PROTECTED INSTREAM FLOW STUDY REPORT WARNER RIVER

Information Meeting

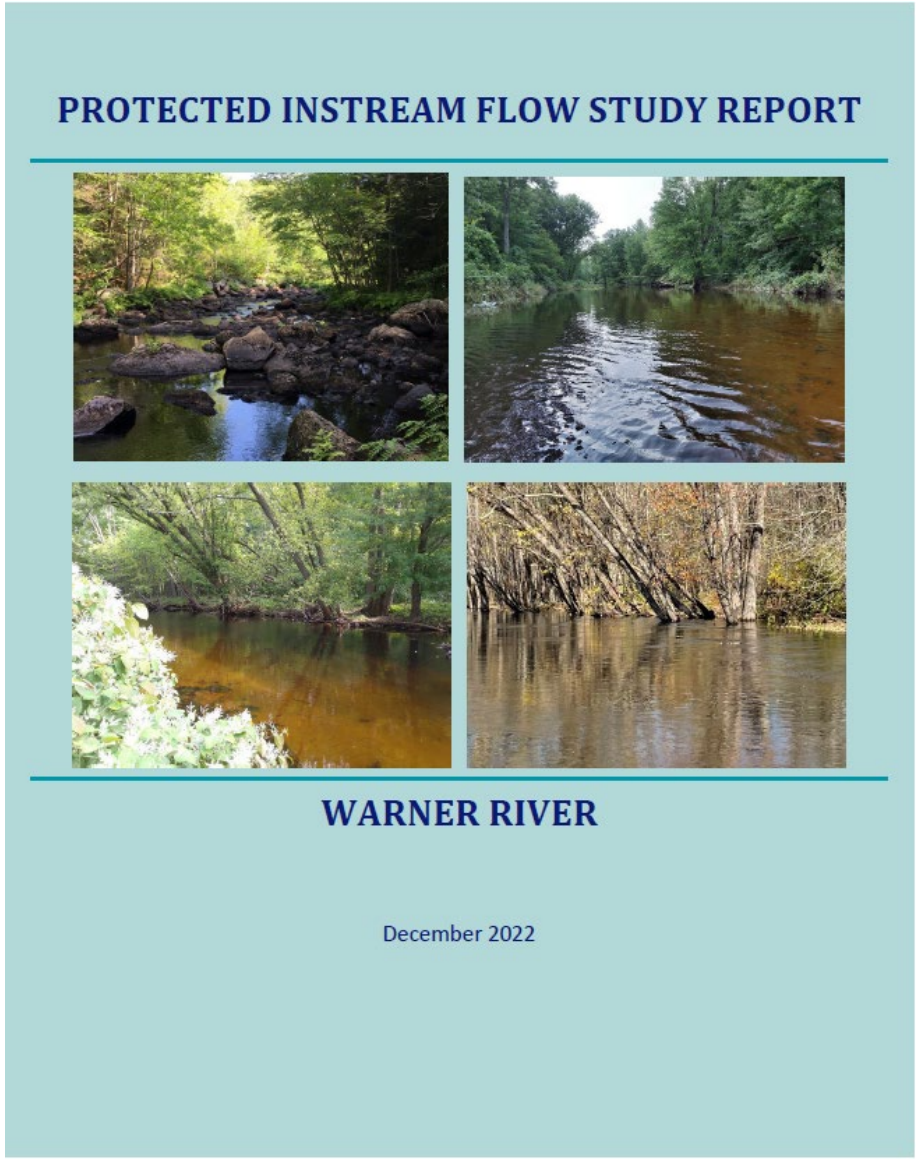
NHDES and Gomez & Sullivan Engineers

Warner Town Hall, Warner, NH

January 24, 2023

7:00 pm

NEW HAMPSHIRE DEPARTMENT OF Environmental Services



Informational Meeting on Warner PISFs

- Public review process of the proposed Protected Instream Flows for the Warner River.
- The public review process is preliminary to the establishment of the protected flows as water quality criteria by the NHDES Commissioner.

Informational Meeting on Warner PISFs

- This is an informational meeting required by the ISF rules.
- The purpose is to present the PISF report and answer questions.
- Comments on the report will be received at a public hearing.
- The public hearing will be held February 23, 2023 at 7:00 pm.
- Comments will be accepted until March 24, 2023 at 4 pm.
- Send comments to Wayne.Ives@des.nh.gov or

Wayne Ives, Instream Flow Specialist

NHDES

PO Box 95

Concord, NH 03302-0095

Warner River Protected Instream Flows

- Study conducted under a contract with Gomez and Sullivan, of Henniker, NH
- PISFs developed following RSA 483 and Env-Wq 1900
- Completed study in 2022
- Draft report for public comment
  - Information meeting
  - Public hearing
- Final report and Establishment by NHDES Commissioner
- Established PISFs are water quality standards for the Warner Designated River

Development of Protected Instream Flows for the Warner River

Prepared for:

NHDES

Presented by:

