Great River Hydro
ILP Study 9 Instream Flow Consultation Meeting
GRH Wilder VT conference room
Tuesday, August 7, 2018, 9:30 am - 3:00 pm

Meeting Notes

A consultation meeting was held August 8, 2018 at Great River Hydro's Renewable Operations Control Center in Wilder, VT to discuss agencies findings regarding instream flow effects.

Meeting attendees in person or identified on the telephone:

Name	Affiliation
Jeff Crocker	VT ANR (via phone)
Melissa Grader	FWS (via phone)
Ken Sprankle	FWS (via phone)
Mark Wamser	Gomez & Sullivan (via phone)
Jim McClammer	CRJC (via phone)
Andrea Donlon	CRC (via phone)
Semiu Lawal	Hatch (via phone)
Eric Davis	VT ANR
Norman Sims	American Whitewater
Lael Will	VTFWD
Katie Kennedy	TNC
Nicole Palmer	TNC
Gregg Comstock	NHDES
Matt Carpenter	NHFGD
Edwin Nason	GRH
John Hart	Gomez & Sullivan
Bob Nasdor	American Rivers
Steve Leach	Normandeau Associates
John Ragonese	GRH
Jen Griffin	GRH
Sean Keniston	GRH
Pete McHugh	VTFWD
Kathy Urffer	CRC

Introduction

John Ragonese opened the meeting and called for introductions by those participating via call in and around the table. He reviewed the last (June 8, 2018) meeting noting that agency/stakeholder wants regarding flows were discussed. He noted that GRH had no specific agenda for this meeting other than to provide an opportunity for VANR and stakeholders to discuss their initial review of Study 9 and other habitat study results and it was handed off to Pete McHugh to lead their review presentation.

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VANR Presentation

Pete McHugh presented a report of agency progress (attached) in review of Study 9, noting that the overall presentation had not yet been reviewed by the full Aquatics Working Group (AWG), but much of the material had been shared and discussed. Generally, everyone should view this as a work product, subject to change. He noted that the AWG task is to make recommendations regarding conservation flows, peaking operations, and impoundment WSE fluctuation considerations with reasonable assurance of meeting state water quality standards, federal protected species (ESA), and other laws. He noted that fish passage related flows were not being discussed in this meeting.

Ken Sprankle commented that CRASC has no plans to expand shad restoration beyond their historic range the falls between Bellows Falls and North Walpole; CRASC will not be looking for shad passage at Bellows Falls.

Pete noted that studies are largely complete and that reports and datasets have been shared by GRH. The AWG stakeholders convened to review flow and passage study results and discuss potential for flows to meet objectives.

Pete presented their assessment of the data (presentation attached). The stated goals of the presentation were to: (1) summarize key modeling results and other hydrological and biological factors that VANR is considering it its evaluation of the current license proposal included in GRH's license application, and (2) facilitate discussion on key findings and possible next steps towards identifying operating conditions that are protective of riverine resources and aquatic habitat, and maintain water quality levels that support designated and existing uses.

Notably, Peter indicated that a proposed operating regime is assumed to provide adequate protection if it (1) results in minimum habitat impact (defined by Study 9, instream flow) or (2) if executed in a way consistent with the river's natural flow regime (i.e., frequency, magnitude, and rate of change); but that the two could provide contradictory results. Have more information for instream flow, not so much for natural flow.

The assessment was mostly based on Study 9. The steady state model (flow vs. habitat) can be used for the Bellows Falls bypassed reach and minimum flows. For peaking operations, more useful to look at dual flow (immobile species) & two-flow (mobile species). 26 flows were modeled for 27 species/life stages on 44 transects. The assessment considered different flow pairs to compare relative impact on quantity and quality (based on suitability curves) of habitat available to a species or species group (slides 16-20). Discussion around how the assessment compared with collection studies, for example, the assessment showed little increase in % habitat remaining with increased flows for tessellated darter, yet the species was collected in all reaches and in high numbers in many reaches. This generated a conversation of suitability curves, whether a population is distressed due to operations as compared to whether indexed habitat is reduced and the need to consider all available data when moving from an assessment like this, to flow recommendations.

Bob Nasdor commented that the assessment assumes more habitat is better or required, how does it consider that some species have plenty of habitat under current operations? Peter responded that it's not an assessment of a species population, but of habitat availability.

Norm Sims remarked that FirstLight is focusing on specific species to determine flows. Ken responded that there are endangered species in that area that are being focused on, but up here looking at groups of species.

Slides 22-25 considered hydrology, using TNC's CRUISE model natural hydrology dataset to identify bounds for operations, noting challenges of: defining baseline, implementing without increasing variability, requires useable storage, does not address impoundment effects.

Slides 26-34 assessed species, habitat and flow in the Bellows Falls bypassed reach. Because of the prominence of a double channel and deep pool in this reach, available habitat decreased and then only increased slightly as flow increased. Bob and Norm noted that the assessment was done with the fish dam in place and wondered how it would change if the dam was removed.

Next steps (slide 40): consider hydraulic habitat conditions (study 9), hydrologic considerations (seasonality, generation frequency, and magnitude, rate of change, duration, and incoming flows), compatibility with desire for operational flexibility, other study considerations, and potential priority areas.

Continued Discussion

Bob asked about a filing date of an amended FLA, and whether flow requirements will be incorporated by general agreement.

John Ragonese noted that an amended final application filing would be on a schedule with FirstLight's amended FLA filing and confirmed that GRH would like to reach agreement regarding operational regimes for including in the amended FLA, which would ideally also be incorporated in the state 401 WQC's.

John Hart noted that FirstLight intended to file by June 30, 2019.

John Ragonese asked, what are the next steps from Stakeholder's perspective?

Mellissa Grader responded that without process of Settlement, we have to propose a mutually agreeable operations regime. It is not clear where we are toward that goal as no one has put flow numbers on the table. Not sure what the process is for taking that next step.

Bob noted that the process could help develop guidance - principles and priorities that would eventually guide proposals.

Andrea Donlon noted that Settlement has some formality, but our discussion has no structure.

John Ragonese disagreed that there is no structure, responding that FERC has given the AWG an opportunity to investigate study results and continue the Study 9 comment period. This allows us to assess potential alternative flows and operations in a formal FERC ILP consultation setting. GRH intends to file an amended FLA. Stakeholders will have an opportunity to comment on that. Settlement isn't part of the ILP process and therefore, there is no specific FERC time-period or process. Moving forward as we are does not preclude Settlement but in GRH's opinion, lacking better understanding of Study 9 and how alternative operating scenarios might impact habitat and project values, it is premature to suddenly enter into Settlement discussions.

Matt Carpenter suggested that GRH should propose operational regimes, generally understanding what the agencies want, but incorporating GRH's desired flexibility / constraints [to the extent possible].

Kathy Urffer suggested, and Eric Davis agreed that GRH consider as a first step, to develop a 'straw-man' [conceptual diagram] proposal – a schematic that describes triggers and limitations (incorporates ramping rates, minimum flows, habitat, market, etc.). John Ragonese agreed that might be a good way to better define and describe the various aspects incorporated in GRH's need for some flexibility.

Action Items

- 90-day update due for filing August 13, if made available, Peter McHugh's Presentation given in this meeting will be included in update.
- GRH will draft meeting notes with action steps [herein].
- GRH examine how to develop a 'straw-man' template that presents a hypothetical alternative operating plan and identifies the necessary flexibility that would be needed to accommodate the important values and markets critical for the hydro projects. Present the template at the next meeting before running it through the model.
- Meet monthly to discuss proposed model runs / results.
- Next meeting scheduled for Tuesday, September 11, 2018.
- Placeholder meeting dates have also been identified for October 16, and November 20.

VERMONT

Vermont Department of Environmental Conservation *Agency of Natural Resources*
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Montpelier, Vermont 05620-3522 [fax] 802-828-1544
watershedmanagement.vt.gov

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August 8, 2018

John Ragonese
FERC License Manager
Great River Hydro, LLC
One Harbour Place, Suite 330
Portsmouth, NH 03801

RE: Wilder, Bellows Falls, and Vernon Hydroelectric Projects (FERC Nos. 1892, 1855, & 1904)
Aquatics Working Group Presentation Materials

Dear John,

Please find enclosed the materials prepared by the Vermont Agency of Natural Resources and presented to Great River Hydro and the Aquatics Working Group on August 7, 2018. The presentation summarizes the Agency's ongoing review of Study 9 (Instream Flow) and related studies conducted in support of the relicensing of the Vernon, Bellows Falls, and Wilder hydroelectric projects. The goals of the presentation were to: (1) summarize key modeling results and other hydrological and biological factors that VANR is considering it its evaluation of the operations proposal including in the GRH's draft license application, and (2) facilitate discussion on key findings and possible next steps towards identifying operating conditions that are protective of riverine resources, aquatic habitat, and maintains a level of water quality that supports designated and existing uses.

Very truly yours,

Eric Davis
River Ecologist

Enc: Appendix A: Vermont ANR Study 9 Progress Report

c: Jennifer Griffin, Great River Hydro
Pete McHugh, Vermont FWD
Jeff Crocker, Vermont DEC

APPENDIX A

VERMONT ANR STUDY 9 PROGRESS REPORT

Progress report from Vermont ANR on the review of Study 9 results

August 7, 2018

Great River Hydro Operations Center

Wilder, Vermont

Overview of presentation

- Recap of tasks, work done to date, data sharing, etc.
- Context:
  - Hydrology and biology
  - Proposed operations
- Review of Study 9 (instream flow study) & key findings:
  - Evaluation of proposed operations (all projects, but Wilder as example)
    - Steady state (conservation flows)
    - Dual flow analysis (habitat in light of hydropeaking cycle)
  - Evaluation of Bellows Falls bypass reach (steady state)
- Concerns emerging from review of other studies
- Where to from here?

Study 9 Review Tasks

To evaluate whether the relicensing proposal has a reasonable assurance of satisfying state and federal laws, including State WQ standards, State & Federal ESAs, other relevant laws, in terms of:

a) Conservation flows
b) Hydropeaking operations
c) Impoundment considerations
d) [fish passage]

Work completed to date

- Studies largely complete, reports and relevant datasets have been shared by GRH
- The working group has convened several times in the last 14 months to:
  - Review flow and passage study results
  - Review supplemental studies
  - Discuss the ability of the relicensing proposal to provide necessary protections

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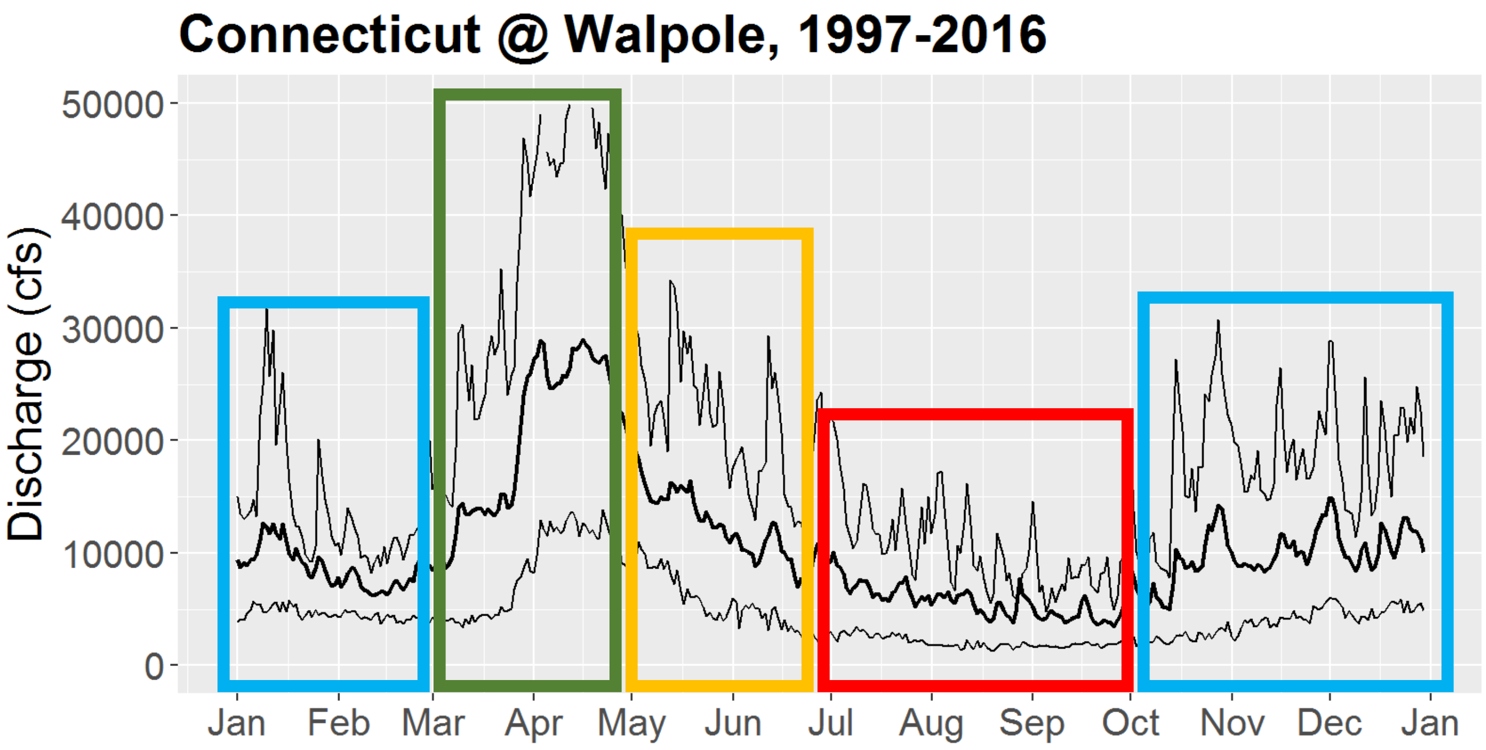
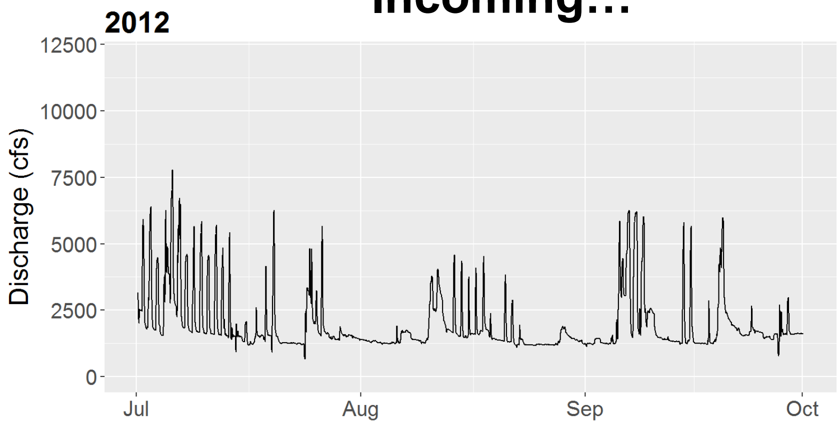


