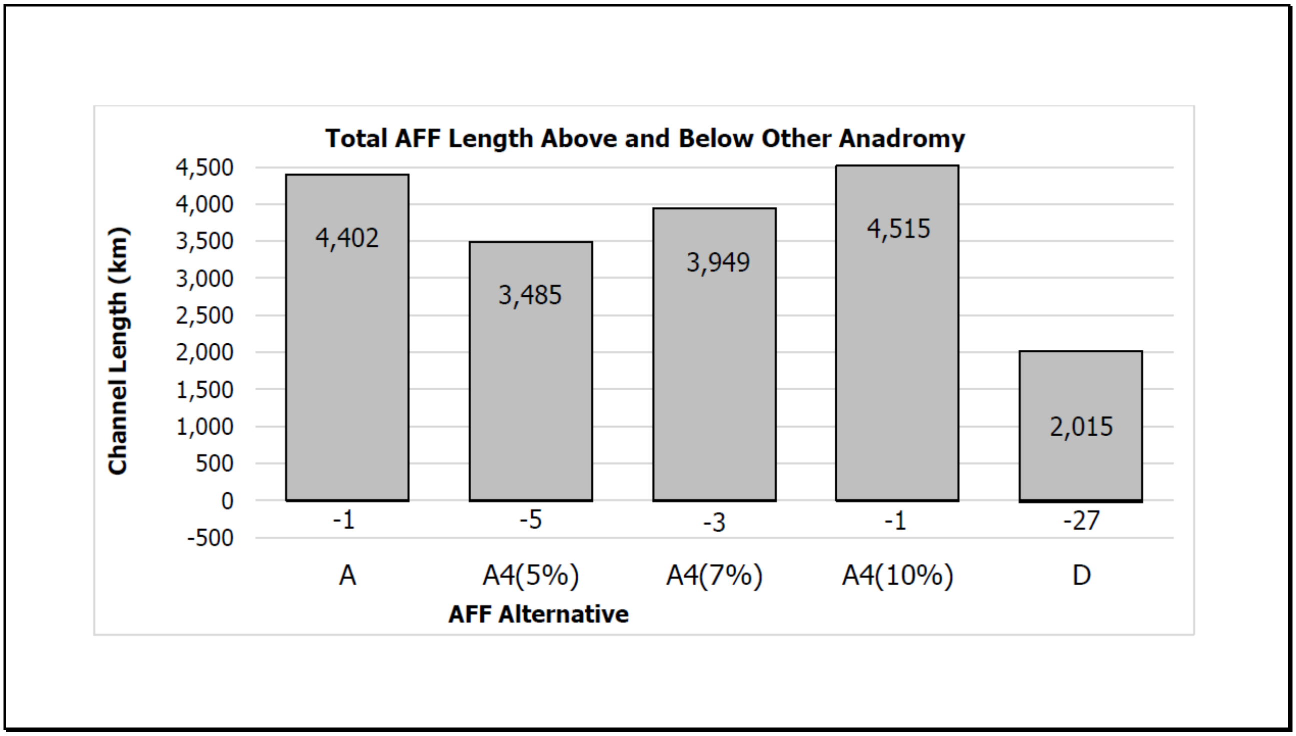

This slide shows the total distances each modeled alternative ended upstream and downstream of ‘other anadromous’ observation data.
Consistent with the idea that all alternatives captured a large proportion of the anadromous waters.
Can use ‘other anadromy’ to quantify ‘undershoots’.
[Draw attention to numbers below bars]. These represent the undershoot errors.
Alt D had the shortest total length had the greatest total distance downstream of anadromous observations (largest undershoot error).
Alternatives with 10% gradient thresholds had the smallest ‘undershoot’ errors. Alternative A4 (5%) had the second largest undershoot error.

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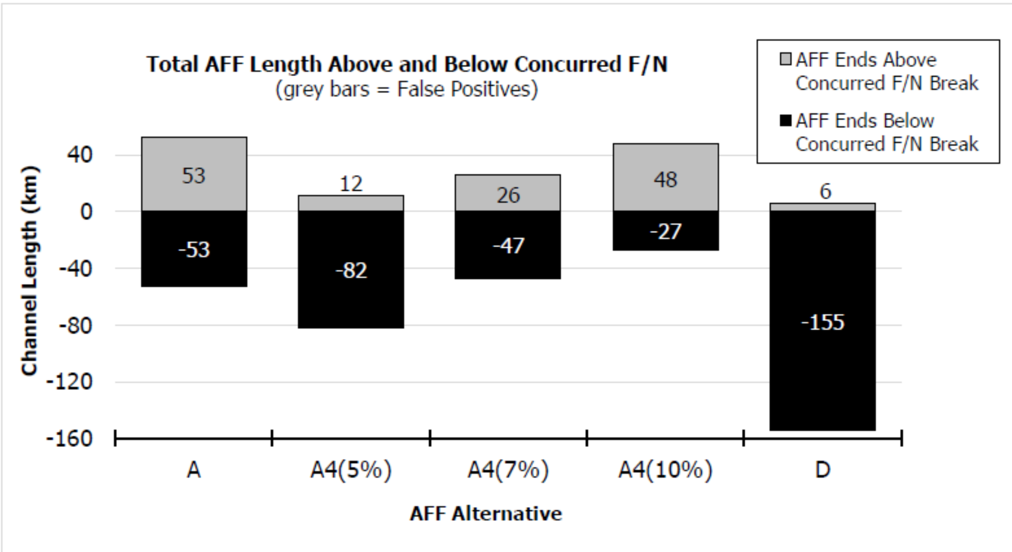

