Great River Hydro
ILP Study 9 Instream Flow Consultation Meeting
Web Based Meeting
Tuesday, October 16, 2018, 9:30 – 12:00

Meeting Notes

Consultation on Great River Hydro's instream flow study (Study 9) continued with a web-based meeting held on October 16, 2018.

Meeting attendees identified on the telephone:

Name	Affiliation
Pete McHugh	VTFWD
Jeff Crocker	VT ANR
Eric Davis	VT ANR
Gregg Comstock	NHDES
Melissa Grader	FWS
Ken Sprankle	FWS
Matt Carpenter	NHFGD
Katie Kennedy	TNC
Kathy Urffer	CRC
Andrea Donlon	CRC
Jim McClammer	CRJC
Mark Wamser	Gomez & Sullivan
John Ragonese	GRH
Jen Griffin	GRH
Edwin Nason	GRH
Steve Leach	Normandeau Associates
Sarah Allen	Normandeau Associates
Semiu Lawal	Hatch
Bob Nasdor	American Rivers
Dan Sullivan	Lyme Properties 2 LLC

Introduction

John Ragonese opened the meeting with introductions and a statement regarding the intent of the meeting: a brief meeting to discuss GRH's thoughts on and interpretations of the presentation given by Pete McHugh on August 21, 2018, and how GRH intends to move forward to propose operational alternatives for analysis.

John introduced a PowerPoint presentation to illustrate agenda, concepts, and talking points for the discussion (attached here).

John with Jen Griffin and with clarifications from Pete McHugh described Dual-Flow and Two-Flow analyses to clarify the differences. Dual-Flow compares the change in habitat on a cell by cell basis. The resulting metric represents the specific habitat that persists under both a base flow and another flow. Dual-Flow is used as a method for analyzing habitat effects of changing from one flow to another on immobile species such as mussels, nest spawning fish, and some fry. Two-Flow compares the total area (AWS) of habitat at base flow and the second flow. Suitable habitat does not need to be persistent or spatially connected. Two-Flow may be appropriate for analyzing effects of different flows on mobile species which will move behaviorally to suitable habitat as it shifts (juvenile and adult fish, broadcast spawning, some fry).

Pete noted that ensuring that GRH and stakeholders are on the same page is time well spent, and confirmed the interpretations of the two techniques. He noted that they (VTFWD) usually include fry as immobile species and so would use Dual-Flow.

John explained that GRH understands that fry may not be capable of transecting the river to locate suitable habitat when previously occupied habitat becomes unsuitable due to increasing depth and/or velocity, but when habitat shifts toward newly inundated and adjacent habitats (such as shallow side of channel / bar) would be available to most fry so GRH would include fry as mobile species.

Katie Kennedy noted that both techniques are useful tools; interpretation must be based on proximity of the habitat –whether it is accessible varies with species, life history, rate of change, etc.

John presented graphical data (slides 5 and 6; combined suitability indices (CSI) plotted on cross-section of river by flow) demonstrating the connectivity of suitable habitat and described that although the graphic suggests that a substantial amount of habitat (for Tessellated Darter) is lost when transitioning from a low flow to a higher flow (1200 cfs to 4,000 cfs in this case), it is important to bear in mind that just because depth and velocity indicate suitable habitat, the species may never have occupied much of the initial suitable habitat (higher flows are the controlling factor for population at that location). The percentage loss in either Dual-flow or Two-flow calculations would overstate the base habitat loss as the base habitat would unlikely be used consistently.

Eric Davis noted, keep in mind that the data do not interpret biology.

Mellissa Grader noted that some things are not captured in these analyses. For example, a riffle with cobble substrate may provide velocity refuge.

John showed on slide 7, graphical depiction of percent of habitat remaining (from minimum flow to generation flow) by month for the suite of species/life stages from Pete's slides.

Pete noted that the slides are tricky to interpret because the denominator in the calculation of % habitat remaining changes every month. It is not a time-series and the lines are just connecting a single point for each month, not intended to indicate seasonal trends. The denominator is based on median monthly naturalized flows. The numerator is the resulting metric of either Dual-Flow or Two-Flow, so it is the persistent or available habitat, depending on mobility.

John asked how we can tell the denominator by looking at the graph.

Pete stated that we would have to look at the output table. He noted that there is a sound rationale for the denominator – it is the habitat occurring at the base (minimum flow) of a daily operational cycle. The numerator is habitat occurring at the peak of the daily cycle. This incorporates seasonal variability. The take-away is that it is a tool to look at seasonal impacts. This was not meant to indicate any flow regime proposal, but to use a real hydrologic lens to analyze.

John showed a slide (#8) with graphic of AWS by flow for a section of Bellows Falls Bypassed Reach with bimodal peak. [The initial peak occurs at relatively low flows then habitat declines as velocity / depth increase with flow until main channel bank is overtopped.] GRH is obviously more interested in the lower flow peak because it provides suitable habitat without sacrificing flow. The concept of shifting a minimum flow from 200 cfs to 1700 cfs (to achieve the second mode) is a Project breaker, economically.

Bob Nasdor stated that is seems there is an assumption that we are comparing steady state alternatives (minimum flow is consistent). We should be mindful of natural variability with high and low flows.

John noted that minimum flows to bypassed reaches are typically fixed.

John showed slides 10 – 12 that suggest the number of species modeled can be reduced in order to focus the analyses. For example, for some species with AWS curves that have the same shape, it makes sense to use one species as surrogate for others, or to combine (e.g., normalized average curves) and asked for reactions.

Pete concurred and noted that part of why it has taken a long time to get to the point of analyzing alternatives is a need to reduce the signal to noise [ratio].