Hydrology context

- ~4 hydro-biological periods
  - Winter (Oct-Feb)
  - Early spring (Mar-Apr)
  - Late Spr./Early Sum. (May-Jun)
  - Summer (Jul-Sep)
- Altered incoming hydrology
  - Storage reservoirs
  - Peak generation (~1,000 / 6,000 cfs cycle from McIndoes)

Incoming…



Within VBW reach…

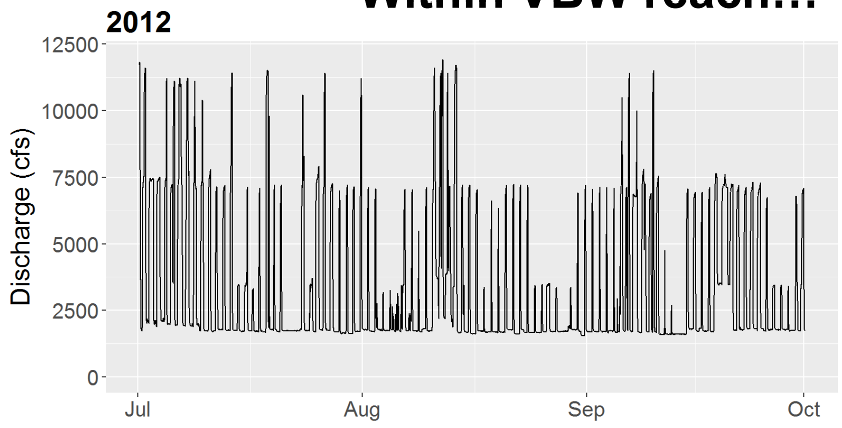


Table 2.1. Timing of key life history events, in full months; see Table 1.1 for sub-monthly life history details. The 1997-2016 daily median discharge at Walpole, rounded to the nearest 100 cfs, is provided below each month for considering linkages between life history and hydrology.

Species	Life stage	Jan 7,700	Feb 6,200	Mar 10,800	Apr 22,700	May 12,500	Jun 7,900	Jul 5,000	Aug 3,700	Sep 3,100	Oct 5,200	Nov 7,700	Dec 8,800
American Shad	Juvenile												
	Adult												
	Spawning												
Walleye	Fry												
	Juvenile												
	Adult												
	Spawning												
Fallfish	Fry												
	Juvenile												
	Adult												
	Spawning												
White Sucker	Fry												
	Juv/Ad												
	Spawning												
Longnose Dace	Juvenile												
	Adult												
	YOY												
Tessellated Darter	Adult												
Sea Lamprey	Spawning												
Smallmouth Bass	YOY												
	Juvenile												
	Adult												
	Spawning												
Macroinvertebrates	all aquatic												
Rainbow Trout	Adult												
Dwarf Wedgemussel[1]	Adult												
Co-occurring Mussels	Adult												

[1]Reproduction occurs summer/fall; glochidia release occurs in the following spring (March-June)

Biological context

- Native riverine & diadromous species
- Important sportfish
- Species of conservation concern:
  - DWM
  - Sea Lamprey
- Macroinvertebrates
- Seasonal presence/ significance

Current/proposed operations

Wilder Project: 675 cfs / 10,700 cfs

(conservation flow / max generation flow)

Bellows Falls Project: 1,083 cfs / 11,400 cfs

Bellows Falls bypass flow: leakage (100-300 cfs)

Vernon Project: 1,250 cfs / 17,100 cfs

(Note: other constraints also apply, e.g., drawdown rates, flood profile, etc.)

This is the operating regime included the draft license application; alternatives may be feasible, but this is what we have to work with currently.

Assessment of proposed operations

A proposed operating regime is assumed to offer adequate resource protection if it meets on of these conditions:

- If it has a minimal impact on the habitat of modeled species (assess using the **Study 9** steady state & dual flow/two flow results, other studies)

OR

- If it is executed in a way that's consistent with the river's natural flow regime, i.e., frequency, magnitude, rate of change, etc.

Overview of presentation

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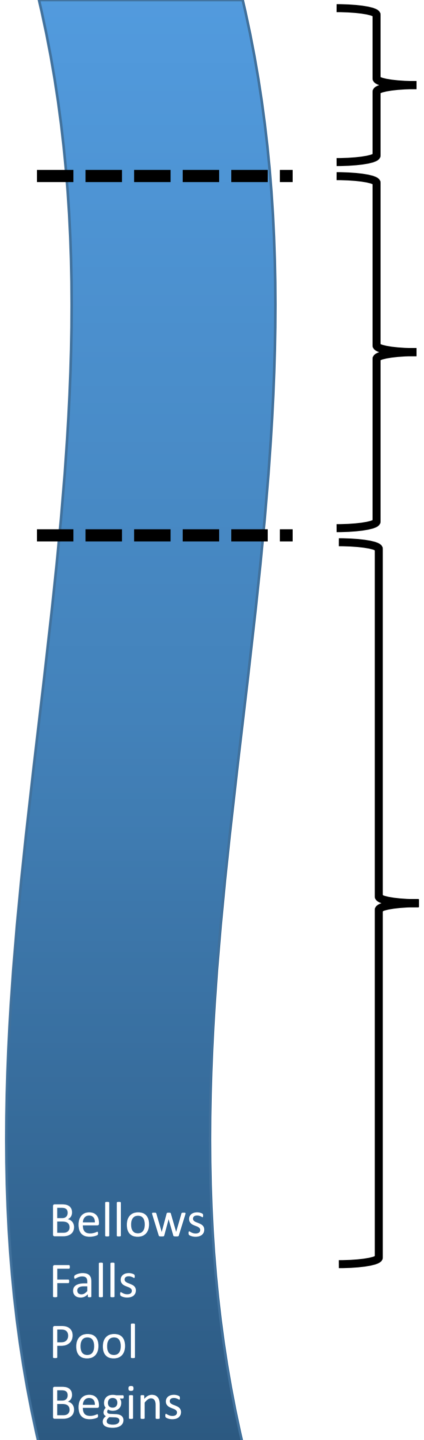
- Where to from here?

Insights from instream habitat modeling

- Steady state model results (flow vs. habitat relationships)
- Dual flow (immobile species), two flow (mobile species)
  - Evaluate base/peak pairs and assess habitat impacts
  - Problems/challenges:
    - Denominator in '% habitat remaining'…lots of options, habitat at base, ave Q, or FMF incoming? (not a determining factor ultimately…)
    - Setting a specific bar for what constitutes a 'minimal impact'
    - Hydrologic & storage constraints will eliminate some base-peak pairs
- Impoundment fluctuation not assessed here



Wilder 1: Wilder Dam to White River:

- 1.5 mi (8%), 12 x 1D transects; pool & run habitat
- Negligible flow accumulation (= Accretion), $Q_{Trans} = Q_{WD}$

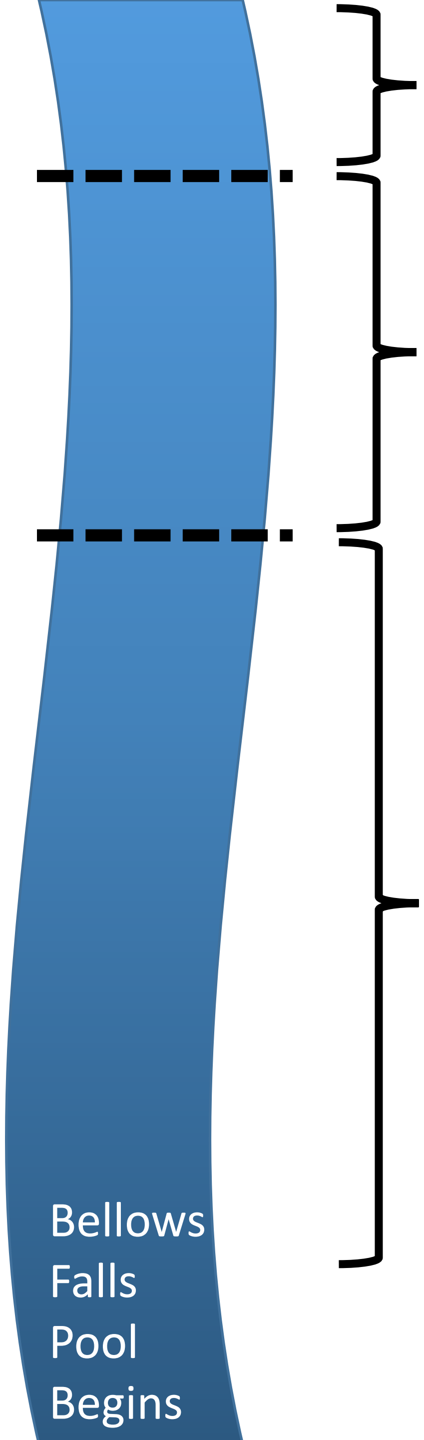
Wilder 2: White R to Ottauquechee R:

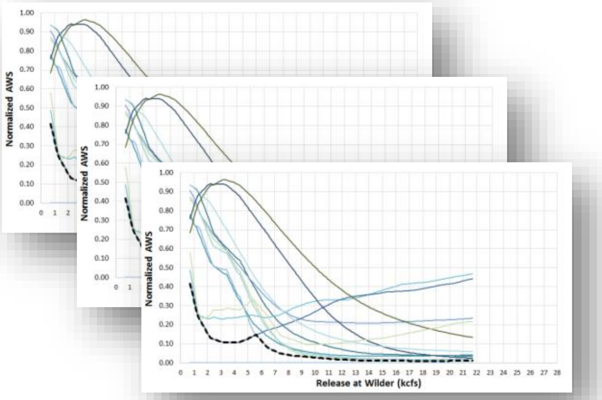
- 5.2 mi (29%), 16 x 1D transects; more habitat diversity & a 2D modeling site (Johnston Island)
- 600-2,500 cfs gained, depending on season, $Q_{Trans} = Q_{WD} + Q_{add1}$

Wilder 3: White to Ottauquechee segment:

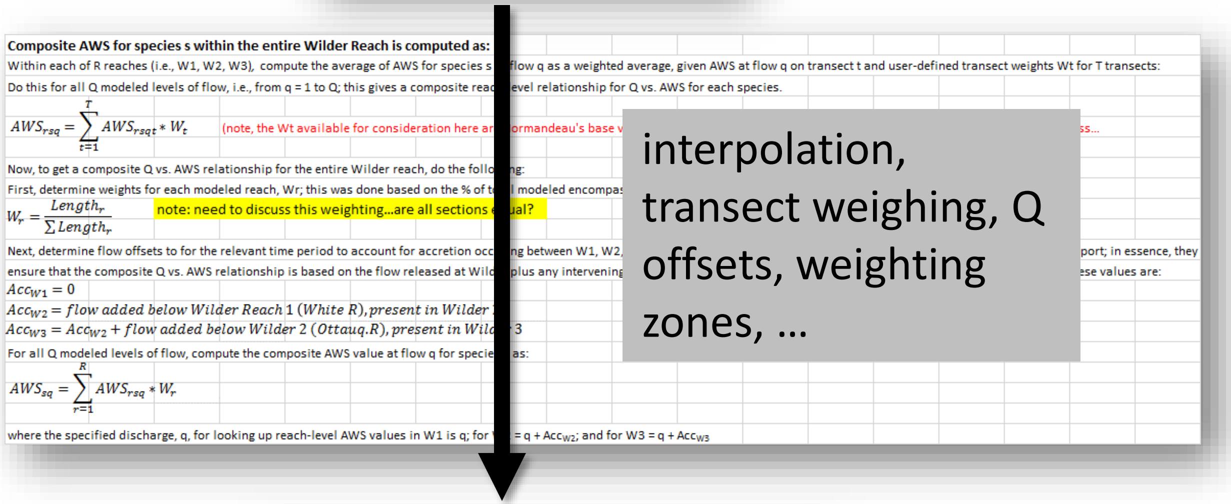
- 11 mi (63%), 16 x 1D transects; more habitat diversity & a 2D modeling site (Chase Island)
- Accretion: 800-3,300 cfs, depending on season , $Q_{Trans} = Q_{WD} + Q_{add1} + Q_{add2}$

26 flows (700-25,000 cfs) were modeled for 27 sp. on 44 transects, with 4 sets of weights…