Gomez and Sullivan Engineers

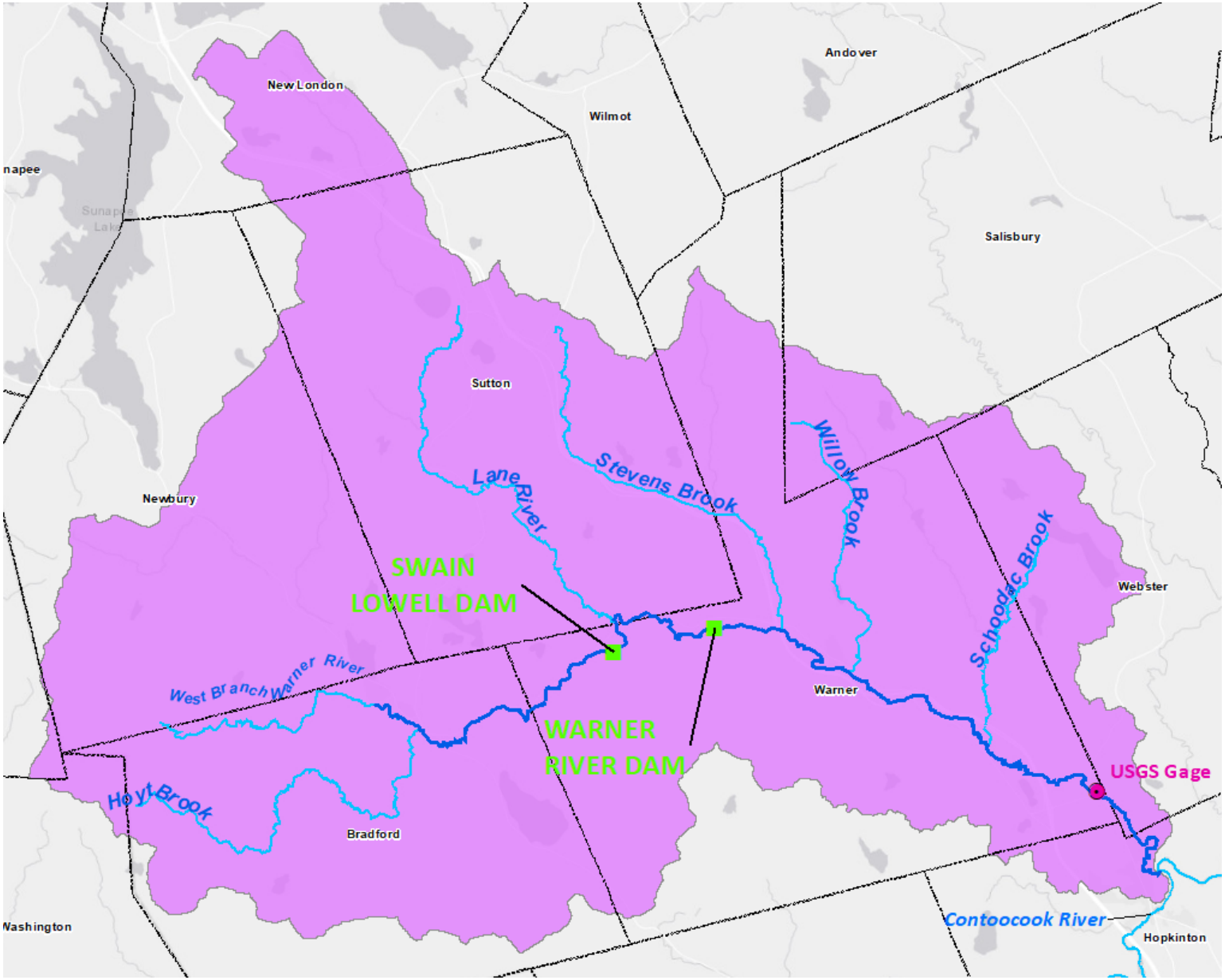
January 24, 2023

Background

Rivers Management and Protection Program (RMPP)

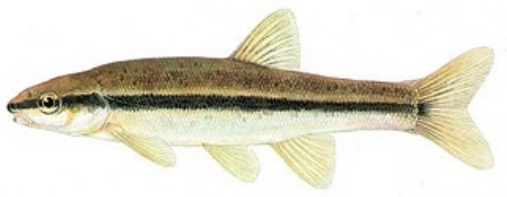
- NH legislature created RMPP within NHDES in 1988
- RMPP protects certain “Protected Rivers” in NH for their outstanding natural and cultural resources
- Cooperative approach – NHDES designation of significant rivers to manage and protect combined with assistance from local communities along the river to develop river management plans
- The Warner River was accepted into the RMPP as a Designated River in 2018
- 20.5 miles of the Warner River are designated
- Env-Wq 1900 – A Protected Instream Flow Study shall be conducted, develop a study report that includes proposed Protected Instream Flows

Warner River Background



Warner River Protected Entities

- Warner River watershed supports diverse habitat – dependent on sufficient water in the river
- Fish species live in the river, including various native species, introduced species (e.g., smallmouth bass), and stocked trout. Historic access by sea-run fish species, currently blocked by the presence of dams.
- Several riparian plant species along the banks rely on the river and its processes
- Recreational opportunities including angling, swimming, and whitewater boating



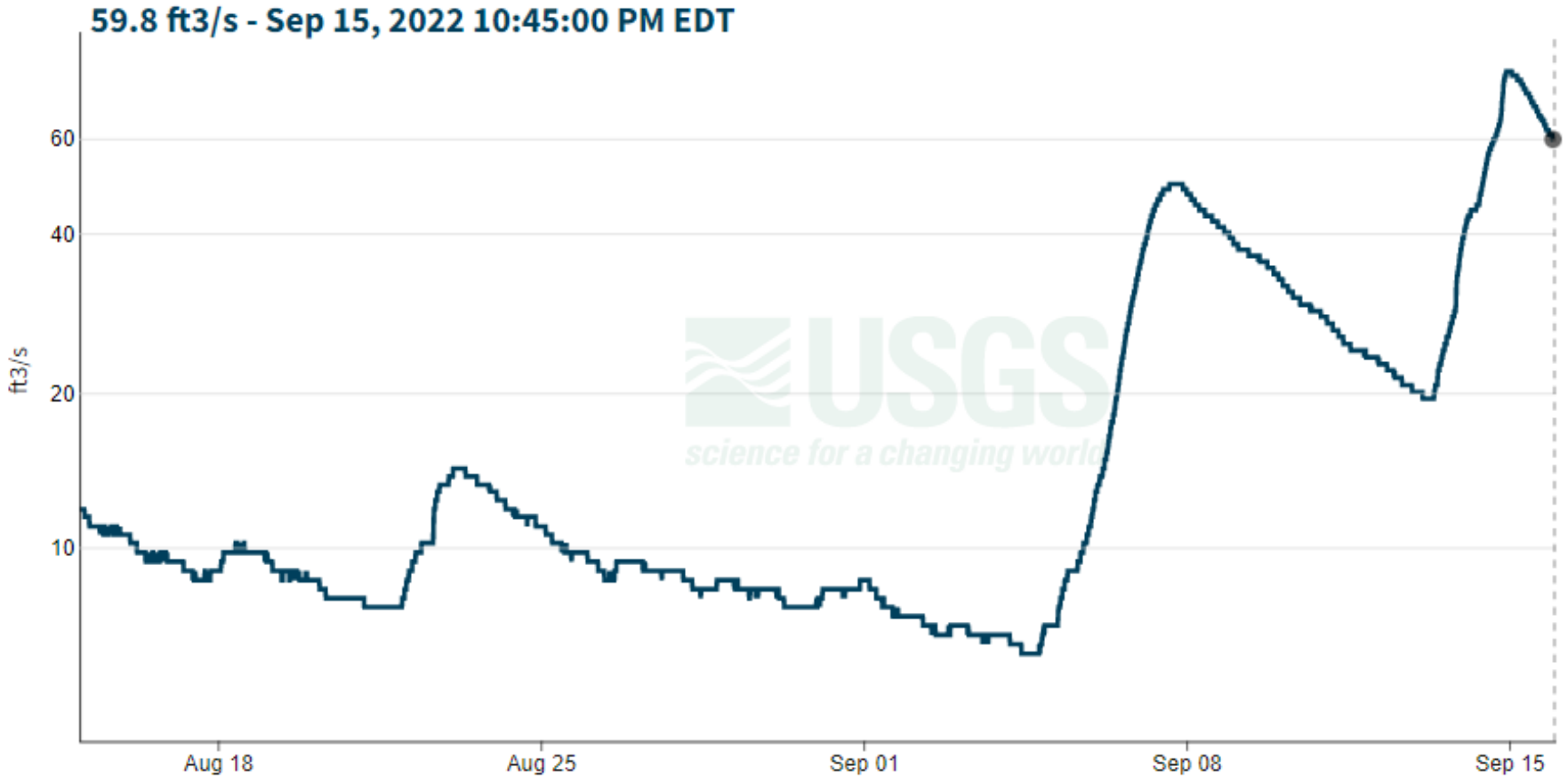
Source: NH Fish and Game Department, 2022