John noted that GRH is not attempting to eliminate or mask anything important, but to focus the analyses to potentially identify common needs.

Mellissa stated that conceptually she agreed, but noted that GRH is focused on minimum flows, not down-ramping. Are you open to running scenarios with reduced peaks at certain times of the year?

John answered, generally no, that is a massive capacity hit, however there could be some considerations, but we need to look at the time series. It is possible that concessions such as increased minimum flow would change the probability of higher flow peaks due to water usage.

Matt Carpenter stated that more naturalized seasonal variation is important. Pete's analysis maybe shows when the greatest seasonal impacts occur. For example, during low flow periods, frequent [large magnitude] fluctuations would have greater impacts.

John asked which was more detrimental, operational range or high spill events?

Matt replied, frequent high magnitude changes are more detrimental than high flow events that recede more slowly. Katie supported Matt point.

John noted that GRH would not be proposing flow regimes that mimic natural conditions in a peaking system, but maybe the frequency and duration can be affected indirectly through other operational changes.

Matt agreed, that would be closer to natural conditions, which is what they are interested in.

John retuned discussion to species/life stages reduction, noted that to assess impacts we need to analyze time series over various hydrologies.

Mellissa noted that operational flexibility has been discussed and asked John to clarify if GRH may be willing to reduce peaks at certain times of the year but allowing for higher flows when called upon by ISO-NE?

John replied that reducing peak operating range in the license is a capacity reduction. That doesn't necessarily mean we can't attempt to describe and provide provisions for a typical and emergency operations in the license. For example, typical operation might include a minimum flow increase and ramp rate change, which could reduce the frequency and extent of high magnitude peaks on a weekly basis, but such a provision wouldn't restricted capacity to peak at the higher magnitude should we be required to or need to for economic reasons.

Bob asked John to distinguish between flexibility and capacity. If there was a cap on generation you wouldn't be able to claim a certain capacity?

John explained that GRH must prove the capacity it claims. If generation is capped, the claimed capacity is lost. In the reserve market, need to be flexible to go to peak.

Melissa noted they're looking for ways to look outside the box to address what GRH needs and what stakeholders need.

Matt noted, some common ground, down ramping rate is more important, ecologically, than up-ramping rate.

John stated next steps – GRH intends to combine/reduce species as we feel appropriate in review of shape and amplitude of curves, seasonality, etc. Then attempt to develop operational alternative scenarios based upon that information. Output from the operations model runs of these alternatives will be analyzed initially in terms of feasibility and undesirable impacts (forced spill, unit capacity exceedance). If reasonably feasible, habitat impact will be examined through time-series analysis of the model output flows for each of the 5 reaches (3 below Wilder, 1 below Bellows and 1 below Vernon) for comparison to base case. Results to be reported at next meeting, assuming it can all be done in time.

Mellissa asked if GRH is not seeking potential scenarios from agencies; Katie indicated they were waiting on GRH to prepare the first proposals. John said he wasn't shutting the door on stakeholders providing scenario, but at this point, GRH will take the lead and report back.

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Mellissa noted that this is responsive of GRH, but a subset of stakeholders plan to develop some scenarios as well.

John asked whether we are moving in the right direction. There was general agreement with the steps that he has outlined.

Matt asked if GRH understands what the agencies are looking for.

John replied that, philosophically, yes but noted that we may not be in agreement whether that can be accomplished.

Greg Comstock and Eric Davis acknowledged approval of next steps. Eric noted that minimizing curves makes sense, with caution not to eliminate important species; not so sure about normalizing.

The next meeting is scheduled for November 20, 2018.

Study 9 Instream Flow, Study 24 Dwarf Wedge Mussel
Aquatic Working Group
Study Report Consultation Meeting

October 16, 2018

Meeting Agenda

- Discussion on Stakeholder review of Study 9 report an analysis
- Developing operational alternative
- Analysis of Operational Alternative(s)
- Results from Analysis

Discussion on Stakeholder review of Study 9 report and analysis

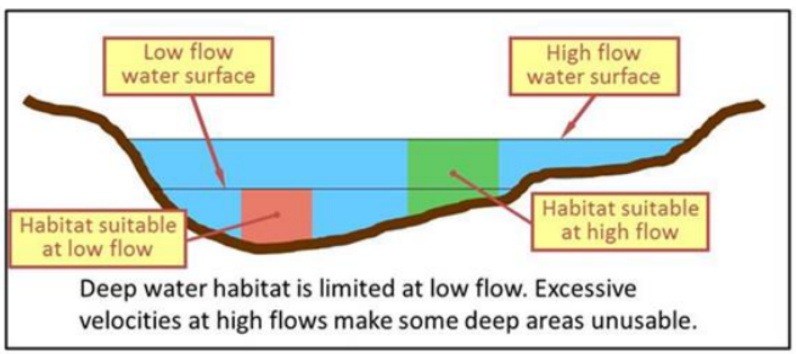
- **Dual Flow vs Two Flow**
  - **Understanding terminology, distinctions and application**
  - **What it means.**
  - **What it doesn't mean.**