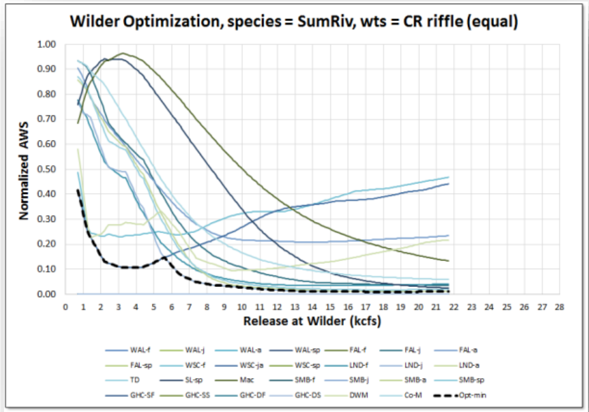




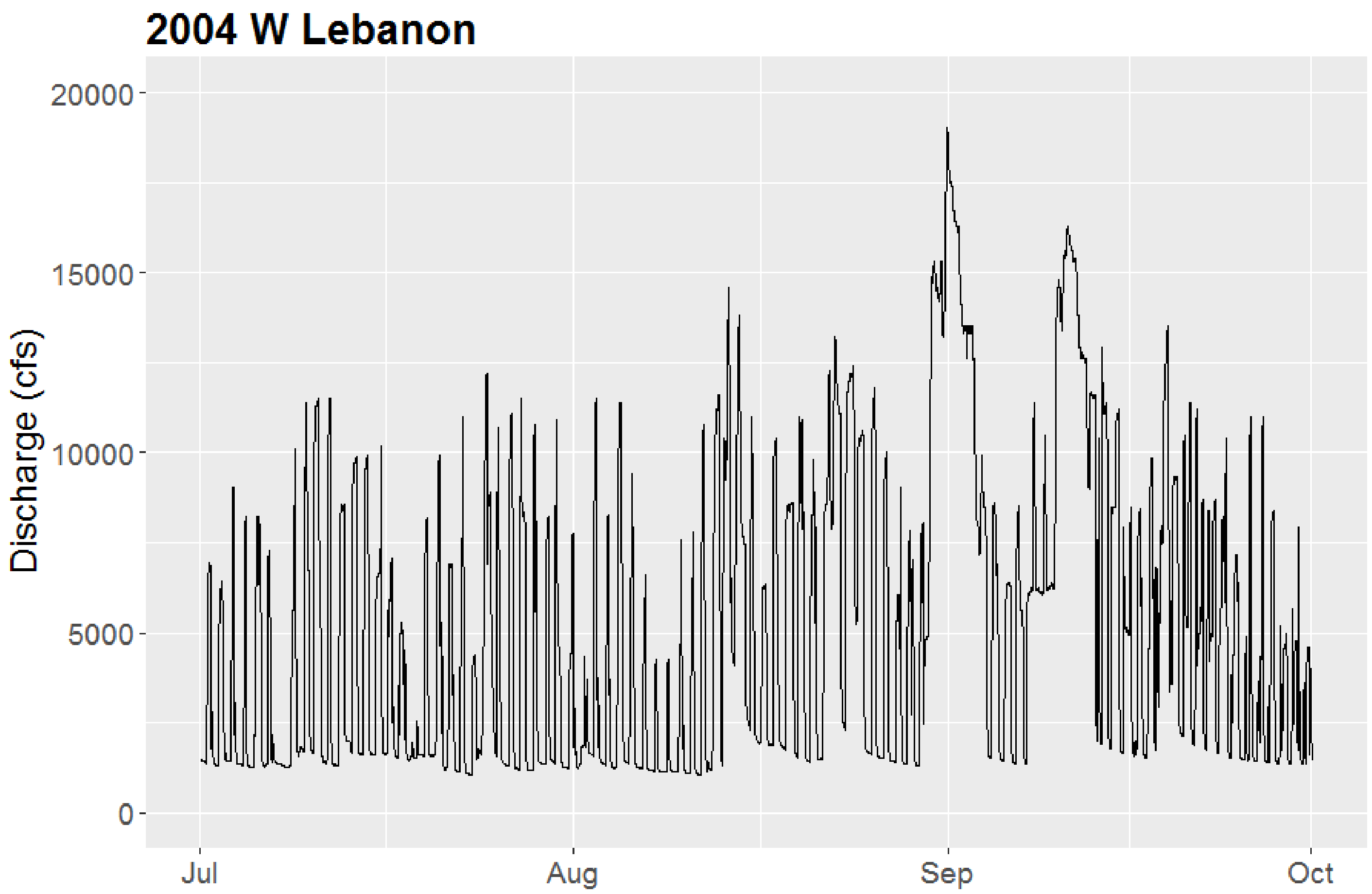
Transect & zone relationships



interpolation, transect weighing, Q offsets, weighting zones, …



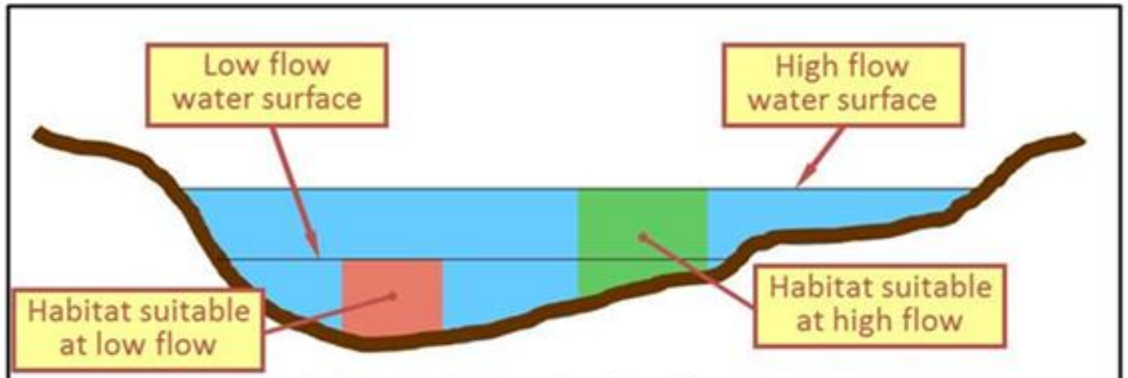
Composite Q vs. habitat relationship


2004 W Lebanon
Discharge (cfs)
20000
15000
10000
5000
0
Jul
Aug
Sep
Oct

Dual flow & two flow assessments

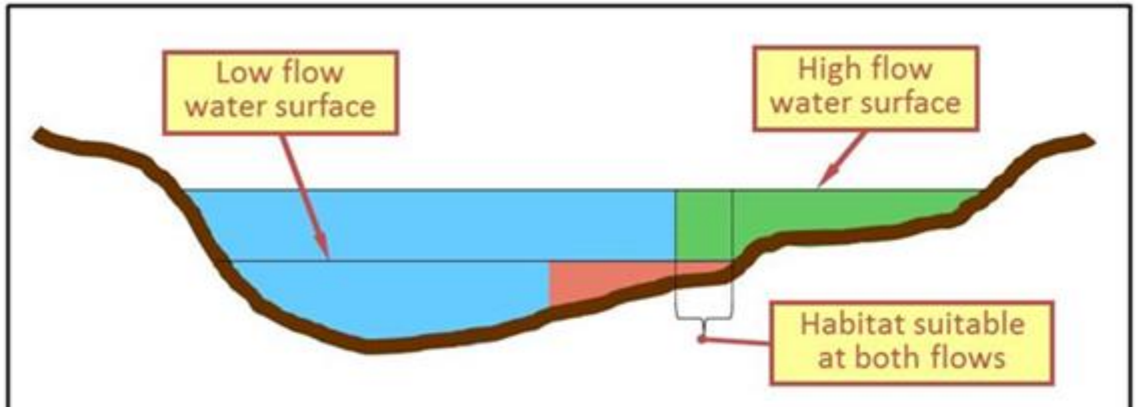
Base Flows	Base Flow AWS	Persistent AWS (ft2/ft) Peaking Flows									
		2500	3175	3850	4475	5400	6350	7025	7700	9525	11400
1300	118.0	np	np	np	59%	47%	36%	31%	27%	21%	16%
1500	115.7	np	np	np	63%	49%	38%	32%	28%	21%	17%
1750	113.3	np	np	np	68%	52%	40%	34%	30%	23%	18%
2000	110.5	np	np	np	72%	54%	41%	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 = $\min(\Sigma H_{bi}, \Sigma H_{pi})$

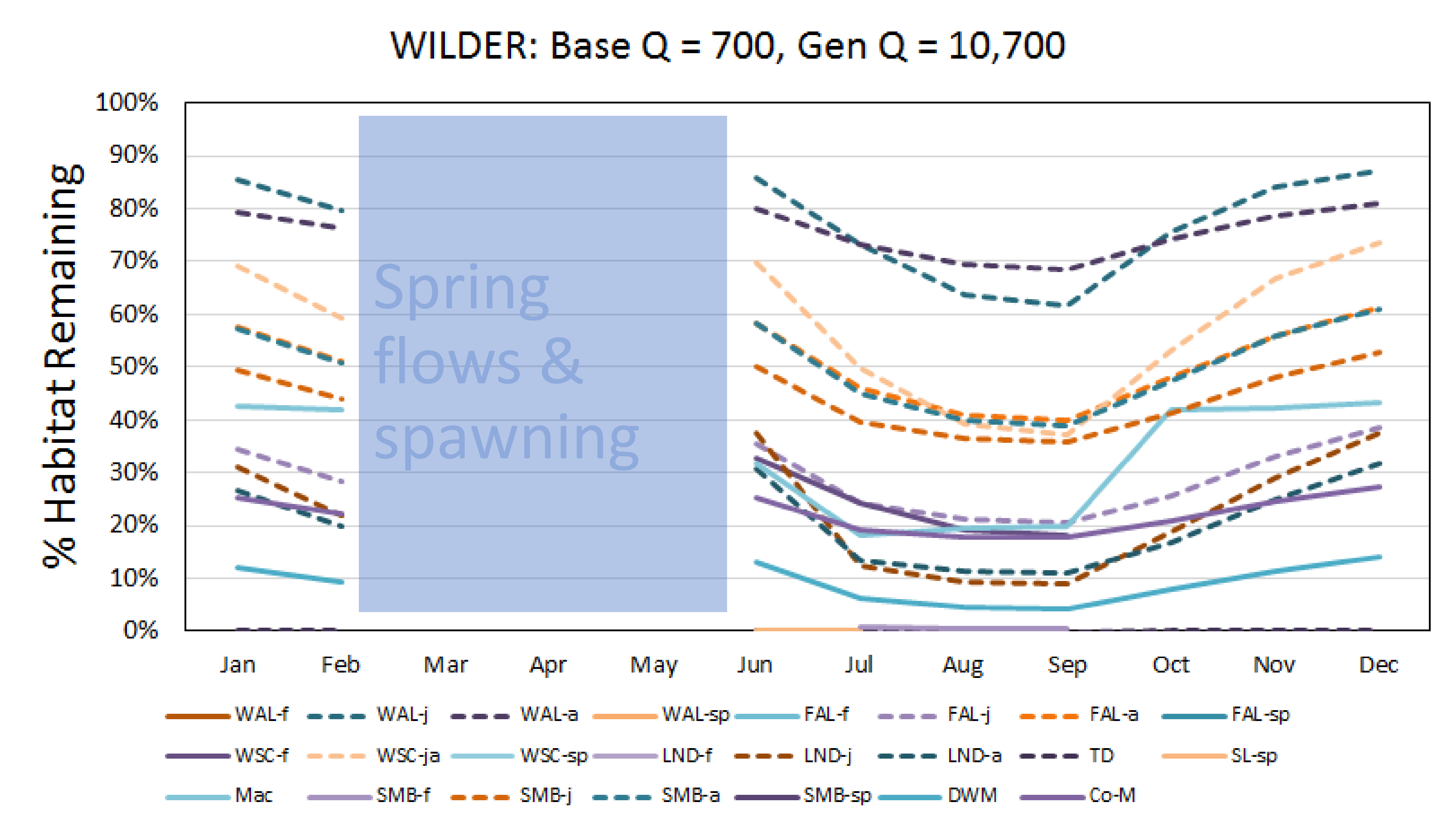


Deep water habitat is limited at low flow. Excessive velocities at high flows make some deep areas unusable.