Source: Go Botany, 2022

Source: American Whitewater, 2022

Warner River Hydrologic Data

- Water flow in a river is measured in volume per time, such as cubic feet per second ("cfs"; "ft^3/s")
- The USGS measures water flow in the Warner River at the Davisville – since 2001



PURPOSE

- Conducted a Protected Instream Flow Study in order to determine what is considered “enough” water in the river for the Warner River protected entities
- Determined the flow (in cfs) on the Warner River that supports fish, riparian plants, and recreation for different times of the year – referred to as Protected Instream Flows
- Used a variety of methods to determine the protected flow for each of the protected entities
  - The relationship between flows and habitat limitations is not linear or easily predicted without detailed assessment, and can vary along the river
  - Water withdrawals or diversions would not be expected to impact habitat in a linear or predictable manner
  - Therefore, this study includes an evaluation of the specific needs of each type of resource that is then tied back to flow at the USGS gage

APPROACH

- Detailed identification of all protected entities present on the Warner River – on-stream reconnaissance
- Used published scientific methods to determine Protected Instream Flows for fish species, riparian plants, and recreation
  - Fish species: Instream Flow Incremental Methodology (IFIM)
  - Riparian plants: Floodplain Transect Method (FTM)
  - Recreation: Recreational surveys and internet research
- Resource-based flow needs defined by:
  - Magnitude (amount of flow, correlated with resource needs);
  - Duration (length of time that events of certain magnitudes occur); and/or
  - Frequency (how often events of certain magnitudes and durations occur)
  - Timing (when events occur, correlated with resource needs)

Recommended Protected Instream Flows on the Warner River

Date Range	Common Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Critical Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Rare Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)
December 1 – February 28/29	317	45	77	80	22	40	39	10	16
March 1 – April 30	1,062	26	44	148	13	27	109	7	11
May 1 – June 30	244	15	37	44	7	11	31	4	6
July 1 – September 30	76	30	71	11	14	24	6	8	15
October 1 – November 30	106	20	39	29	11	22	23	8	15

Retain Flood Frequencies:

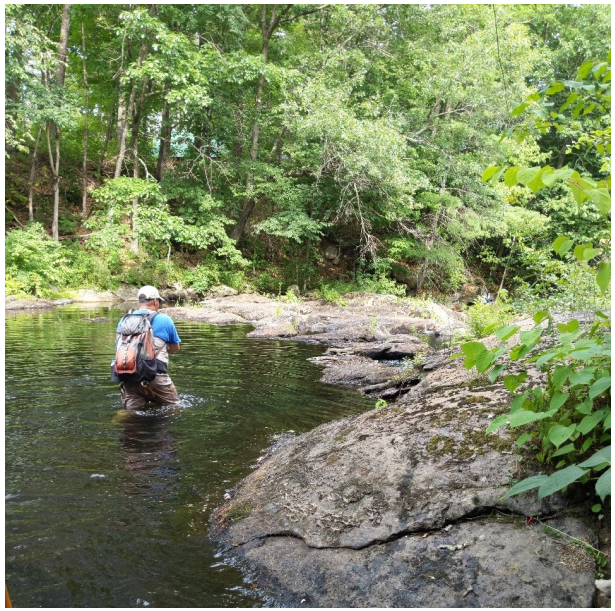
- Inter-annual flow events of at least 400 cfs multiple times per year for emergent and riverine wetlands
- Annual flood frequency of at least 1,160 cfs for shrub scrub and seasonally/semi-permanently flooded floodplain forests
- 2-year flood frequency of at least 2,225 cfs for higher elevation floodplain forests

Optimum Recreational Boating Flows (Spring and Fall): Provide flow events of 565 cfs to 800 cfs

Reconnaissance and Study Site Selection

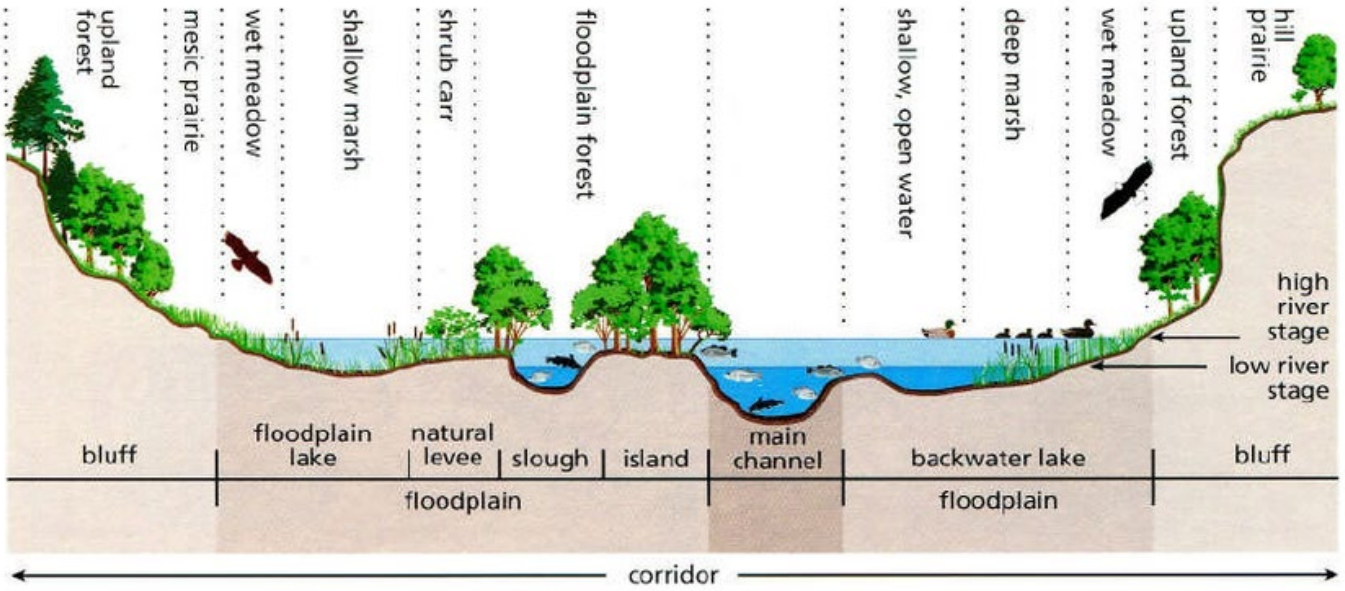
On-Stream Reconnaissance

- Traversed the entire river by wading to:
  - Confirm the presence and occurrence of protected entities and designated water uses
  - Document different aquatic habitats present in the river
  - Select specific sites for riparian and fish habitat assessment and documented recreation sites