Addendum Figure 5 (equivalent to Figure 11 in main report). Distances that the modeled AFF alternatives terminate upstream and downstream of the F/N break point data. The positive bars (grey) are referred to as 'False Positives' in the framework of Figure 2 in the main report.

This slide shows the total distances upstream and downstream of the F/N break reference data (representing mostly resident fish use).
Alt D had the shortest extensions beyond the F/N break points.
As the gradient threshold increased in the A4 options, so did the extensions beyond the F/N breaks.

there are locations where the overshoots extend long distances (several kilometers) upstream of the F/N breaks (Addendum Figure 18). As a result of these long distances, relatively few of these overshoot locations account for large proportions of the total 'overshoot 'stream lengths.
Having reviewed many of the WTMFs for the F/N breaks that the model overshot, we can explain that the extensive modeled overshoots occurred most often where the model didn't register a barrier feature that was identified in the field.

Summary

- No alternative perfectly captured the anadromous stream length without extending beyond F/N breaks

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- The various alternatives represent tradeoffs between 'undershooting' the known anadromous data and 'overshooting' the F/N breaks

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- The various alternatives represent tradeoffs between ‘undershooting’ the known anadromous data and ‘overshooting’ the F/N breaks
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Summary

- No alternative perfectly captured the anadromous stream length without extending beyond F/N breaks
- The various alternatives represent tradeoffs between ‘undershooting’ the known anadromous data and ‘overshooting’ the F/N breaks
- Alt D minimized overshoots but maximized undershoots.
- The alternatives that used the 10% gradient threshold maximized overshoots and minimized undershoots.

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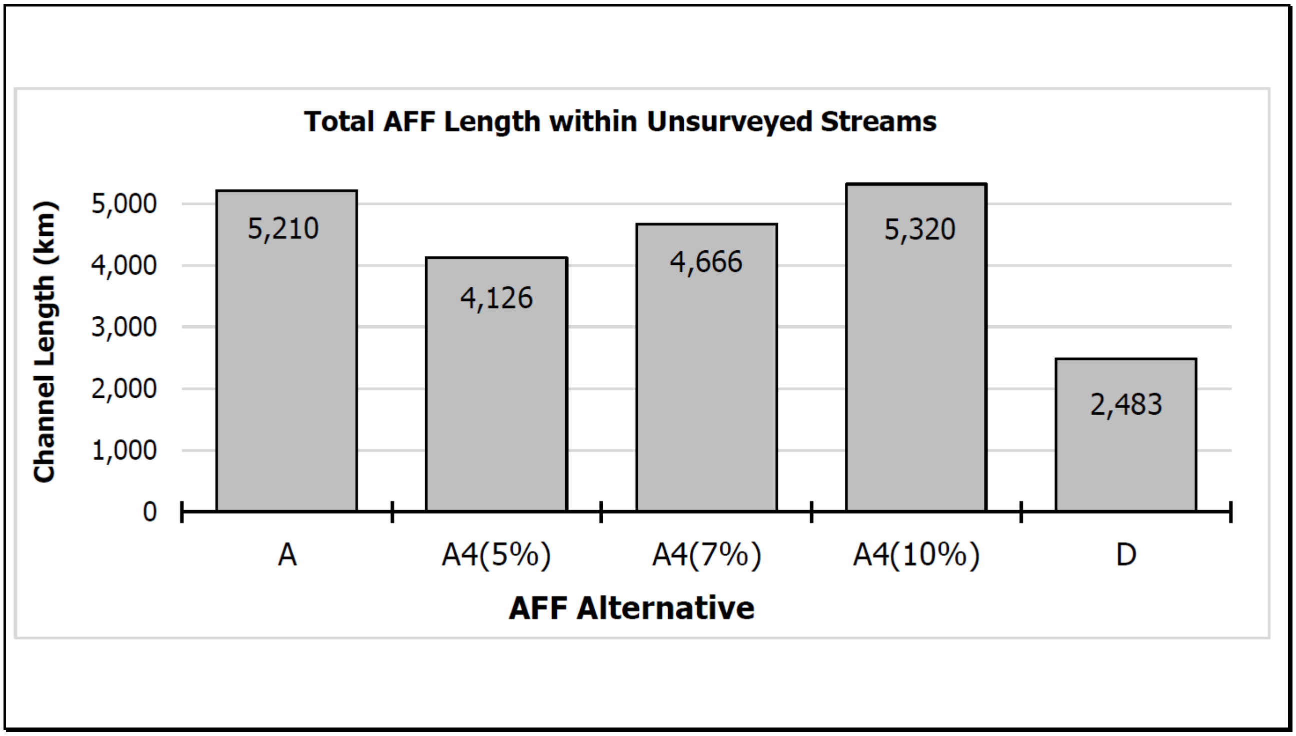