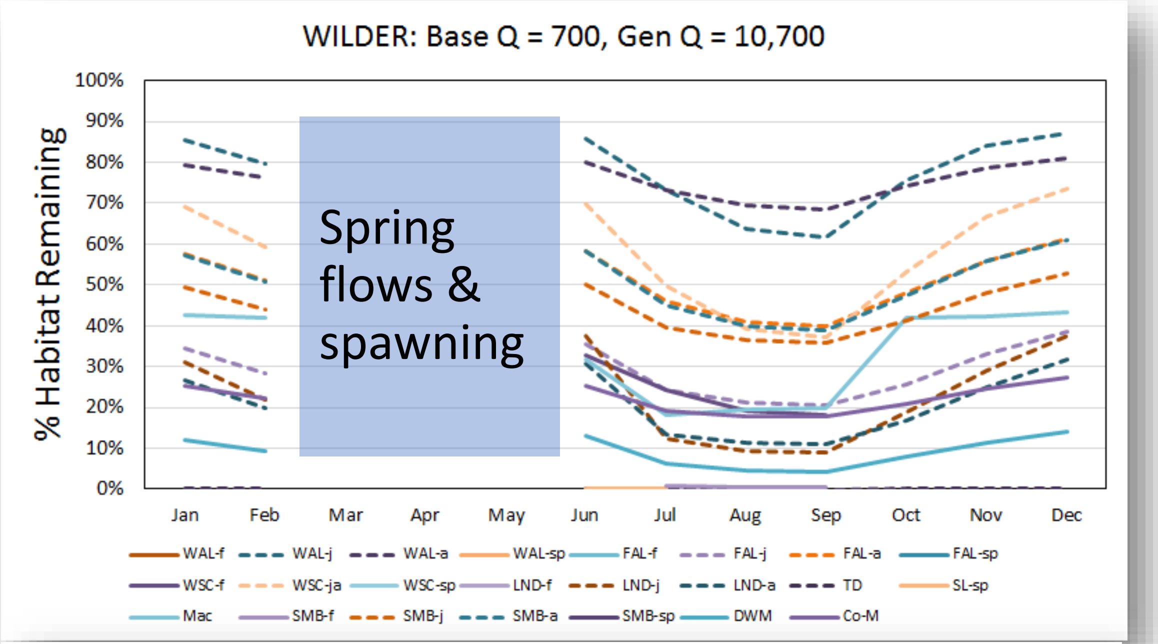
Immobile spp/stages, habitat = $\Sigma(\min(H_{bi}, H_{pi}))$

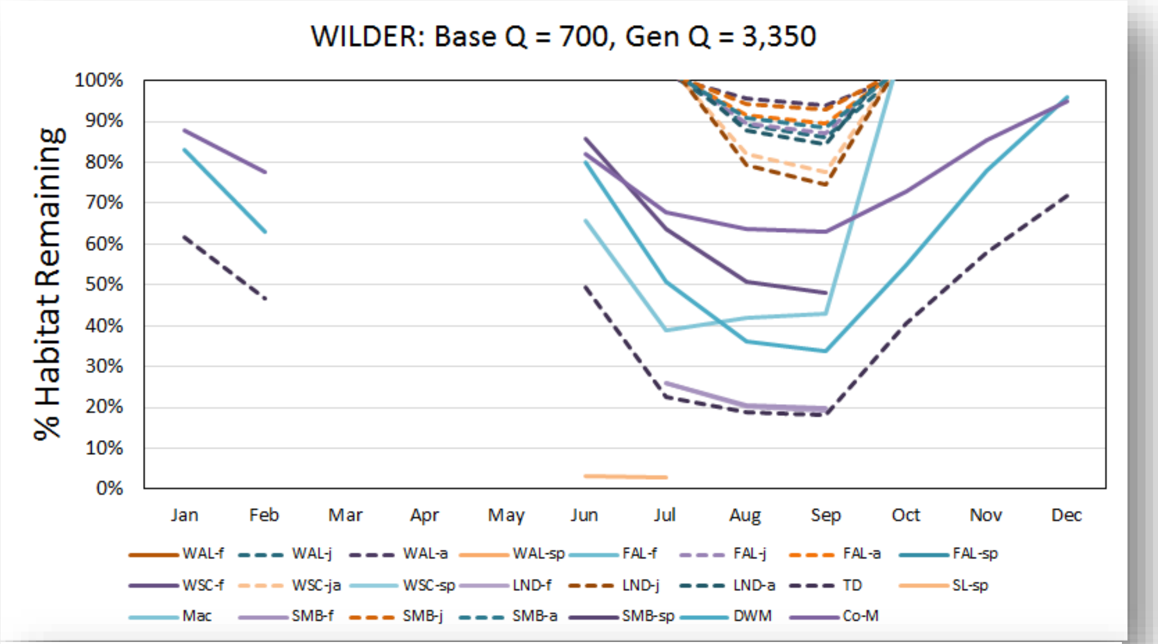


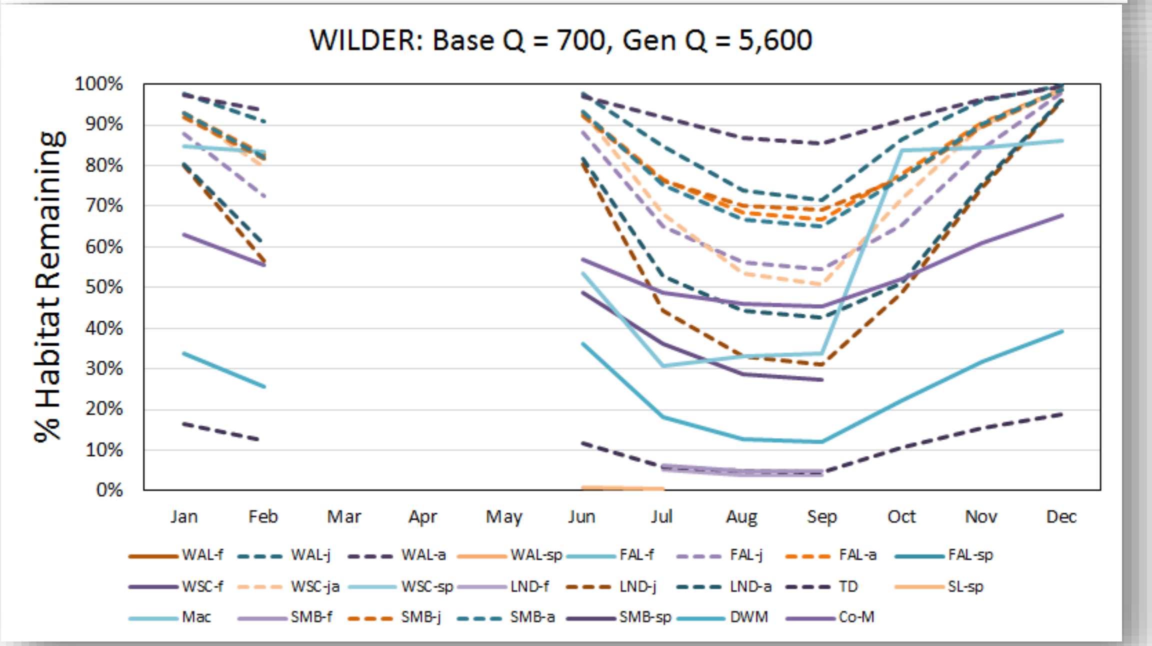
The location of shallow-slow habitat changes with flow

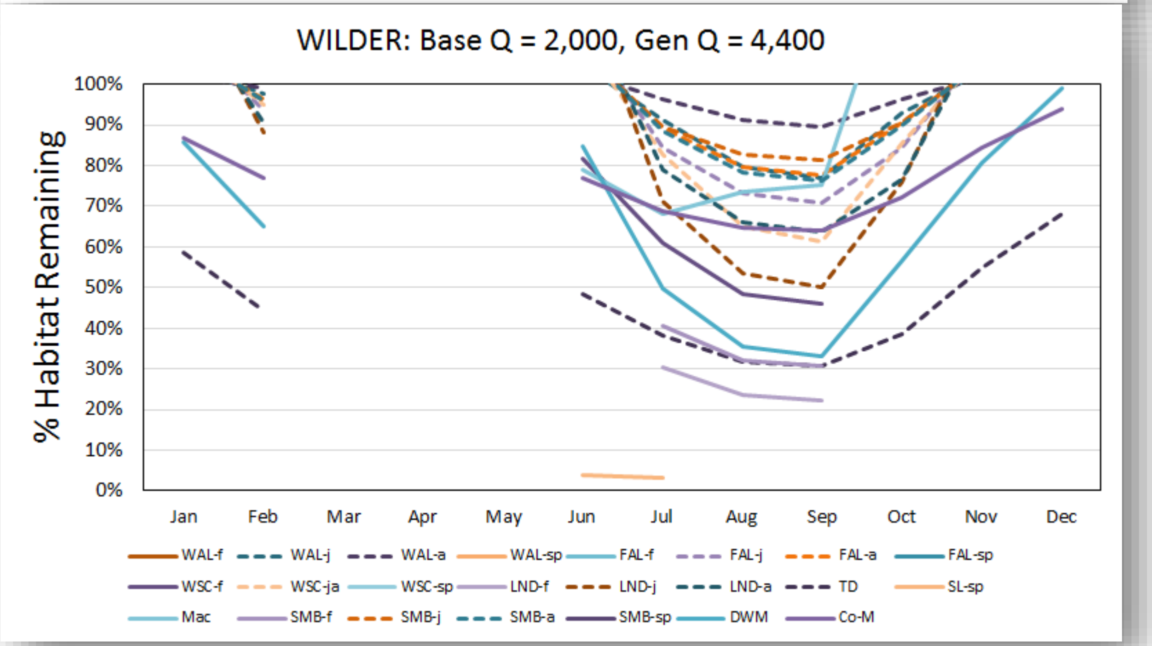

WILDER: Base Q = 700, Gen Q = 10,700
% Habitat Remaining
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Spring flows & spawning
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
WAL-f
WAL-j
WAL-a
WAL-sp
FAL-f
FAL-j
FAL-a
FAL-sp
WSC-f
WSC-ja
WSC-sp
LND-f
LND-j
LND-a
TD
SL-sp
Mac
SMB-f
SMB-j
SMB-a
SMB-sp
DWM
Co-M

