



Thompson Falls Hydroelectric Project No. 1869

Initial Study Plan Meeting

May 5, 2022



Welcome



Thompson Falls Hydroelectric Project Relicensing Initial Study Report Meeting

In-person Participation

- **One Speaker at a Time:** Limit side conversations to reduce noise distortion so everyone in the room and participating via Zoom can hear.

Virtual Participation via Zoom

- **Video and Audio:** Keep OFF, unless you are speaking as a presenter or called on to ask a question.
 - Phone controls for participants – *6 – to toggle mute/unmute.
- **Technical Difficulties:** If you are having technical issues, please contact Lydia Holland at 916.200.8233, lholland@geiconsultants.com, or use the “Chat” function.

Accurate Attendance

- **In-person:** Be sure to sign-in.
- **Zoom:** If you are shown by a phone number or abbreviated name please send Lydia Holland a message via “Chat” to capture your attendance.

Asking a Question

- **In-person:** Raise your hand to be recognized; once recognized, please speak up to ask your question.
- **Zoom:** During the Q&A – click on the “Chat” icon and type your question or click on the “Raise Your Hand” icon to be recognized; once recognized, please unmute yourself and ask your question.
 - Phone controls for participants – *9 – to raise hand.

Agenda

- The time for each segment of the schedule will be maintained.

Trains are responsible for many deaths, injuries and property damage incidents every year.

- Always look both ways before crossing railroad tracks.
- Pay attention when near tracks.
- Do not wear headphones or text when near tracks.
- Never stop your vehicle on railroad tracks.
- Never attempt to race across a crossing to avoid waiting for a train to pass.
- Always obey safety signals at crossings.
- Never walk on railroad tracks unless you are crossing at a designated crossing.
- Give trains plenty of space when they are passing.



Start Time	Topic
9:00 AM	Introduction and Zoom Tips, Overview of the FERC Process
9:15 AM	Operations Study
10:15 AM	Hydraulic Condition Study
10:45 AM	Break (15 min)
11:00 AM	Fish Behavior Study
11:30 AM	Downstream Fish Passage Literature Review
12:00 PM	Lunch (NorthWestern provides)
12:30 PM	TDG Study
1:00 PM	Visitor Use Survey
1:30 PM	Cultural Resource Study
2:00 PM	Adjourn



- Introductions

- NorthWestern representatives and consultants representing engineering, operations, legal, and hydro license compliance (including biologists, water quality experts and cultural, land, and recreation specialists).
- FERC representatives
 - Michael Tust – Licensing Coordinator, Aquatics, Threatened and Endangered Species



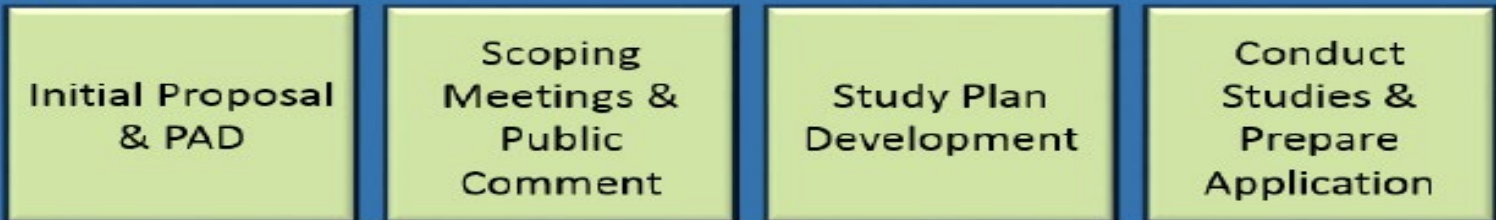
Licensed by the Federal Energy Regulatory Commission (FERC)

- 1938 – Original License
- 1979 – License was renewed for 40 years
- 1990 – Major Modification to the License for additional powerhouse
- 2025 – License expires



Integrated Licensing Process Default

Pre-filing



Post-filing



1.5 years

Date	Completed Relicensing Steps
Jul 1, 2020	NorthWestern filed PAD/NOI
Aug 28, 2020	FERC issued notice the relicensing is commencing and SD1
Oct 27, 2020	Comments on the PAD/SD1 and study requests were due
Dec 9, 2020	FERC issued SD2
Dec 11, 2020	NorthWestern filed Proposed Study Plan (PSP)
Jan 6, 2021	NorthWestern held PSP Meeting
Mar 11, 2021	Comments on the PSP are due to FERC
Apr 12, 2021	NorthWestern filed Revised Study Plan (RSP)
Apr 27, 2021	Comments on the RSP due to FERC
May 10, 2021	FERC Study Plan Determination (*)
2021-2022	NorthWestern conducts first season studies
April 28, 2022	NorthWestern filed Initial Study Report

Date	Future Relicensing Steps
May 5, 2022	NorthWestern Holds Initial Study Report Meeting (today)
May 20, 2022	NorthWestern Files Initial Study Report Meeting Summary
June 20, 2022	Study Disputes or Requests to Modify Study Plan*
July 20, 2022	Responses to Disputes or Study Requests
Aug 20, 2022	FERC Study Plan Determination, if needed
2022-2023	Second Study Season for Two-Year Studies

*Any participant may file a disagreement concerning the meeting summary, setting forth the basis for the disagreement. This filing must also include any requests for modifications to ongoing studies or new studies.