TRANSECT SELECTION

- Detailed evaluation of habitat along the entire river would take extensive time and effort
- Selected several representative **transects** at different points along the river for riparian and aquatic habitat (discussed in further detail later)
  - **Transect**- a method for gathering scientific field data on a line across the river perpendicular to flow



Source: Milhous, et al., 2012

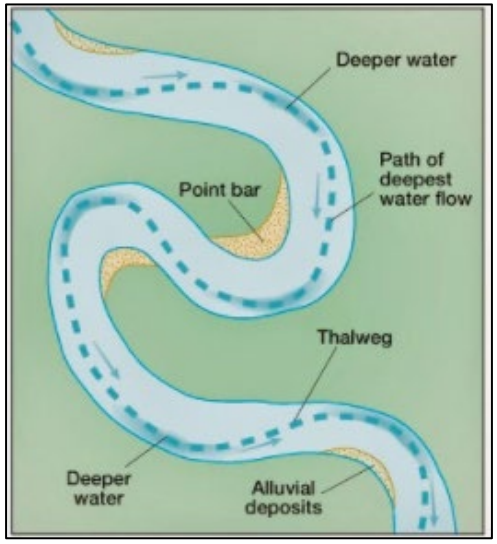
RECREATION

- Flow dependent recreation on the Warner River includes:
  - Boating – Whitewater boating between Melvin Mills to Waterloo Covered Bridge
- Recreational sites identified during on-stream reconnaissance – included informal pull-offs and trails along the river, Riverside park, Bagley Park, and the Waterloo Covered Bridge
- Conducted field observations, online outreach, and recreational surveys

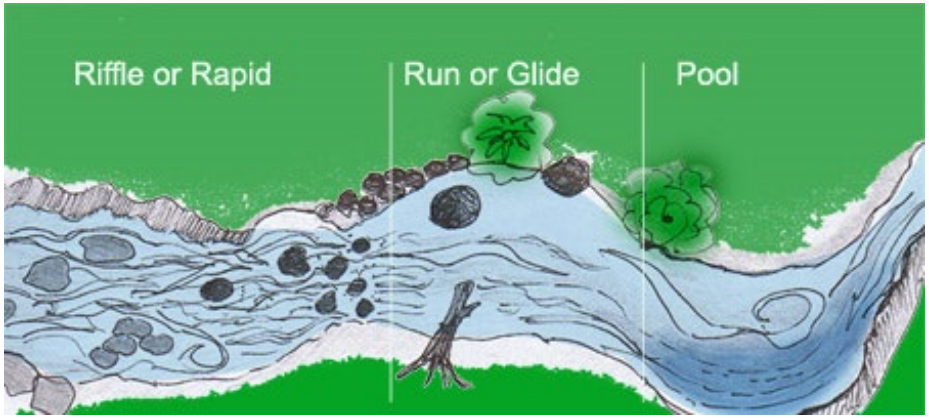
Methodology for Fish Habitat Assessment

Fish/Aquatic Habitat

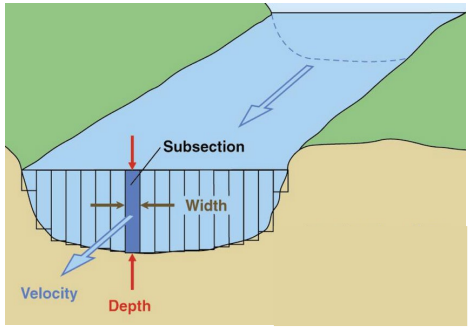
- Macrohabitat
  - Broad river characteristics
  - Food supply and predation
  - Water temperature and quality
- Mesohabitat
  - Pool
  - Run
  - Riffle
- Microhabitat
  - Substrate
  - Water depth
  - Water velocity



Source: Aerialgeologist.blogspot.com, 2021



Source: Bishfish.co.nz, 2021.



Source: USGS, 2021

IFIM Process

- Map mesohabitats (pools, riffles, runs, other) on the Warner River
  - Done during the on-stream reconnaissance
- Define study reaches and select study transects in different mesohabitats within each reach
- Collect detailed habitat data
- Select fish species and life stages to evaluate
- Develop relationship between habitat and flow based on published habitat needs
- Analyze habitat within the context of the flow dataset

Warner River Mesohabitats

- 20+ miles were mapped
  - 46 riffles
  - 127 pools
  - 139 runs
- Riffles – 5.2%
- Pools – 23.3%
- Runs – 52.6%
- Backwater (8.5%) and pocket water (5.7%) habitats also present, as well as braided channels

- 12 transects were selected
  - 7 in runs
  - 2 in riffles
  - 2 in pocket water
  - 1 in pool

WARNER RIVER TRANSECTS

Field Data Collection

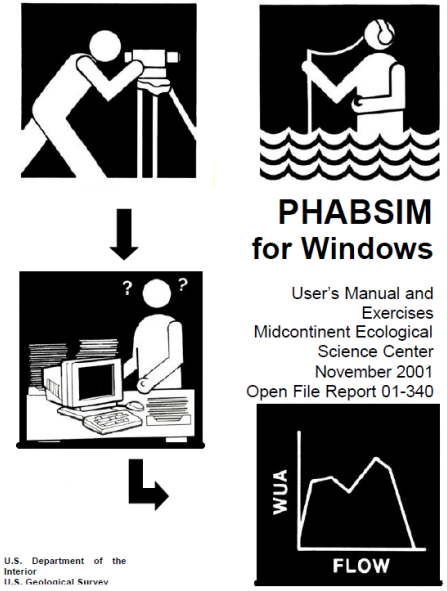
- Ropes strung across the river at each transect, perpendicular to flow
- At every foot across the river, collected:
  - Bed elevation – Total Station
  - Substrate type – Visual inspection
  - Water depth – Flow Meter
  - Water velocity – Flow Meter