Current/proposed regime



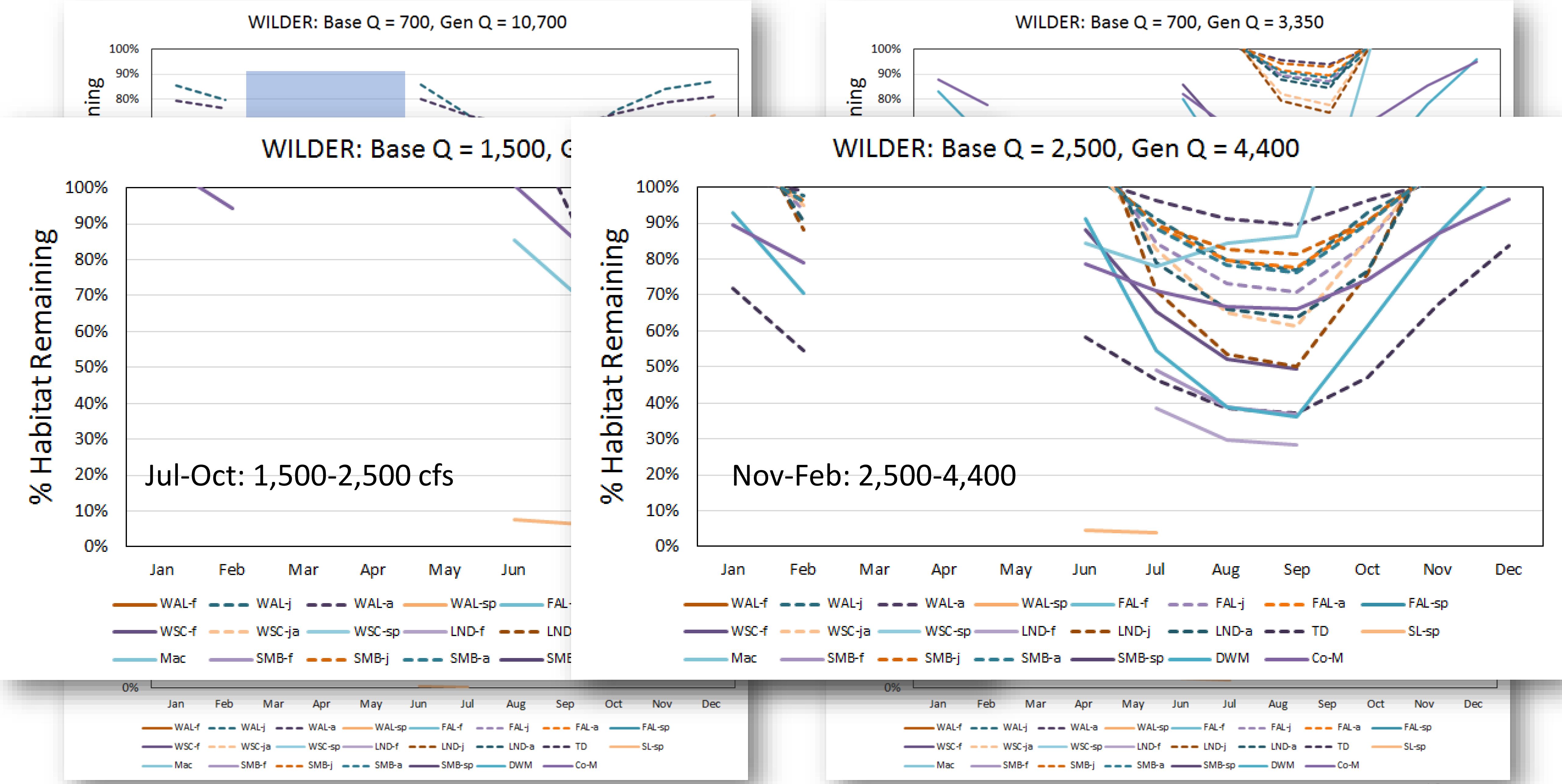


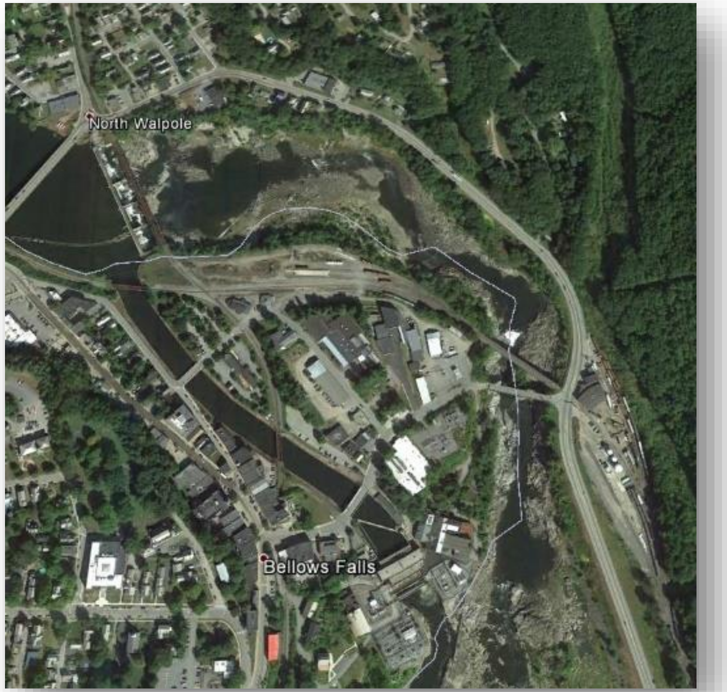




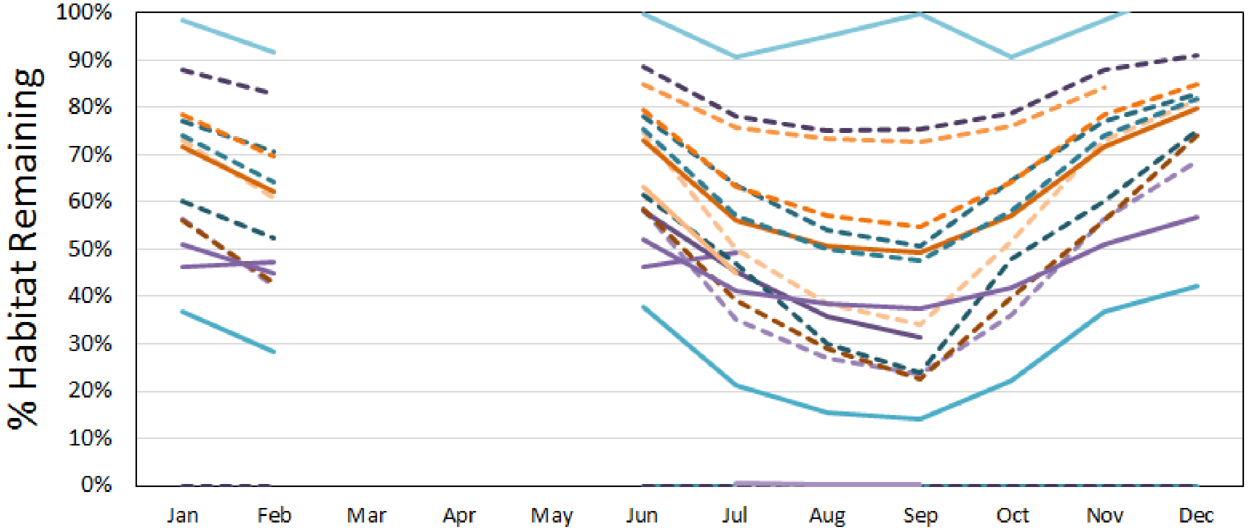
Current/proposed regime

Current/proposed regime

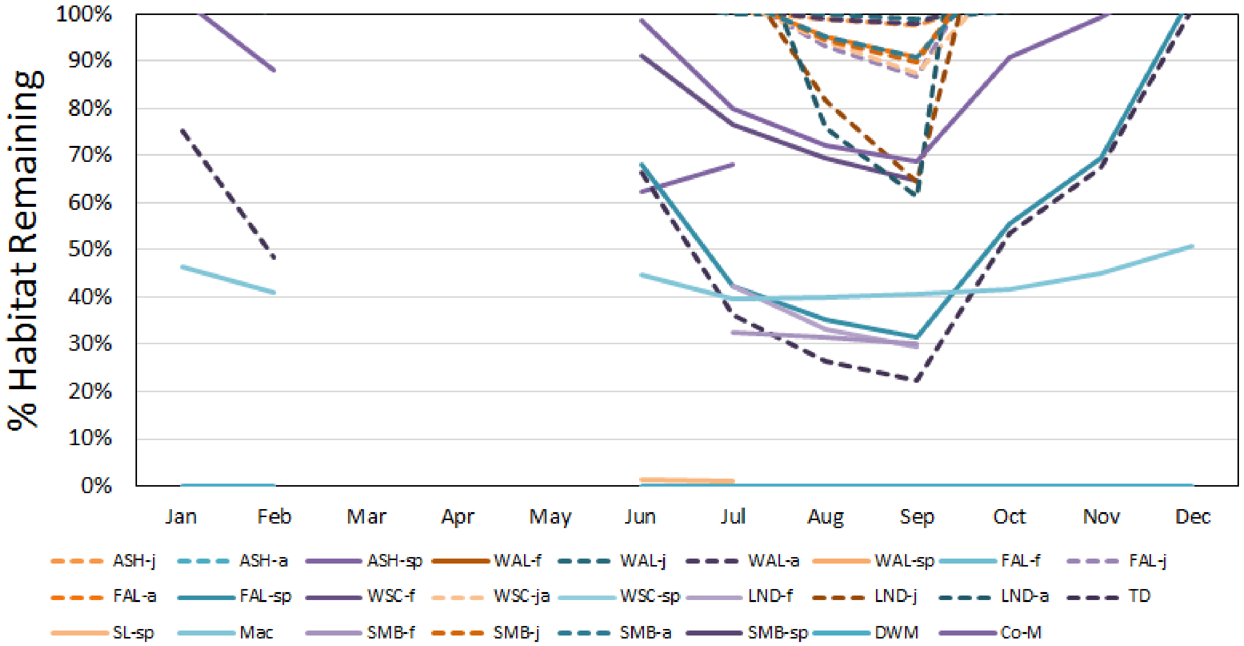




BELLOWS: Base Q = 1,300, Gen Q = 11,400



VERNON: Base Q = 2,500, Gen Q = 7,440 (TF at 180.6)



Assessment of proposed operations

A proposed operating regime is assumed to offer adequate resource protection if it meets on of these conditions:

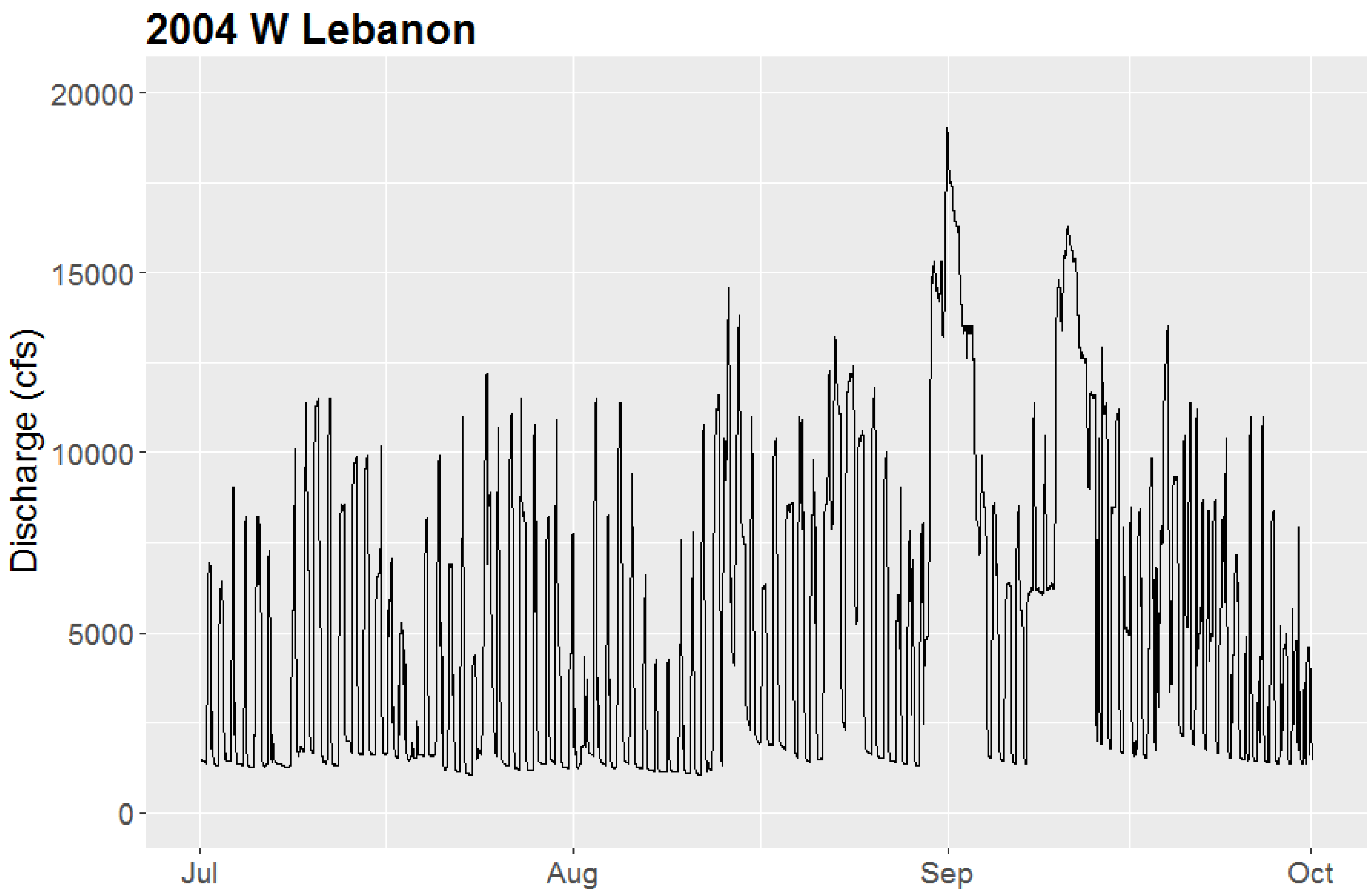
- If it has a minimal impact on the habitat of modeled species (assess using the **Study 9** steady state & dual flow/two flow results, other studies)

OR

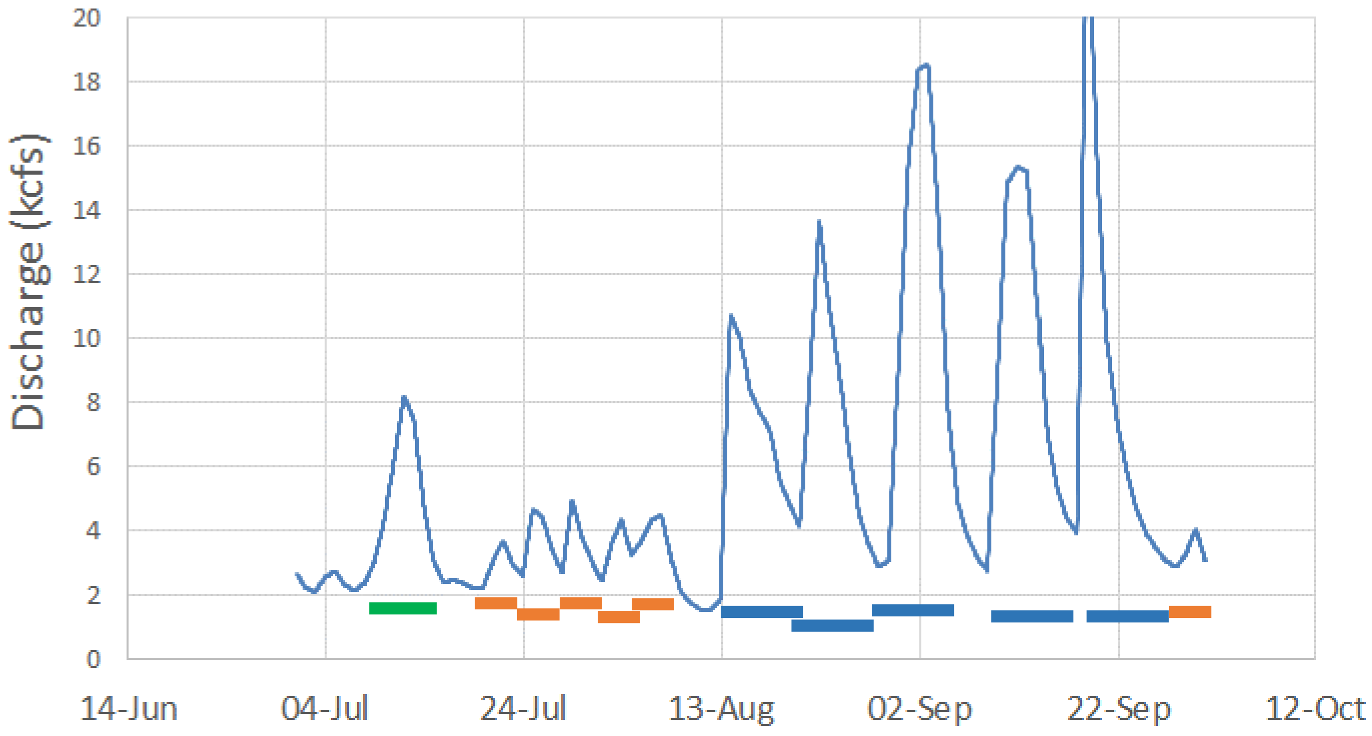
- If it is executed in a way that's consistent with the river's natural flow regime, i.e., frequency, magnitude, rate of change, etc.