Discussion on Stakeholder review of Study 9 report and analysis

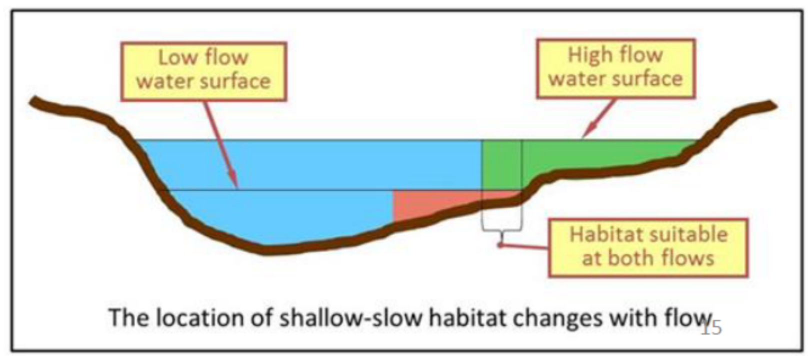
Dual flow & two flow assessments

Base Flows	Base Flow AWS	Persistent AWS (ft2/ft)									
		Peaking Flows									
		2500	3175	3850	4475	5400	6350	7025	7700	9525	11400
1300	118.0	np	np	np	59%	47%	36%	31%	27%	21%	16%
1500	115.7	np	np	np	63%	49%	38%	32%	28%	21%	17%
1750	113.3	np	np	np	68%	52%	40%	34%	30%	23%	18%
2000	110.5	np	np	np	72%	54%	41%	35%	31%	23%	19%
2250	106.0	np	np	np	75%	56%	43%	37%	32%	24%	20%
2500	100.8	np	np	np	78%	58%	44%	38%	33%	25%	20%
3000	90.8		np	np	82%	61%	47%	40%	35%	27%	21%
3500	82.9			np	85%	64%	49%	42%	37%	28%	23%
4000	75.6				88%	66%	50%	43%	38%	29%	24%
4500	67.3					67%	52%	44%	39%	30%	24%
5000	59.1					69%	53%	46%	40%	31%	25%
6000	45.6						55%	48%	42%	32%	26%

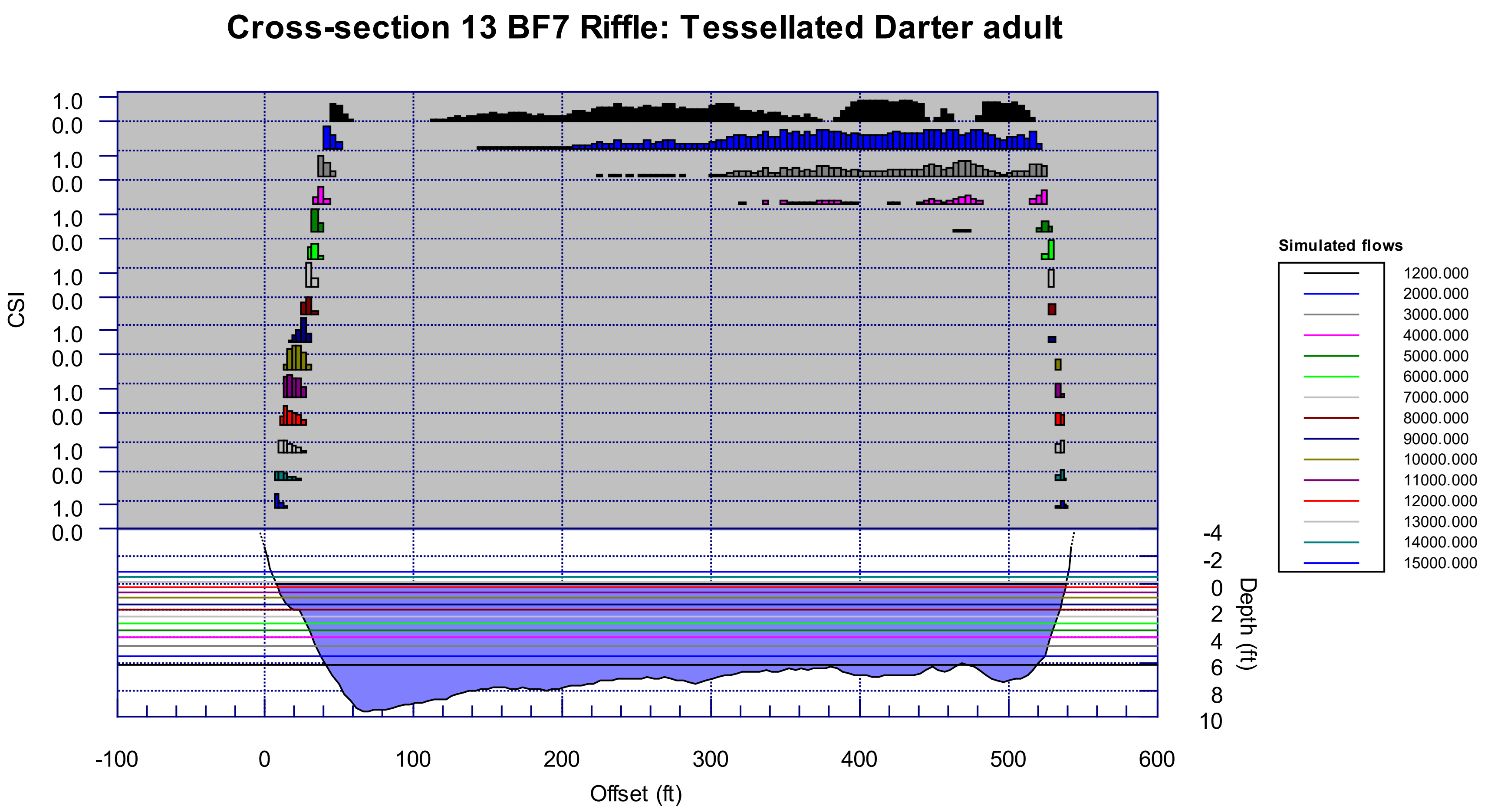
Mobile spp/stages, habitat = $\min(\Sigma H_{bi}, \Sigma H_{pi})$