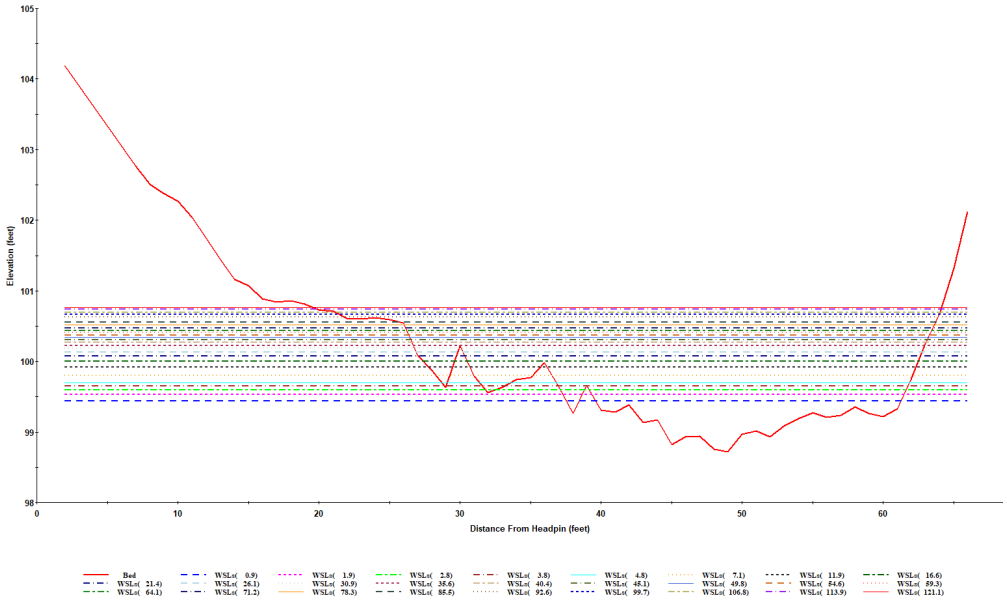
- Depth and velocity are flow dependent – collected at different flows

Field Data Collection Dates	Range of River Flow at USGS Gage	Average River Flow (cfs)
6/9/2021 – 6/10/2021	56.2 cfs to 59.7 cfs	58.5 cfs
8/12/2021 – 8/13/2021	161 cfs to 175 cfs	167 cfs
8/15/2022 – 8/16/2022	9.36 cfs to 11 cfs	10.5 cfs

HYDRAULIC MODELING

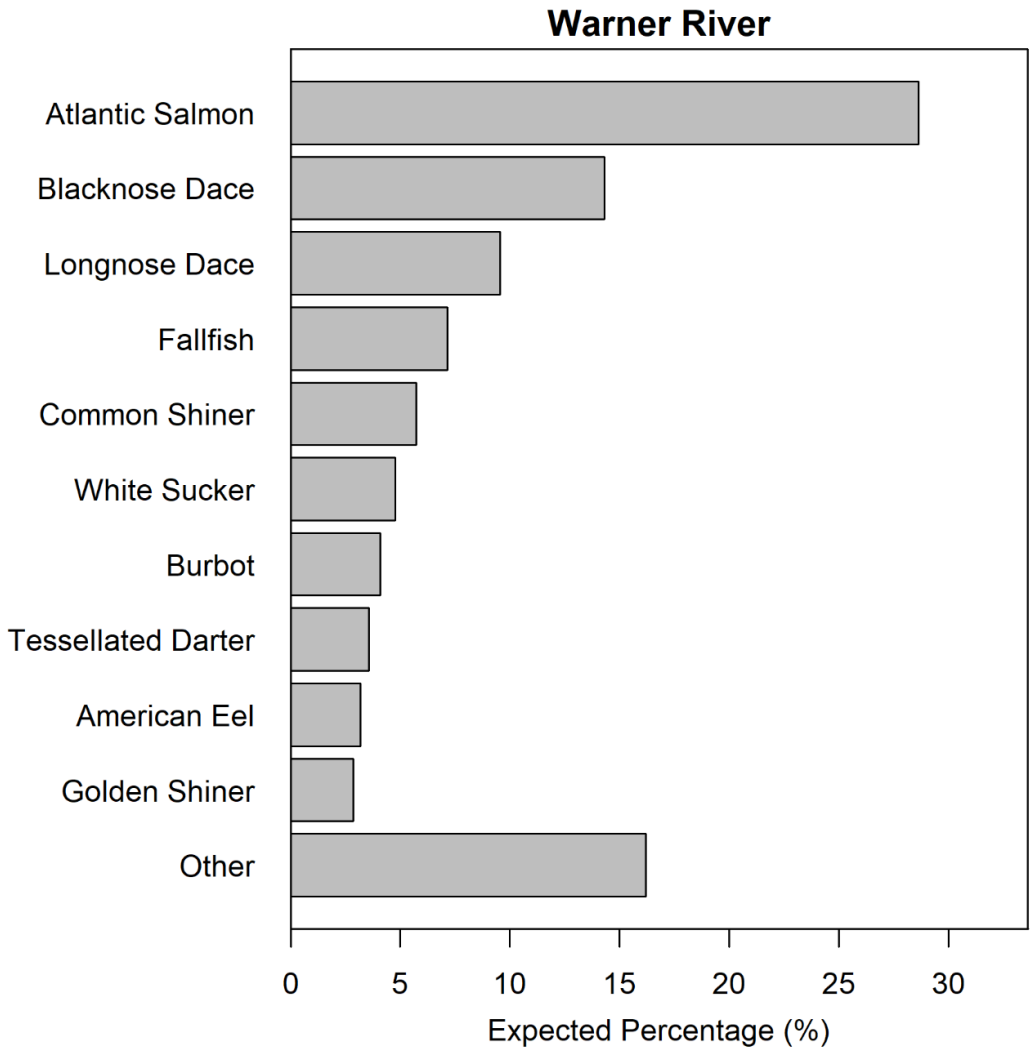
- Collected data at 3 flows – used hydraulic modeling to simulate water depth and velocity of 27 additional flows not measured in the field
- Used the Physical Habitat Simulation model (PHABSIM) to model water depth and velocity at a range of flows
- Results at each transect were adjusted based on drainage areas in order to standardize results to the USGS gage





U.S. Department of the Interior
U.S. Geological Survey
USGS
science for a changing world