Insights from a natural flow perspective

- Quantify relevant statistics of background hydrology (freq, mag, etc.)
- Use these to identify potential bounds for operation
- Problems/challenges:
  - What is the right hydrologic baseline for evaluation?
  - How to implement without increasing flow variability overall?
  - Practical constraints to implementation?
  - Requires usable storage and does not address impoundment fluctuation


2004 W Lebanon
Discharge (cfs)
20000
15000
10000
5000
0
Jul
Aug
Sep
Oct

Frequency & Magnitude



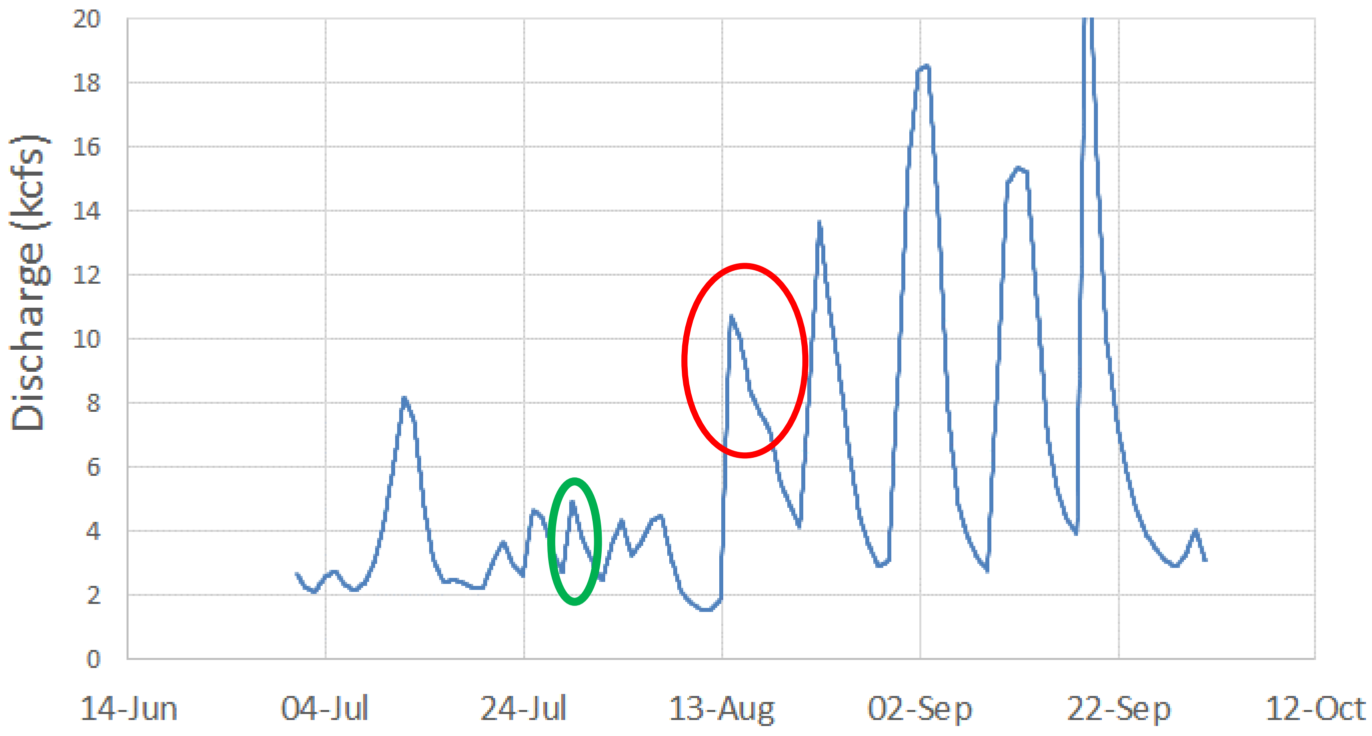
Approx. 2-3 kcfs to 4-5 kcfs, n = 6

Approx. 2-3 kcfs to 8 kcfs, n = 1

Approx. 2-3 kcfs to 10+ kcfs, n = 5

(i.e., 12 events vs. 80-90 ~1 kcfs to 8-10 kcfs per summer currently)

dQ/dt & Duration



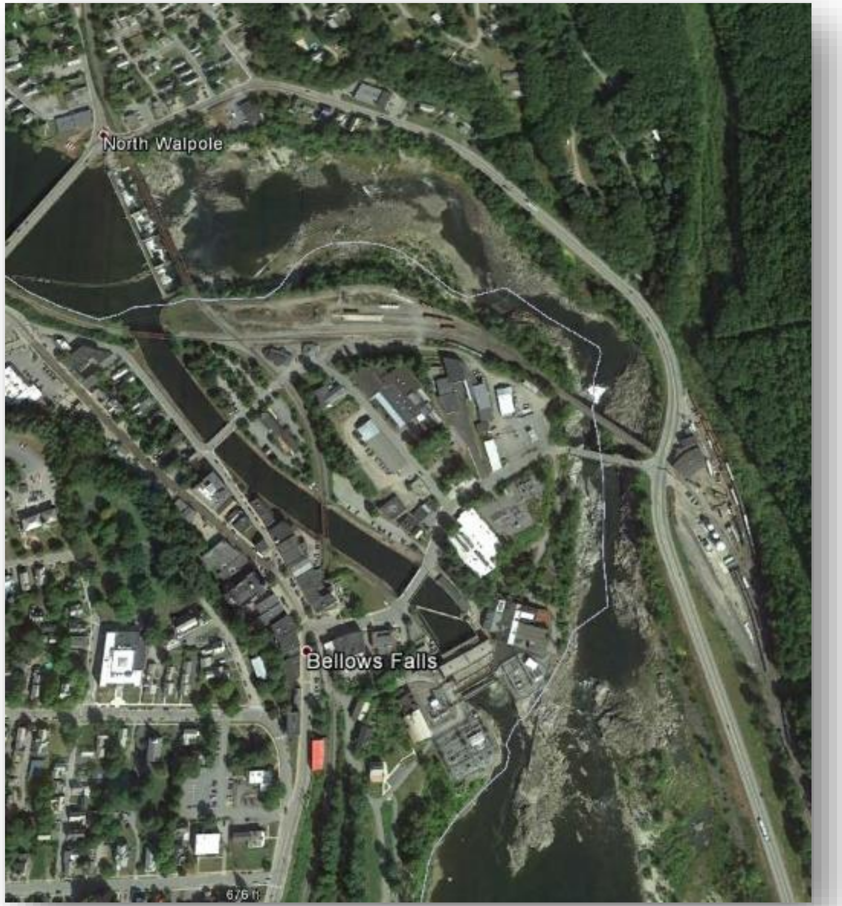
Event 1, 27-31 July:
2.7 to 4.9 kcfs
Duration: 4 d (96 h)
dQ/dt: +87 & -34 cfs/h

Event 2, 11-20 Aug:
1.5 to 10.7 kcfs
Duration: 9.2 d (221 h)
dQ/dt: +173 & -39 cfs/h

Current Operations:
~1 to 11 kcfs
Duration: 1 d (24 h)
dQ/dt: 600-700 cfs/h

The Bellows Falls bypass reach

- ~0.7 mi long, pool-dom'd (73%)
- Fish dam at bottom
- Several species present, likely spawning hab. ltd.
- Current flow 100-300 cfs; 7Q10 is ~1500 cfs
- Habitat survey incl. 7 transects (2 pool, 5 run/riff/gld)



The Bellows Falls bypass reach

- What species & life stages to include?

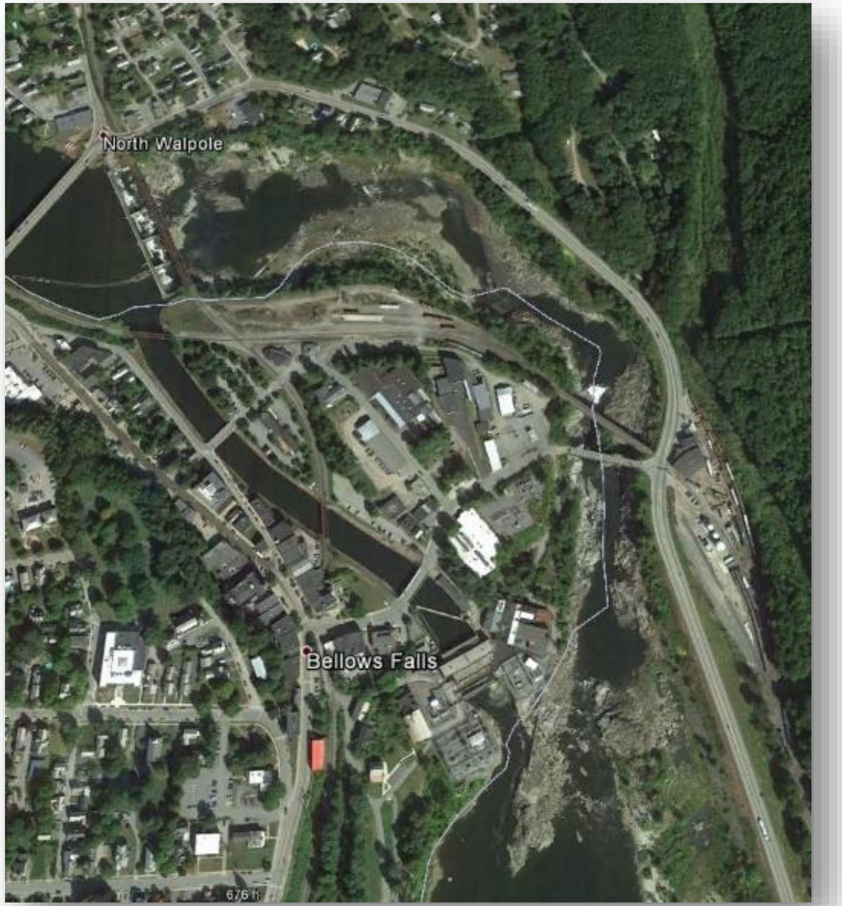


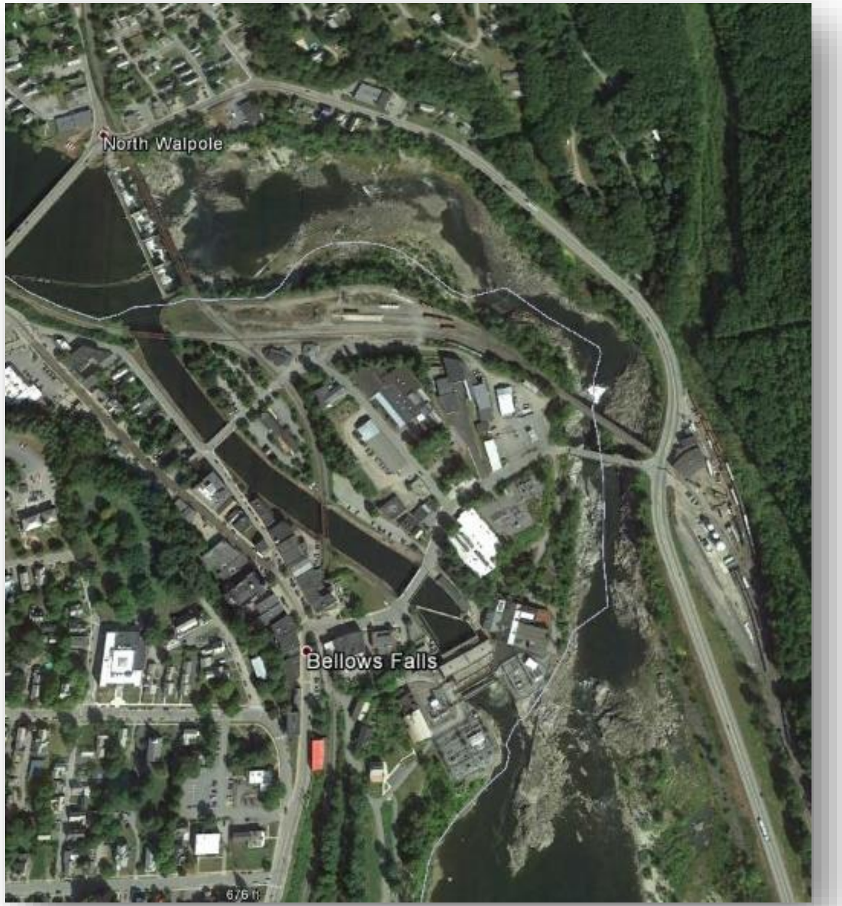
Table 2.1. Timing of key life history events, in full months; see Table 1.1 for sub-monthly life history details. The 1997-2016 daily median discharge at Walpole, rounded to the nearest 100 cfs, is provided below each month for considering linkages between life history and hydrology.

Species	Life stage	Jan 7,700	Feb 6,200	Mar 10,800	Apr 22,700	May 12,500	Jun 7,900	Jul 5,000	Aug 3,700	Sep 3,100	Oct 5,200	Nov 7,700	Dec 8,800
American Shad	Juvenile												
	Adult												
	Spawning												
Walleye	Fry												
	Juvenile												
	Adult												
	Spawning												
Fallfish	Fry												
	Juvenile												
	Adult												
	Spawning												
White Sucker	Fry												
	Juv/Ad												
	Spawning												
Longnose Dace	Juvenile												
	Adult												
	YOY												
Tessellated Darter	Adult												
Sea Lamprey	Spawning												
Smallmouth Bass	YOY												
	Juvenile												
	Adult												
	Spawning												
Macroinvertebrates	all aquatic												
Rainbow Trout	Adult												
Dwarf Wedgemussel[1]	Adult												
Co-occurring Mussels	Adult												