Immobile spp/stages, habitat = $\Sigma(\min(H_{bi}, H_{pi}))$



Discussion on Stakeholder review of Study 9 report and analysis



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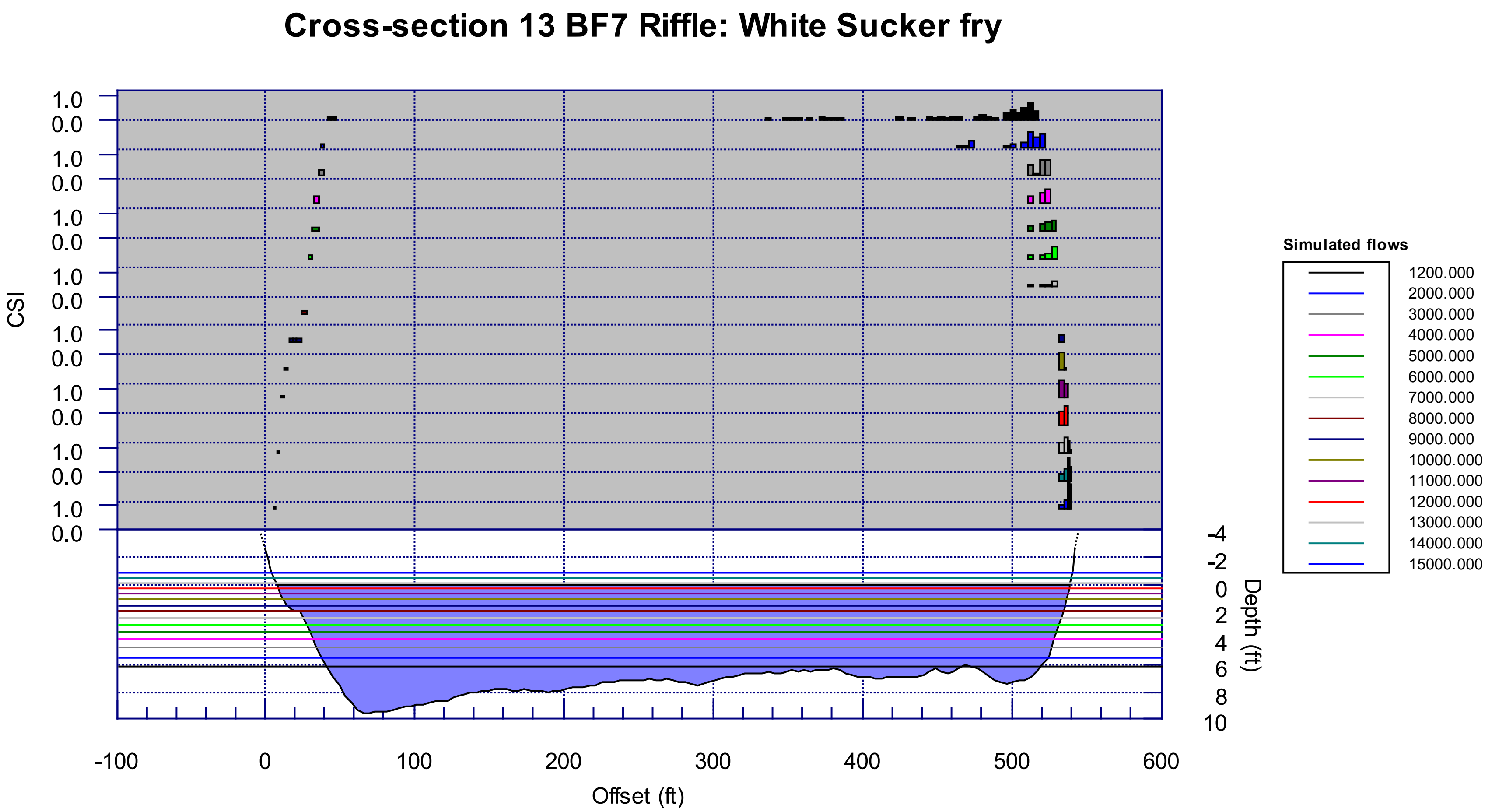

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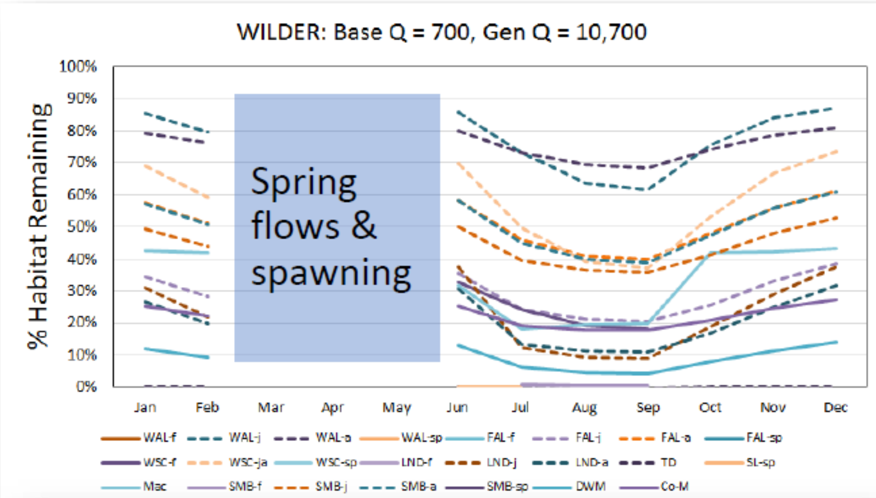