Total AFF Length within Unsurveyed Streams
Channel Length (km)
5,000
4,000
3,000
2,000
1,000
0
5,210
4,126
4,666
5,320
2,483
A
A4(5%)
A4(7%)
A4(10%)
D
AFF Alternative

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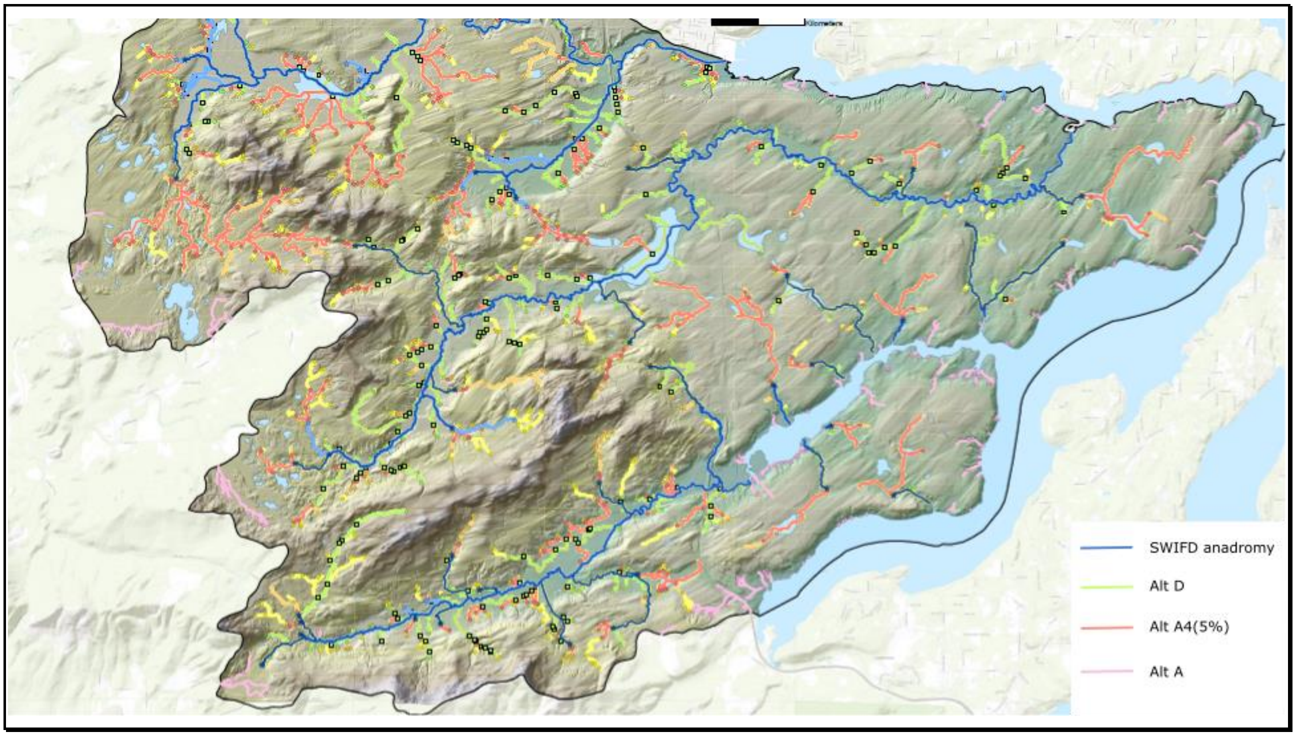

Southern Mason County, Kitsap Peninsula. Low lying topography, low gradient stream systems.
Blue: SWIFD
Green: Alt D
Red: Alt A4 (5%)
Pink: Alt A
Yellow: Alt A4 (7%)
You can assume all higher gradient threshold alternatives line up underneath Alt D.