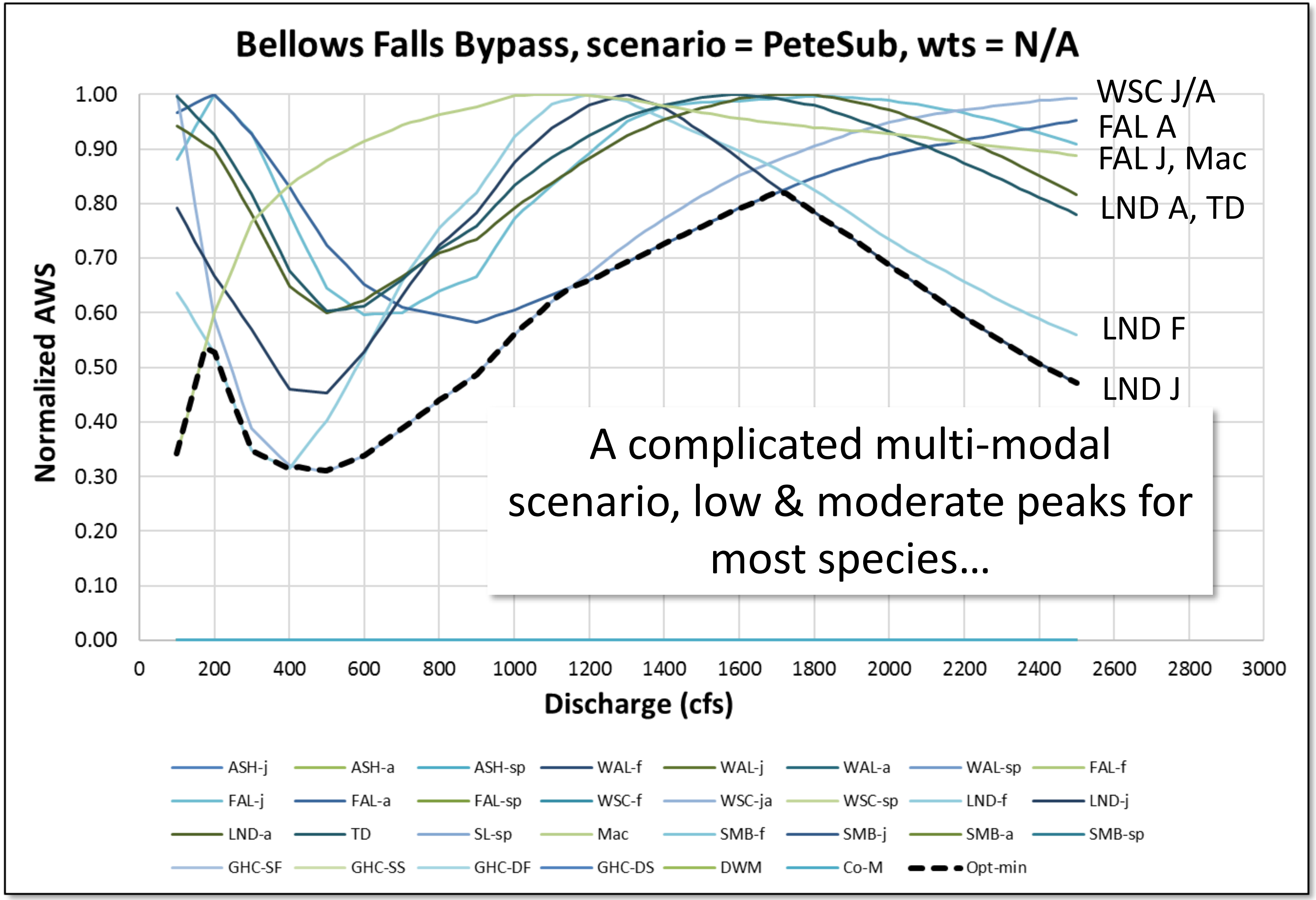
[1]Reproduction occurs summer/fall; glochidia release occurs in the following spring (March-June)

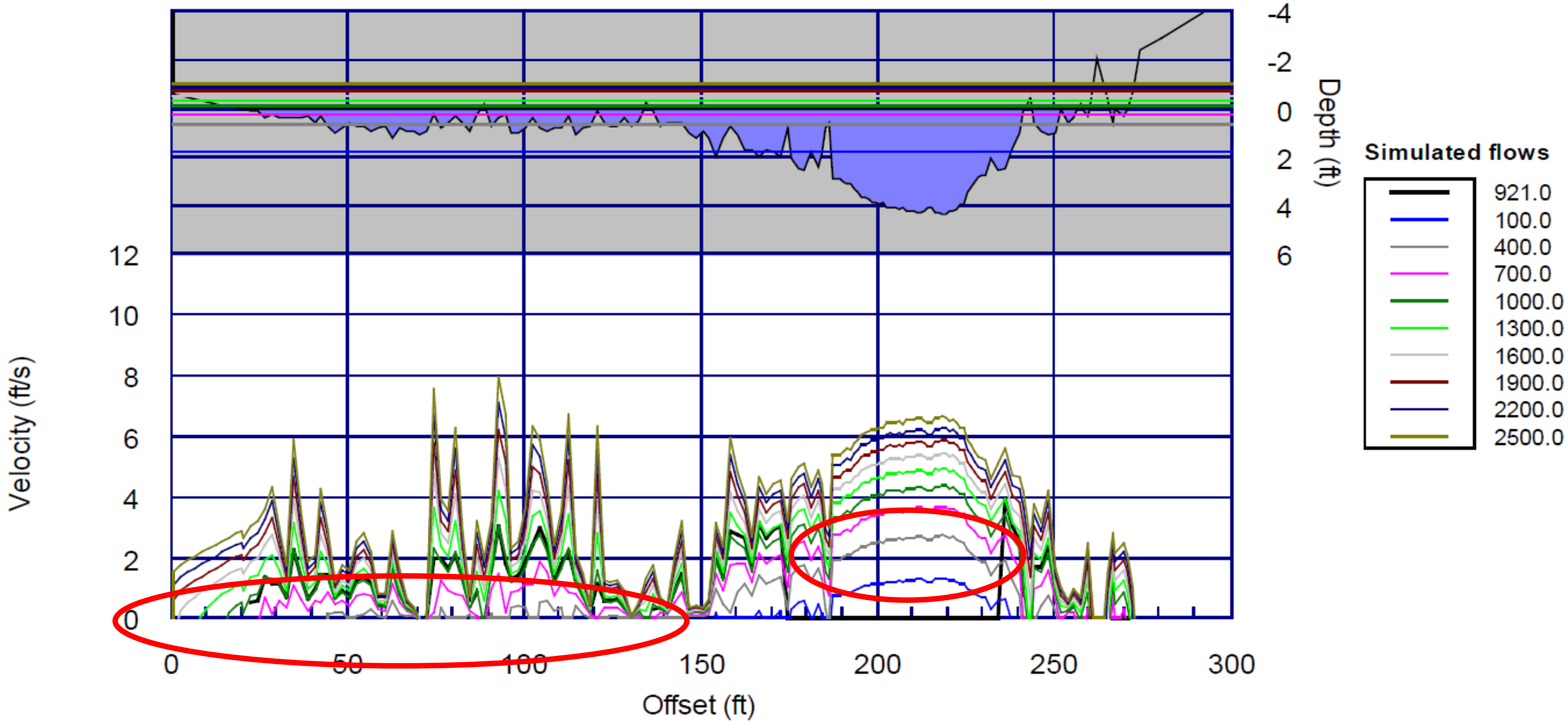
The Bellows Falls bypass reach

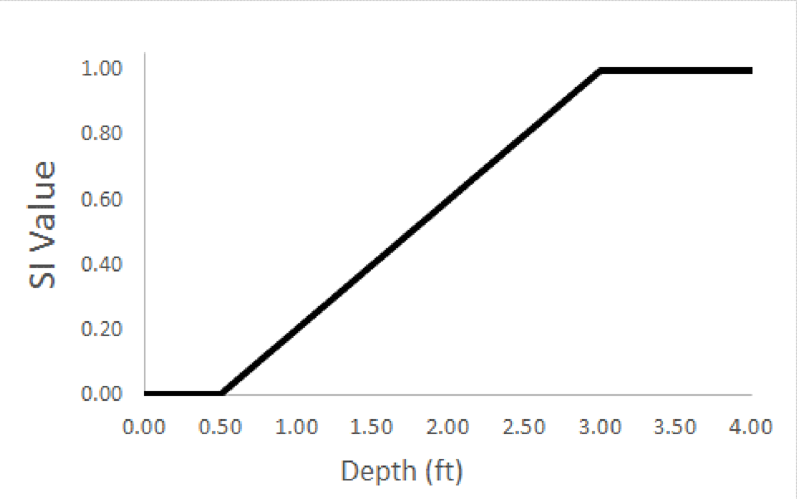
- What species & life stages to include?
- Focus on fast-water, riverine species, non-spawning stages; non-pool habs
- Draft list:
  - Fallfish J/A
  - Longnose Dace F/J/A
  - Tessellated Darter
  - White Sucker J/A
  - Macroinverts

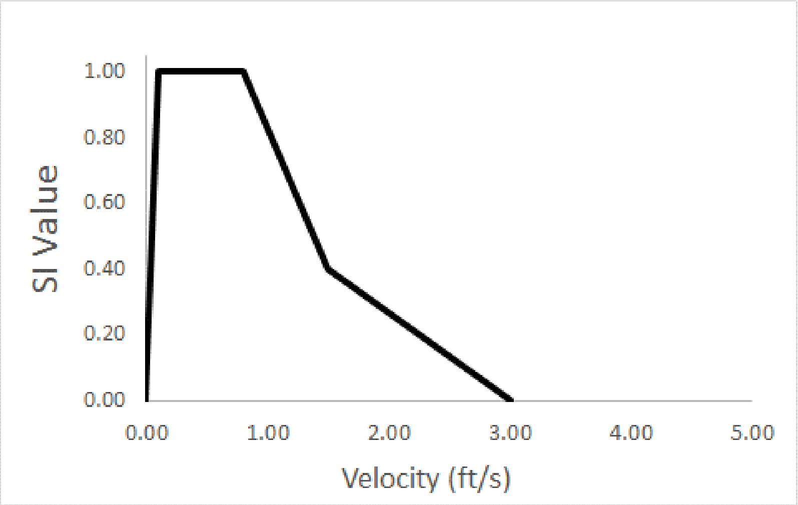


Habitat modeling results

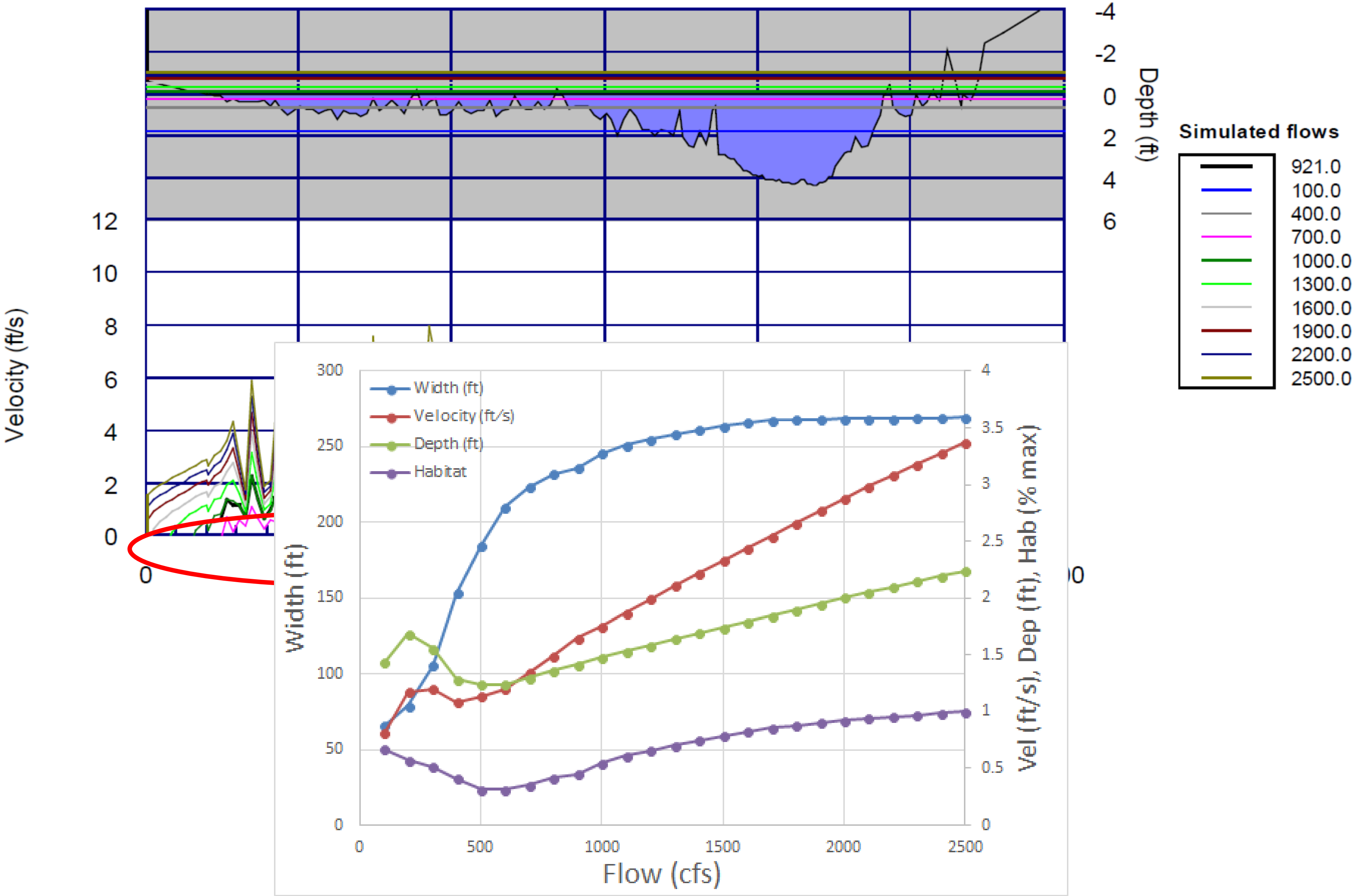



Velocity (ft/s)
Depth (ft)
Offset (ft)
Simulated flows
921.0
100.0
400.0
700.0
1000.0
1300.0
1600.0
1900.0
2200.0
2500.0
12
10
8
6
4
2
0
-4
-2
0
2
4
6
0
50
100
150
200
250
300