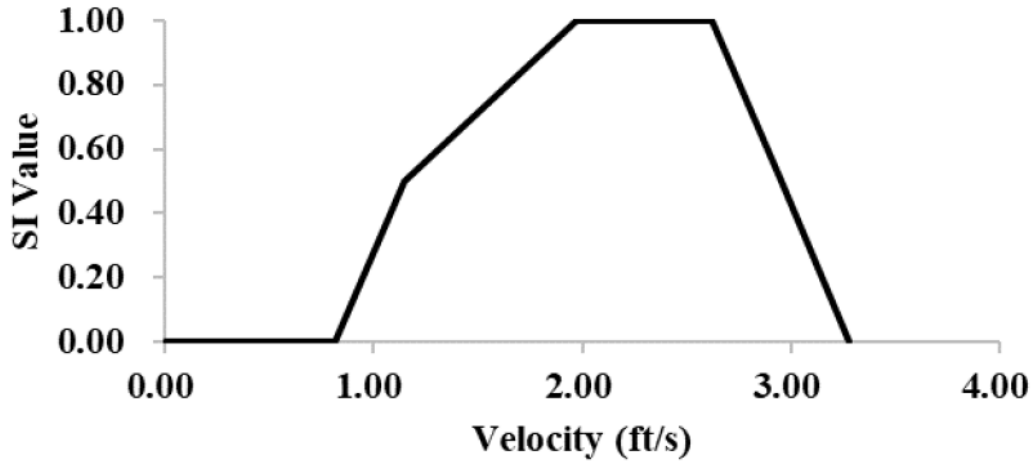
Fish Species Selected for Evaluation

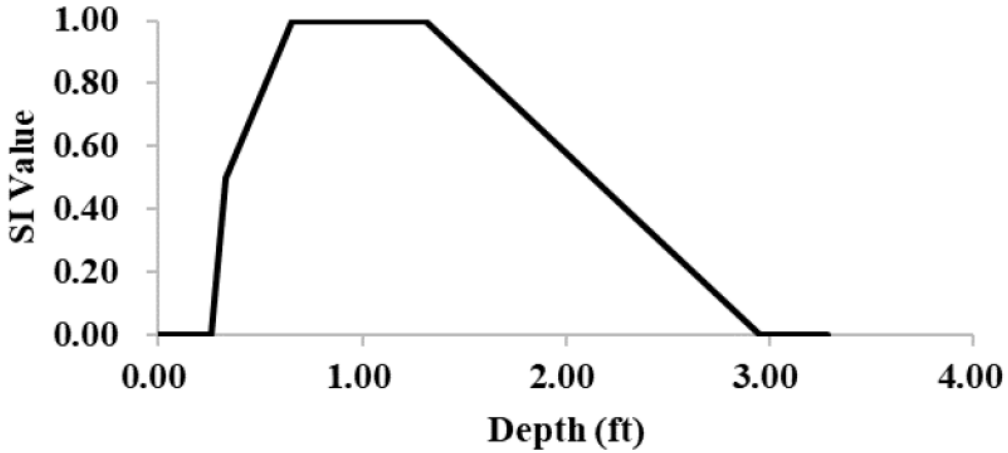


- Fish species selected for evaluation were based on the Target Fish Community
  - Represents the fish community that would be expected to exist in the river, not necessarily what is there currently
- Sea-run species historically present were also included (American Shad, Herring)

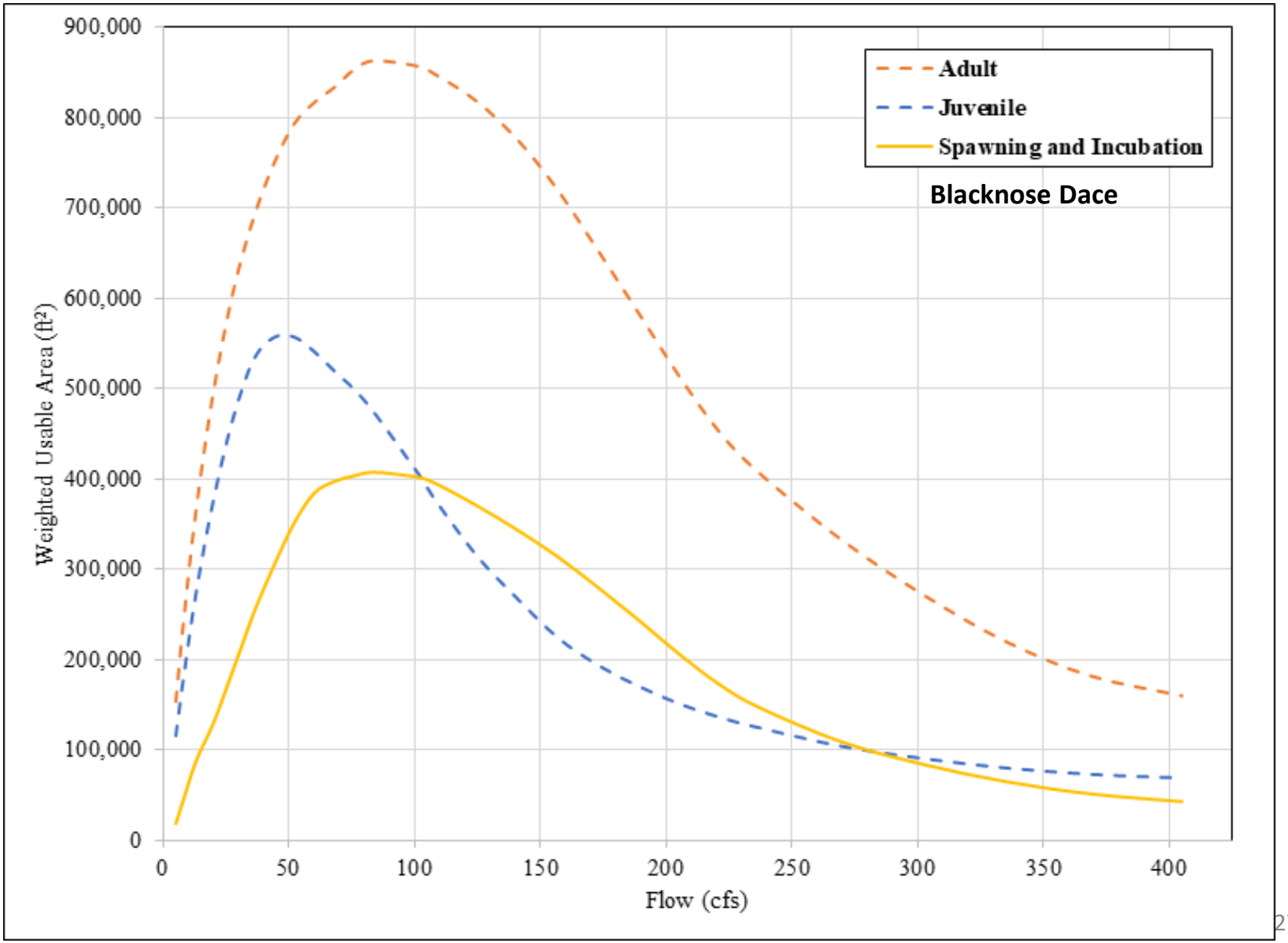
HABITAT SUITABILITY CURVES

- Microhabitat preferences (depth, velocity, substrate) for each species and life stage obtained from published literature – Habitat Suitability Curves