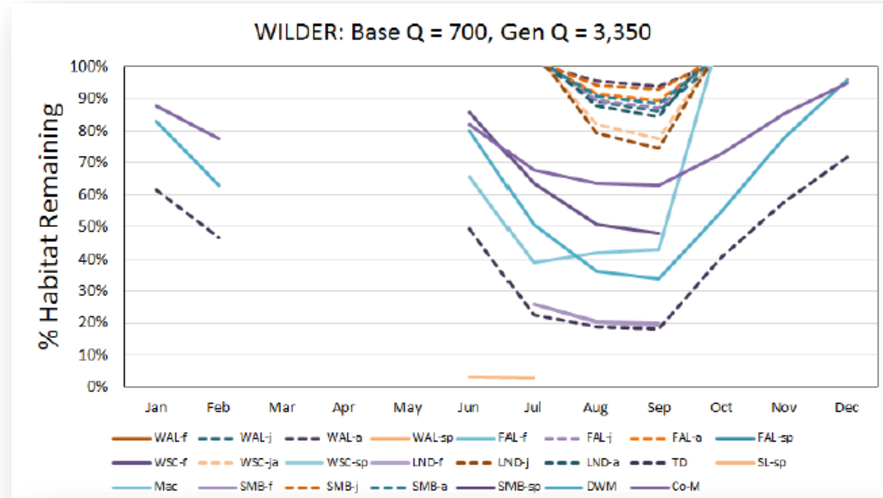

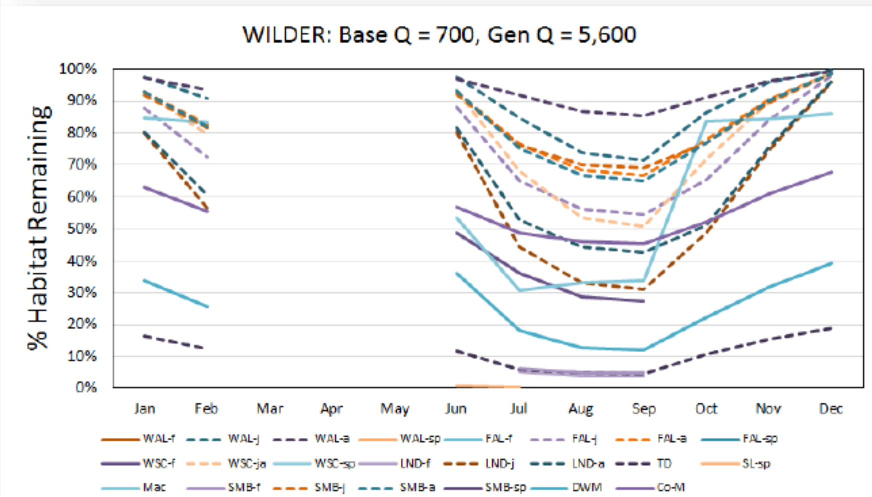

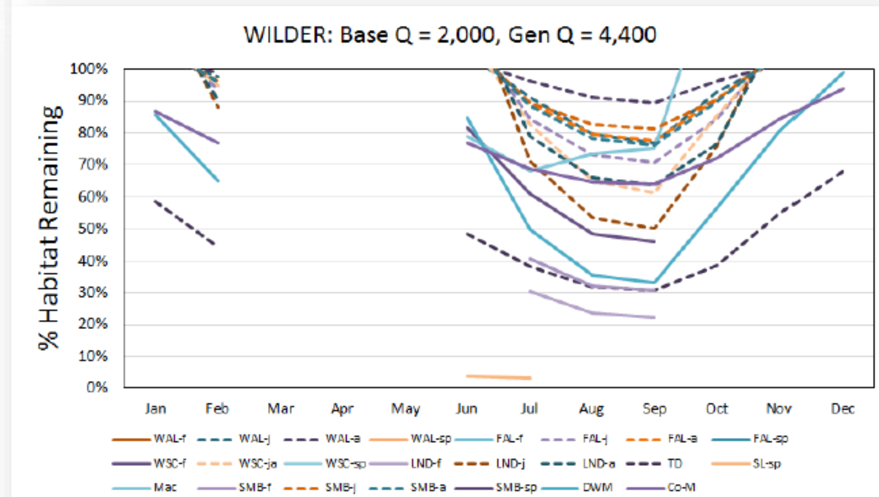