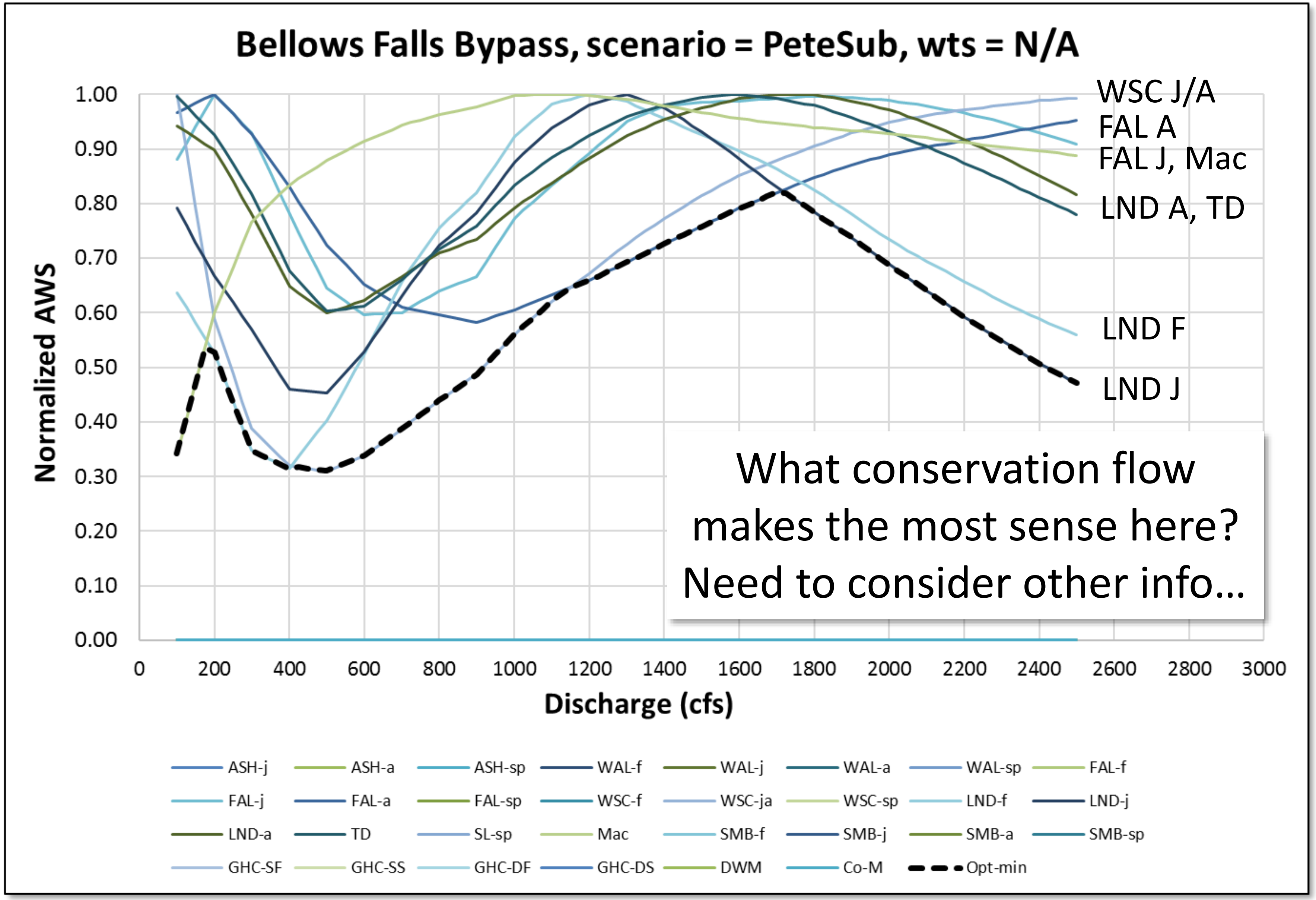

SI Value
Depth (ft)
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00

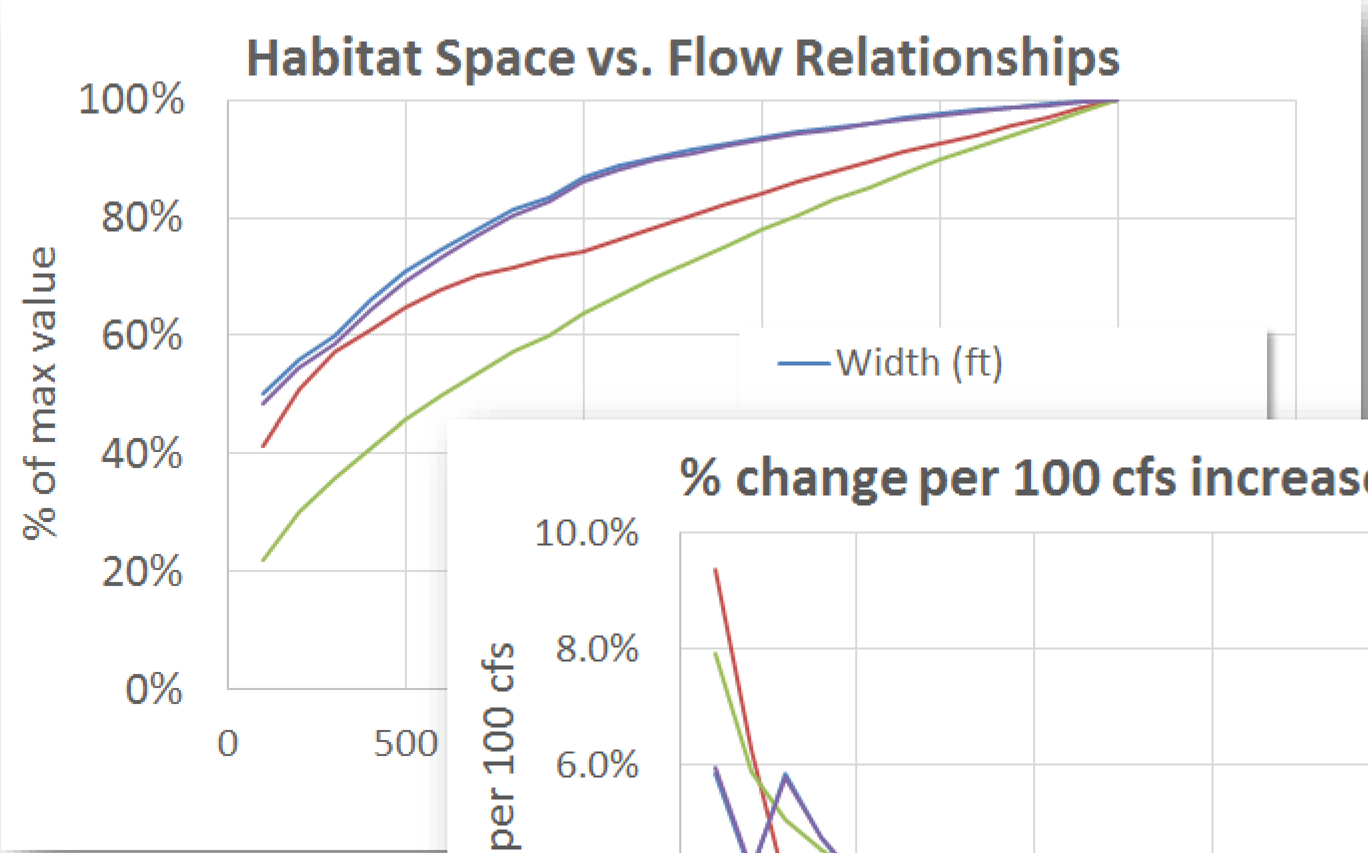

SI Value
Velocity (ft/s)
1.00
0.80
0.60
0.40
0.20
0.00
0.00
1.00
2.00
3.00
4.00
5.00

BFB4: Mid Velocities

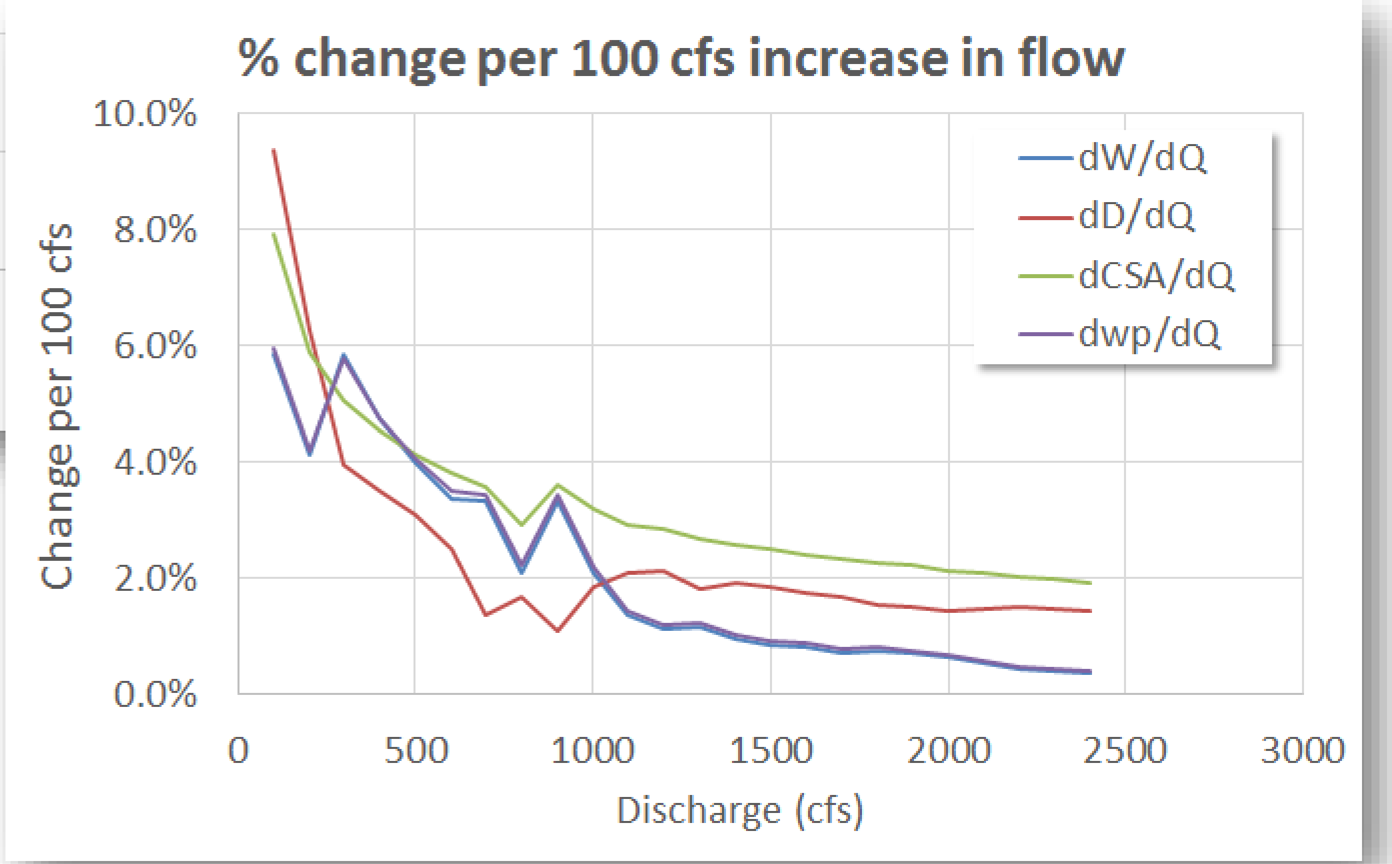


Habitat modeling results





Habitat Space vs. Flow Relationships
100%
80%
60%
40%
20%
0%
% of max value
0
500
Width (ft)



% change per 100 cfs increase in flow
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
Change per 100 cfs
0
500
1000
1500
2000
2500
3000
Discharge (cfs)
dW/dQ
dD/dQ
dCSA/dQ
dwp/dQ

Overview of presentation

- Recap of tasks, work done to date, data sharing, etc.
- Context:
  - Hydrology and biology
  - Proposed operations
- Review of Study 9 (instream flow study) & key findings:
  - Evaluation of proposed operations (all projects, but Wilder as example)
    - Steady state (conservation flows)
    - Dual flow analysis (habitat in light of hydropeaking cycle)
  - Evaluation of Bellows Falls bypass reach (steady state)
- Concerns emerging from review of other studies
- Where to from here?

RT&E Species Studies

1. Study 28: Fowler's Toad rearing habitats vulnerable to washout (tadpoles, eggs) from project-related flow increases
2. Study 26: routine inundation of adult habitat and larval burrows, sometimes completely so; only Cobblestone found, no Puritans
3. Study 25: Impacts of rapid water level fluctuation to SGCN taxa (Riverine Clubtail) during eclosion window
4. Study 24: Dwarf wedgemussel and Co-occurring mussels…?

Effects of operations on spawning (Studies 14-16)

1. Early spawning fish species:
   - Yellow Perch egg masses highly susceptible
2. Late spawning fish species:
   - Dewatering & sedimentation at ~1/3 Smallmouth Bass nests (riverine sites)
   - Dewatering of ~1/3 Fallfish nests (riverine)
   - Shallow or dewatered LMB and sunfish nests
   - 26% of Sea Lamprey redds dewatered at least once; sedimentation evident (project effect?)
3. Info on esoscids, Walleye, suckers, other cyprinids insufficient to determine impacts

Non-biological Studies

1. Studies 2-3: Erosion study, many comments submitted and results are in dispute (?)
2. Study 30: Recreation study, 43% of interviewed users identified a desire for lower flow fluctuation
3. Study 31: Desirable flows for whitewater paddling at Sumner Falls (4.7 and 13 kcfs) and Bellows Falls Bypass (2.0-4.4 kcfs) identified
4. Study 32: Bellows Falls aesthetics study suggests flows 1,600-2,400 cfs most desirable

Overview of presentation

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- Where to from here?

Where to from here?

Considerations for identifying a protective operating regime:

- Hydraulic habitat conditions (Study 9)
- Hydrologic considerations:
  - Seasonality of operations
  - Frequency of generation cycles
  - Magnitude (min/max)
  - Rate of change on front/back of a generation cycle
  - Duration
  - Incoming flows
- Other studies and considerations
- Compatibility with desire for operational flexibility?
- Potential priority areas?