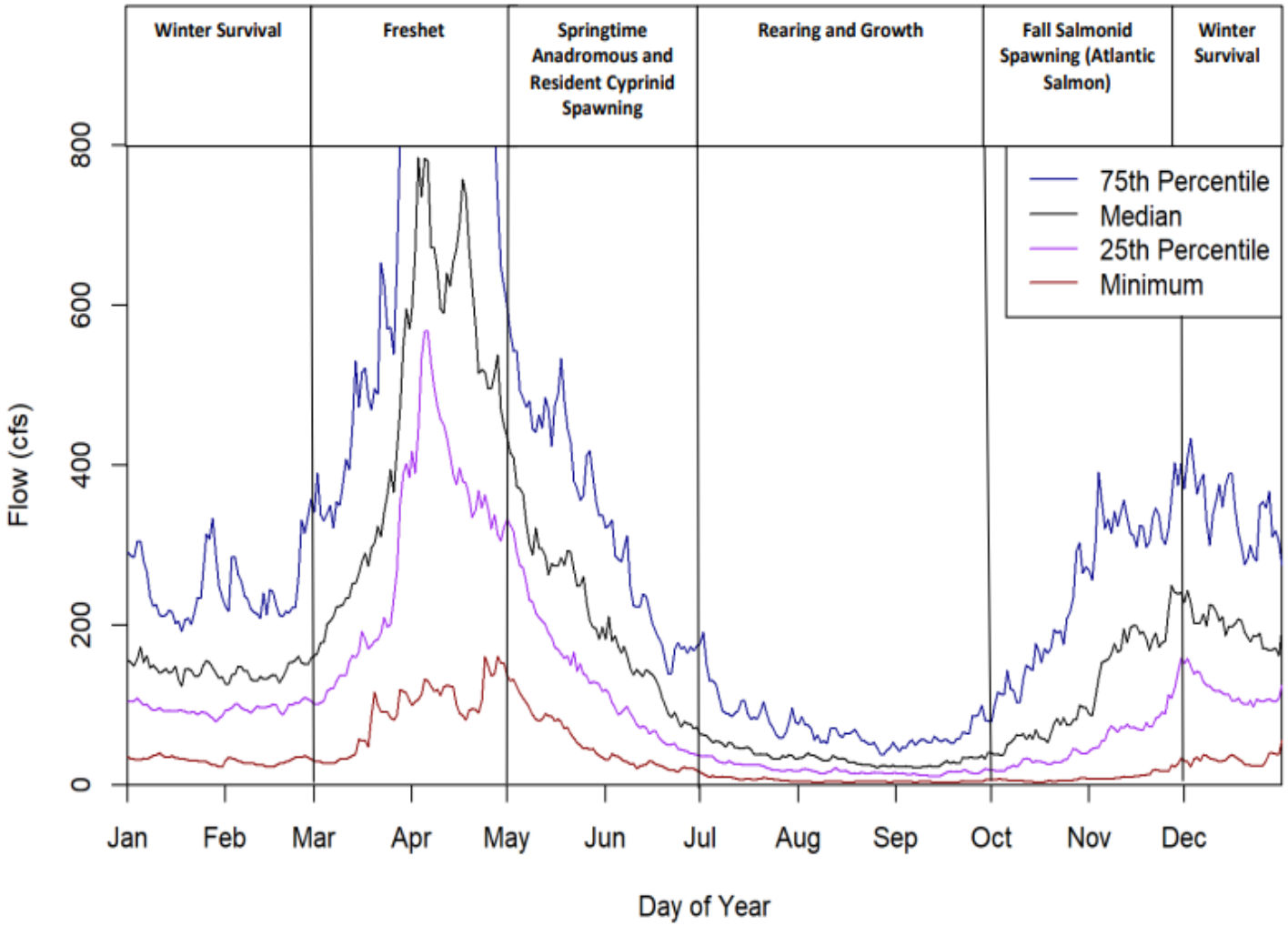


Habitat Modeling (Flow-Habitat Relationships)



BIOPERIODS

- Hydrologic breaks based on needs for target species and life stages – the needs for aquatic species change depending on the time of year and the flows that would occur



Habitat Timeseries Analysis

- Flow data were converted to habitat values (from flow vs. habitat relationships)
- Uniform Continuous Under Threshold (UCUT) curves were developed from the habitat timeseries data for species associated with each bioperiod
  - This is a complex statistical process that allows for evaluation of the frequency of habitat limitation events, characterized by habitat amounts and the length of time that the events persist
- Habitat Limitation Events
  - Common, critical and rare habitat events (related to amount of habitat) – these are tied back to the flow rate that would have resulted in habitat limitation events
  - Critical and catastrophic durations (related to the length of time that habitat limitation events of a certain magnitude occurred)
- Overall goal is to provide a flow and duration recommendation that would provide frequencies of habitat limitation events that are consistent with events that would have historically occurred (and avoid degradation due to human impacts)

Aquatic Protected Instream Flows

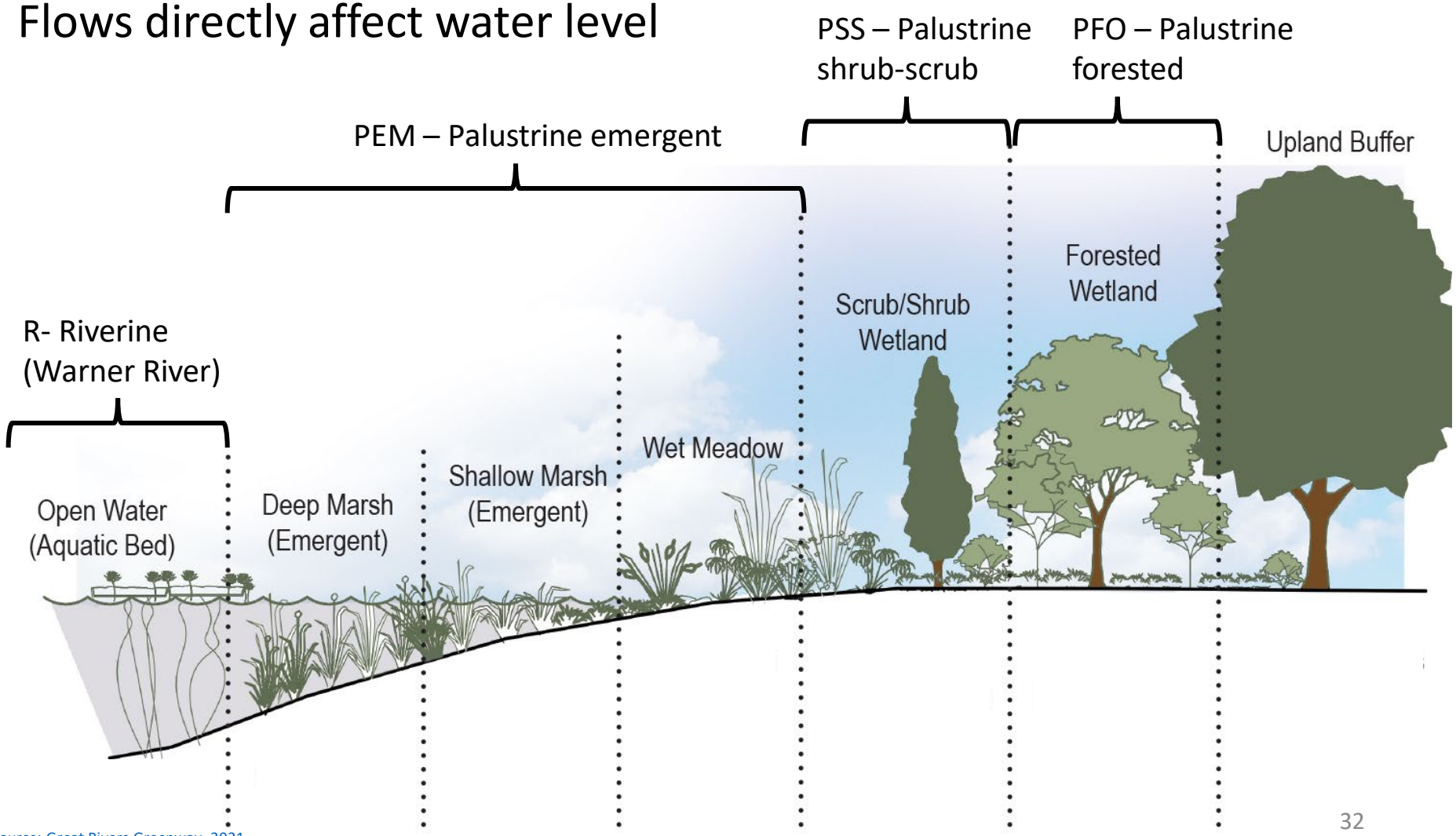
Date Range	Common Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Critical Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Rare Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)
December 1 – February 28/29	317	45	77	80	22	40	39	10	16
March 1 – April 30	1,062	26	44	148	13	27	109	7	11
May 1 – June 30	244	15	37	44	7	11	31	4	6
July 1 – September 30	76	30	71	11	14	24	6	8	15
October 1 – November 30	106	20	39	29	11	22	23	8	15