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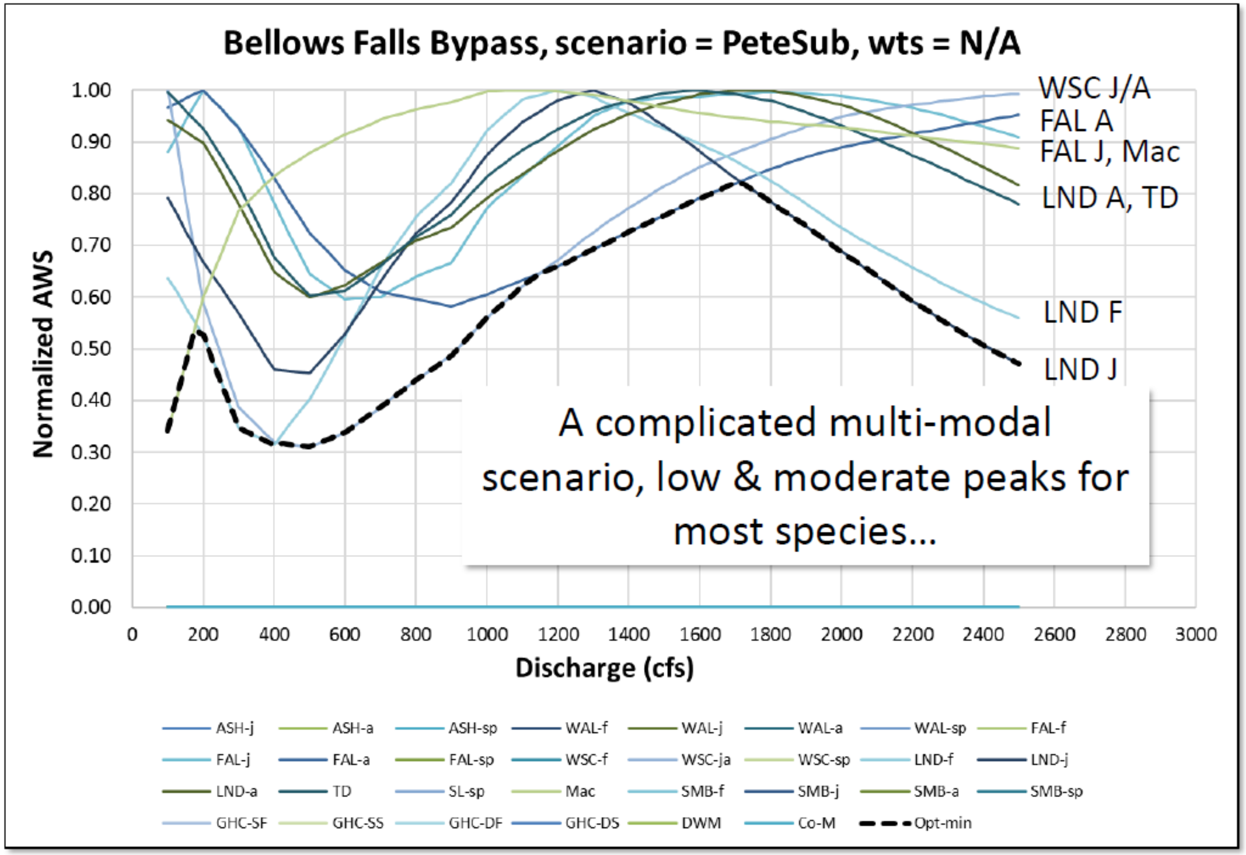
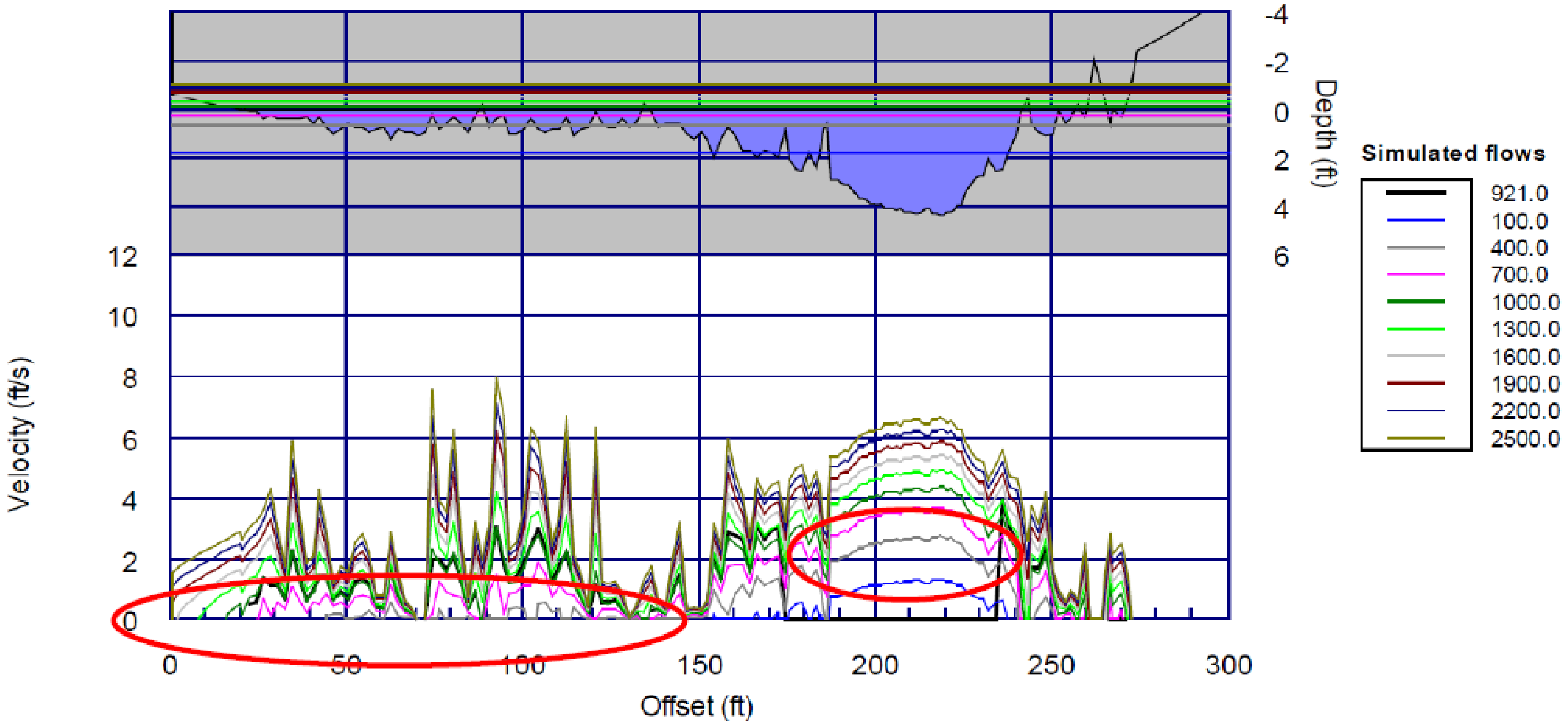
Bellows Falls Bypass