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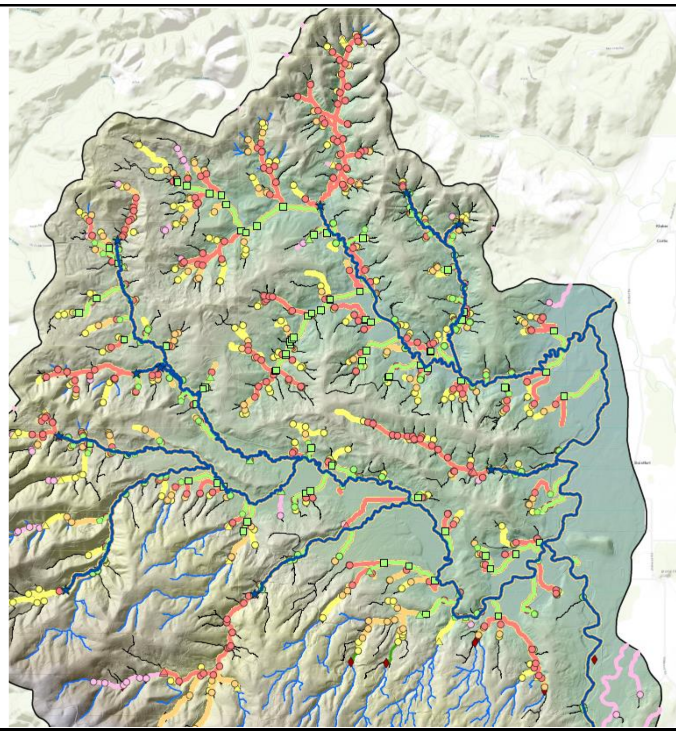

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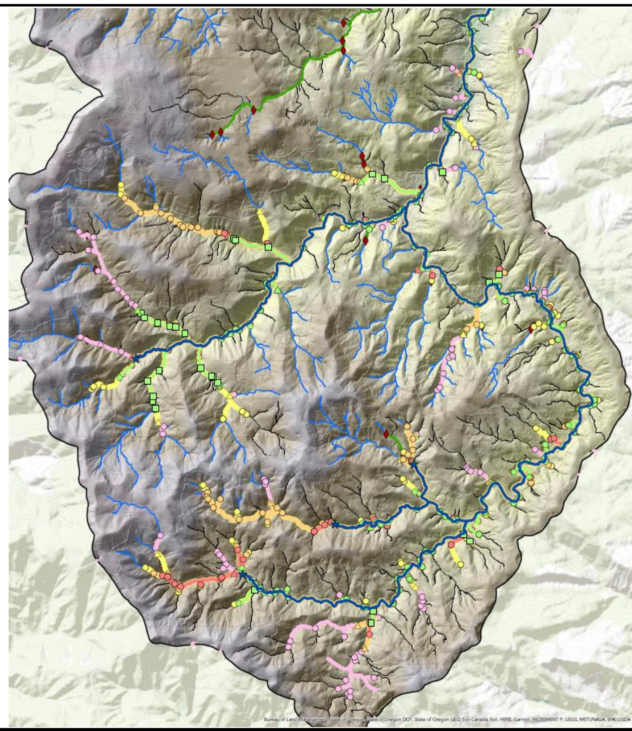

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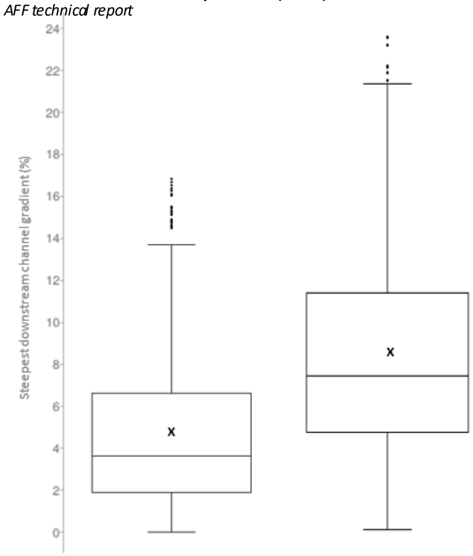
Distribution of maximum sustained gradient values downstream from the highest observed anadromous points (left) and F/N break points (right).

Fig.17 from original AFF technical report

The mean steepest gradient threshold downstream of the highest observed anadromous points was 4.7% (median 3.7%)



The mean steepest gradient threshold downstream of the F/N Break Points was 8.4% (median 7.5%)

It is important to consider the following when interpreting the steepest downstream gradient results: the documented and presumed anadromy points used in this analysis do not necessarily represent the upstream extent of anadromy (anadromy likely extends further upstream, and above steeper sustained gradients) and may not capture the full range of anadromy.