- Values were selected based on the needs of the most sensitive species evaluated within each bioperiod
- Additional detail is provided in the study report

Floodplain Transect Method for Riparian Habitat

Riparian Ecosystems and Wetlands

- Plant communities and wetlands within the river channel or floodplain rely on flows in the Warner River to maintain the community structure
- Flows directly affect water level



Source: Great Rivers Greenway, 2021

Floodplain Transect method

- Identified flow-dependent communities during initial reconnaissance
- Selected 6 transects in locations with exemplary natural communities and riparian wetlands
- Performed riparian ecosystem and vegetation surveys along each transect – surveyed the elevation of each community
- Measured water levels at each transect to determine flows that inundate each community
  - Measured continuously during a wide range of flows – September 2021 to April 2022

WARNER RIVER TRANSECTS

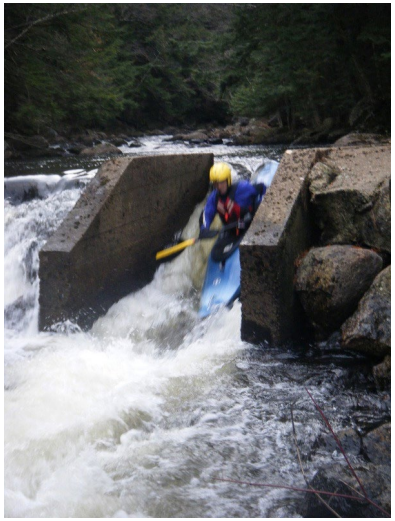
Identification of Flows for Riparian Habitat

- Correlated recorded water level to recorded USGS gage flow
- Determined water levels that inundated each type of community at the established transects
- Determined the flows that would provide those water levels
- The frequency of occurrence of those flows was determined based on their frequency in the flow dataset:
  - Inter-annual flow events of at least 400 cfs multiple times per year for emergent and riverine wetlands
  - Annual flood frequency of at least 1,160 cfs for shrub scrub and seasonally/semi-permanently flooded floodplain forests
  - 2-year flood frequency of at least 2,225 cfs for higher elevation floodplain forests

Recreational Surveys

Recreational Flow Preferences

- Based on recreational surveys – swimmers and anglers did not have flow preferences – swimming more determined by weather
- Angling – protected by fish habitat recommendations
- Several instances of whitewater boating documented – surveys and online social media research indicated flow preferences
  - Optimum boating flows: Between 565 cfs and 800 cfs
- Flows commonly occur naturally in spring – March, April, and May
- Most common run: Melvin Mills to W. Roby District Road



Source: American Whitewater, 2023

Source: American Whitewater, 2023

Source: American Whitewater, 2023

Summary

Study Findings

- Protected Instream Flows driven by aquatic habitat, riparian habitat, and paddling
- Other public uses of the stream (angling, swimming) are either not flow-dependent, or their needs would be satisfied by the recommendations for aquatic and riparian habitat

Recommended Protected Instream Flows on the Warner River

Date Range	Common Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Critical Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)	Rare Flow (cfs)	Allowable Duration Under (days)	Catastrophic Duration (days)
December 1 – February 28/29	317	45	77	80	22	40	39	10	16
March 1 – April 30	1,062	26	44	148	13	27	109	7	11
May 1 – June 30	244	15	37	44	7	11	31	4	6
July 1 – September 30	76	30	71	11	14	24	6	8	15
October 1 – November 30	106	20	39	29	11	22	23	8	15

Retain Flood Frequencies:

- Inter-annual flow events of at least 400 cfs multiple times per year for emergent and riverine wetlands
- Annual flood frequency of at least 1,160 cfs for shrub scrub and seasonally/semi-permanently flooded floodplain forests
- 2-year flood frequency of at least 2,225 cfs for higher elevation floodplain forests

Optimum Recreational Boating Flows (Spring and Fall): Provide flow events of 565 cfs to 800 cfs

Questions and Discussion

REFERENCES

Aerialgeologist.blogspot.com. 2021. Thawing Thalweg. [online] Available at: <http://aerialgeologist.blogspot.com/2015/04/thawing-thalweg.html> [Accessed 22 September 2021].

American Whitewater. 2023. Warner | Melvin Mills to Warner. [online] Available at: <https://www.americanwhitewater.org/content/River/view/river-detail/3603/main> [Accessed January 10 2023]

Bishfish.co.nz. 2021. Where to find trout in lakes, rivers and streams. [online] Available at: <http://www.bishfish.co.nz/webbooks/smttrout/findtrout.htm> [Accessed 22 September 2021].

GoBotany Native Plant Trust. Gobotany – Native Plant Trust. [Accessed January 10 2023].

Great Rivers Greenway. 2021. RECOMMENDATIONS FOR WETLAND/ POND EDGE PLANTING - Great Rivers Greenway. [online] Available at: <https://greatriversgreenway.org/design-guidelines/environmental/wetland-pond-edge-planting/> [Accessed 22 September 2021].

Milhous et. al. 2012. MODELING ENVIRONMENTAL FLOW NEEDS FOR RIPARIAN VEGETATION.

NH Fish and Game Department. 2023. Profiles | Fishing | New Hampshire Fish and Game Department. [online] Available at: <https://www.wildlife.state.nh.us/fishing/profiles/blacknose-dace.html > [Accessed January 12 2023].

USGS. 2021. How Streamflow is Measured. [online] Available at: <https://www.usgs.gov/special-topic/water-science-school/science/how-streamflow-measured?qt-science_center_objects=0#qt-science_center_objects> [Accessed 22 September 2021].