Habitat modeling results

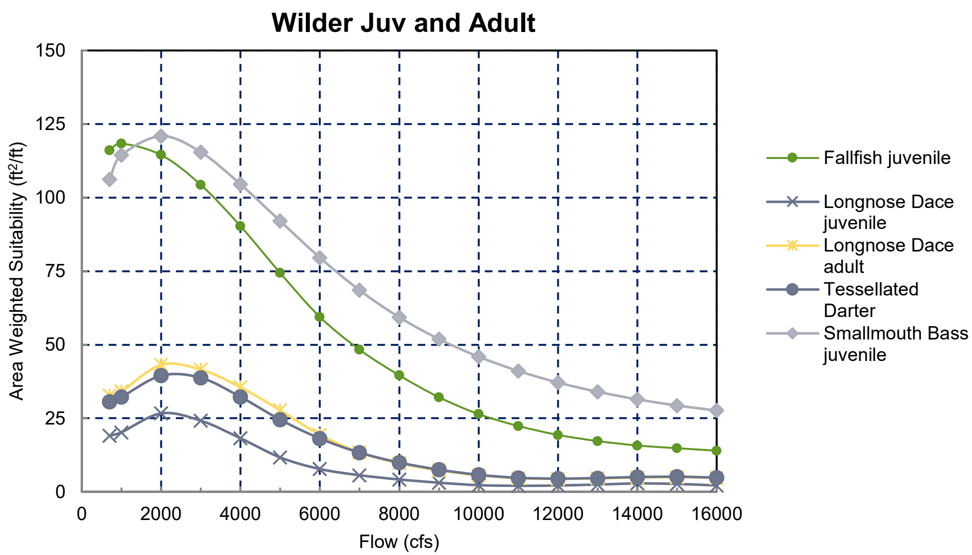


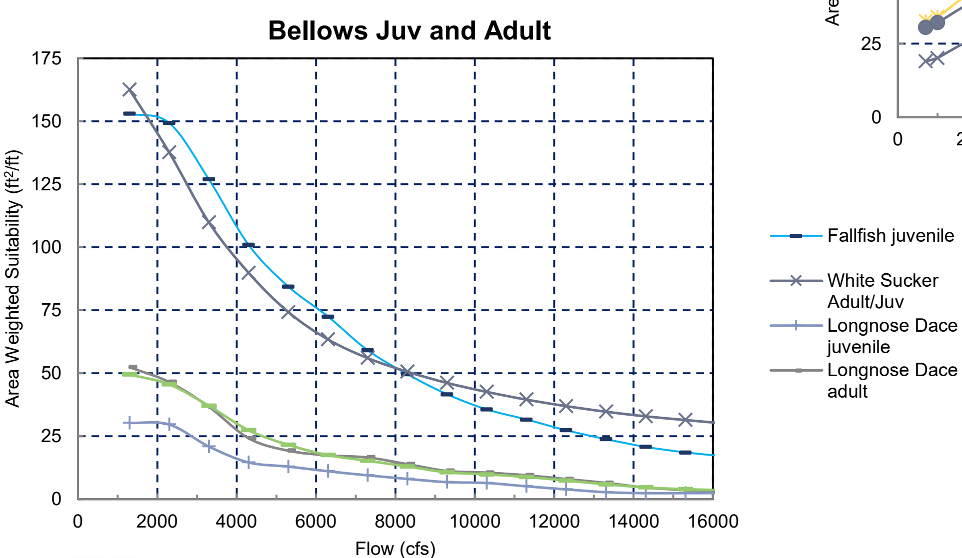
Bellows Falls Bypass



Developing operational alternative

Species and life stages can be combined based on similar AWS curves





Developing operational alternative

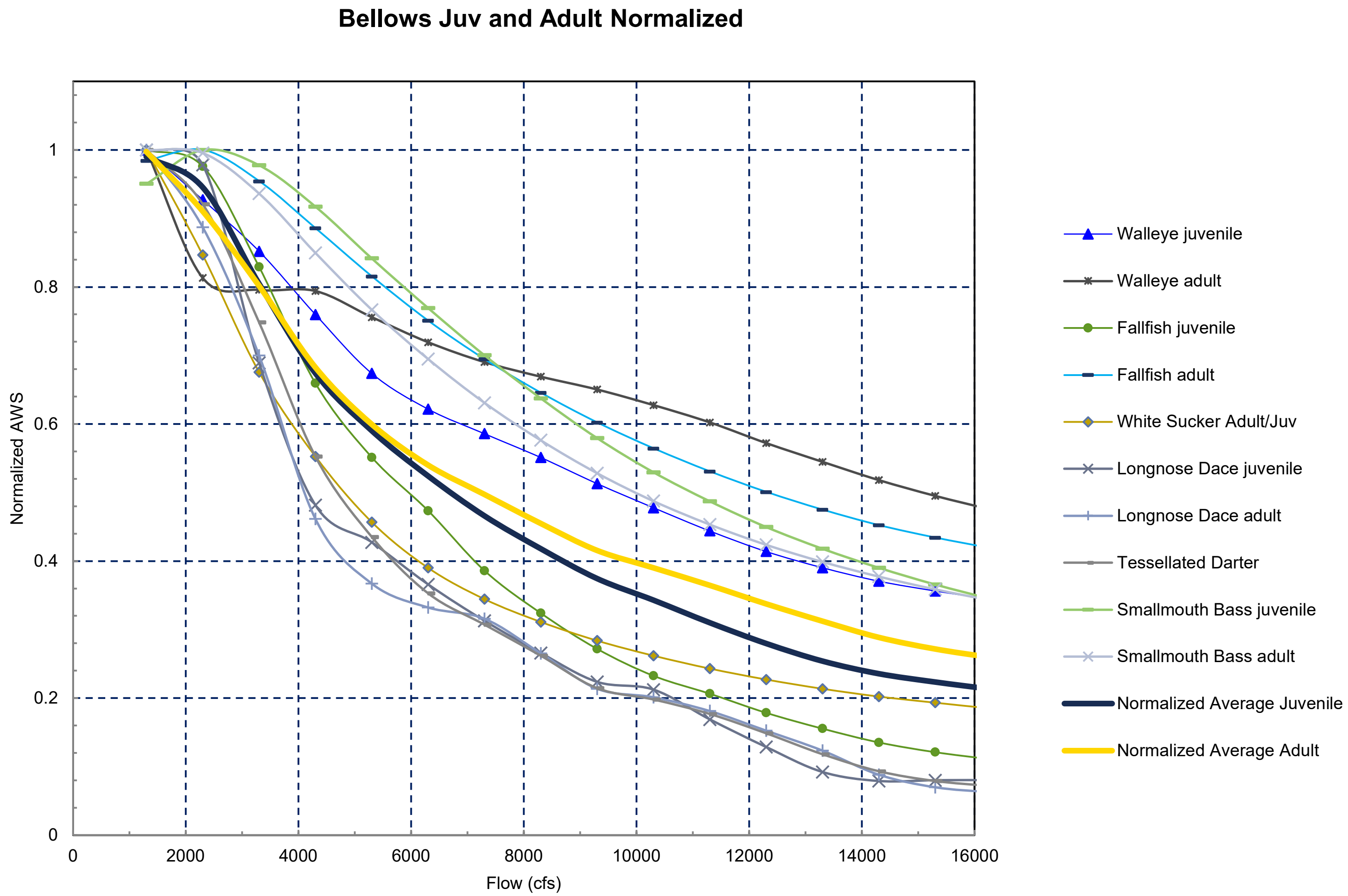
One way is to normalize and average life stages – Example juvenile and adult

Normalized Juvenile and Adult (some overlap with White Sucker)

Flow (cfs)	Walleye juvenile	Walleye adult	Fallfish juvenile	Fallfish adult	White Sucker Adult/Juv	Longnose Dace juvenile	Longnose Dace adult	Tessellated Darter	Smallmouth Bass juvenile	Smallmouth Bass adult
1300	1	1	1	0.98	1	1	1	1	0.95	1
2300	0.93	0.81	0.98	1.00	0.85	0.98	0.89	0.92	1.00	1.00
3300	0.85	0.80	0.83	0.95	0.68	0.69	0.70	0.75	0.98	0.94
4300	0.76	0.79	0.66	0.89	0.55	0.48	0.46	0.55	0.92	0.85
5300	0.67	0.76	0.55	0.82	0.46	0.43	0.37	0.44	0.84	0.77
6300	0.62	0.72	0.47	0.75	0.39	0.37	0.33	0.35	0.77	0.69
7300	0.59	0.69	0.39	0.69	0.34	0.31	0.32	0.31	0.70	0.63
8300	0.55	0.67	0.32	0.65	0.31	0.27	0.27	0.26	0.64	0.58
9300	0.51	0.65	0.27	0.60	0.28	0.22	0.21	0.21	0.58	0.53
10300	0.48	0.63	0.23	0.56	0.26	0.21	0.20	0.20	0.53	0.49
11300	0.44	0.60	0.21	0.53	0.24	0.17	0.18	0.18	0.49	0.45
12300	0.41	0.57	0.18	0.50	0.23	0.13	0.15	0.15	0.45	0.42
13300	0.39	0.54	0.16	0.48	0.21	0.09	0.12	0.12	0.42	0.40
14300	0.37	0.52	0.14	0.45	0.20	0.08	0.09	0.09	0.39	0.38
15300	0.36	0.50	0.12	0.43	0.19	0.08	0.07	0.08	0.37	0.36
16300	0.34	0.48	0.11	0.42	0.18	0.08	0.06	0.07	0.34	0.34
17300	0.33	0.46	0.10	0.40	0.18	0.08	0.06	0.07	0.33	0.33
18300	0.32	0.44	0.09	0.39	0.17	0.06	0.06	0.06	0.31	0.32
19300	0.30	0.43	0.09	0.38	0.16	0.05	0.05	0.06	0.30	0.30
20300	0.29	0.42	0.08	0.37	0.16	0.05	0.05	0.05	0.28	0.29
21300	0.28	0.41	0.08	0.36	0.15	0.05	0.04	0.05	0.27	0.29
22300	0.27	0.40	0.07	0.36	0.15	0.05	0.04	0.05	0.26	0.28
23300	0.26	0.39	0.07	0.35	0.14	0.04	0.03	0.04	0.25	0.27
24300	0.25	0.38	0.06	0.34	0.13	0.04	0.03	0.04	0.25	0.26
25300	0.24	0.37	0.06	0.34	0.13	0.03	0.03	0.03	0.24	0.26

Normalized Average Juvenile	Normalized Average Adult
0.99	1.00
0.95	0.91
0.80	0.80
0.67	0.68
0.59	0.60
0.52	0.54
0.47	0.50
0.42	0.45
0.37	0.42
0.34	0.39
0.31	0.36
0.28	0.34
0.25	0.31
0.24	0.29
0.22	0.27
0.21	0.26
0.20	0.25
0.19	0.24
0.18	0.23
0.17	0.22
0.17	0.22
0.16	0.21
0.15	0.20
0.15	0.20
0.14	0.19

Developing operational alternative



Developing and Analyzing operational alternatives

- Combine as best we feel is appropriate
  - Shape
  - Amplitude
  - Seasonality
- Look for distinct flow needs
- Will unlikely limit max station flows
- Sensitivity versions
- Output analyzed in terms of feasibility and impacts
- Output run though Time series analysis
- Comparison to Base Case time series
- Report out at next meeting