1. Discuss the first-year study results
2. Discuss the second-year studies
3. Review proposals to modify the study plan

Criteria for modification must show good cause & demonstrate:

- (1) Approved studies were not conducted as provided for in the approved study plan;
or
- (2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

Criteria for new study must show good cause & explain, as appropriate:

- (1) Any material changes in the law or regulations applicable to the information request
- (2) Why the goals and objectives of any approved study could not be met with the approved study methodology
- (3) Why the request was not made earlier
- (4) Significant changes in the project proposal or that significant new information material to the study objectives has become available
- (5) Why the new study request satisfies the study criteria in 18 CFR § 5.9(b)



Thompson Falls Hydroelectric Project No. 1869

Initial Study Plan Meeting – Operations Study

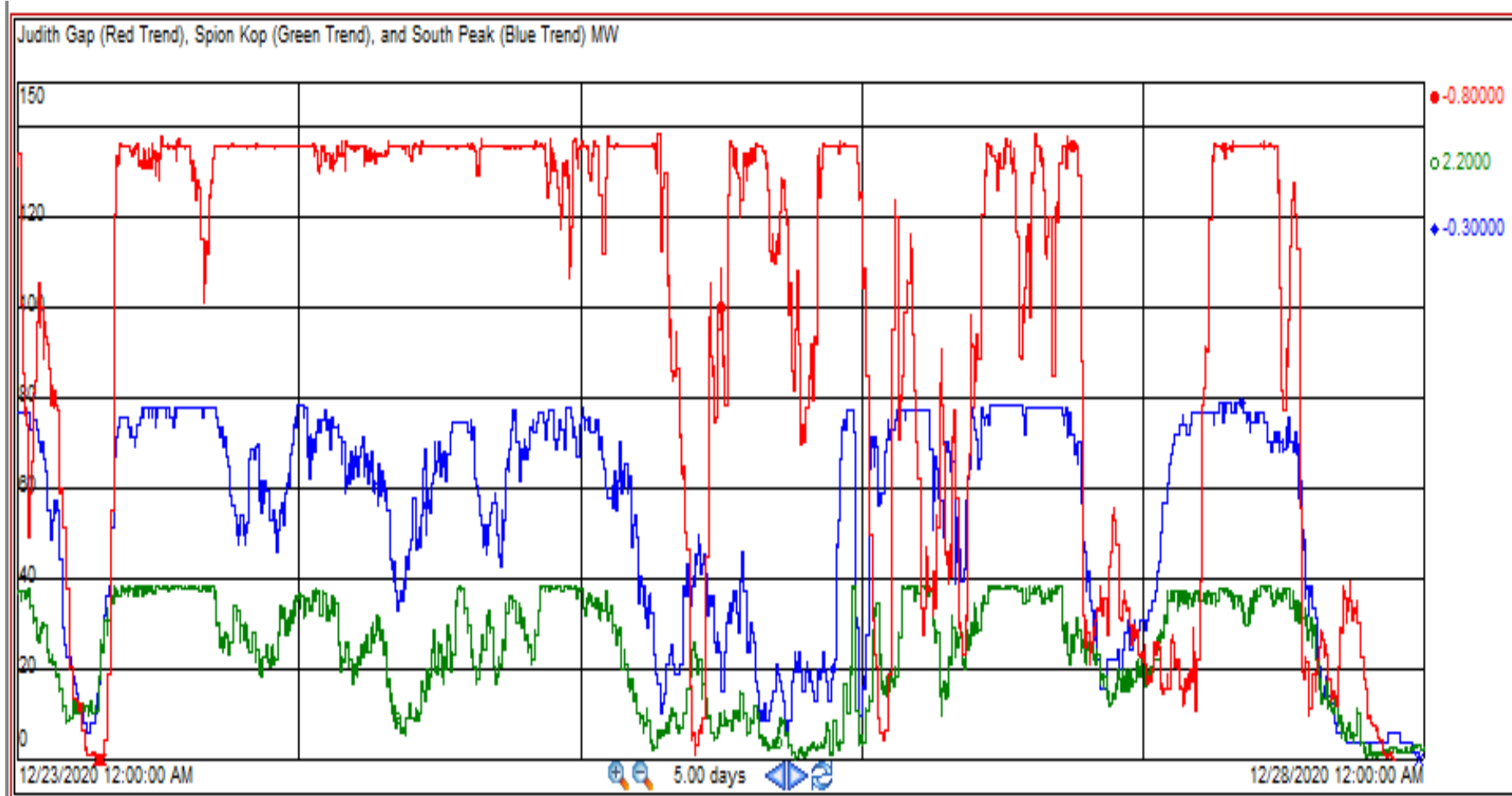
May 5, 2022



- Flexible Capacity
 - Required to maintain grid stability by balancing electrical inputs and outputs on our system.
 - Load (consumption) changes throughout the day and seasons.
 - Generation changes dynamically due to intermittent resources and plant availability.
 - Increased or decreased generation from the Thompson Falls plant supports grid stability by using available reservoir volume.



Operations Study Variable Generation





Operations Study Goals

1. Validate and quantify flexible capacity capability and benefits of the plant under multiple operational scenarios.
2. Evaluate the effects of flexible capacity operations and possible impacts on project resources.



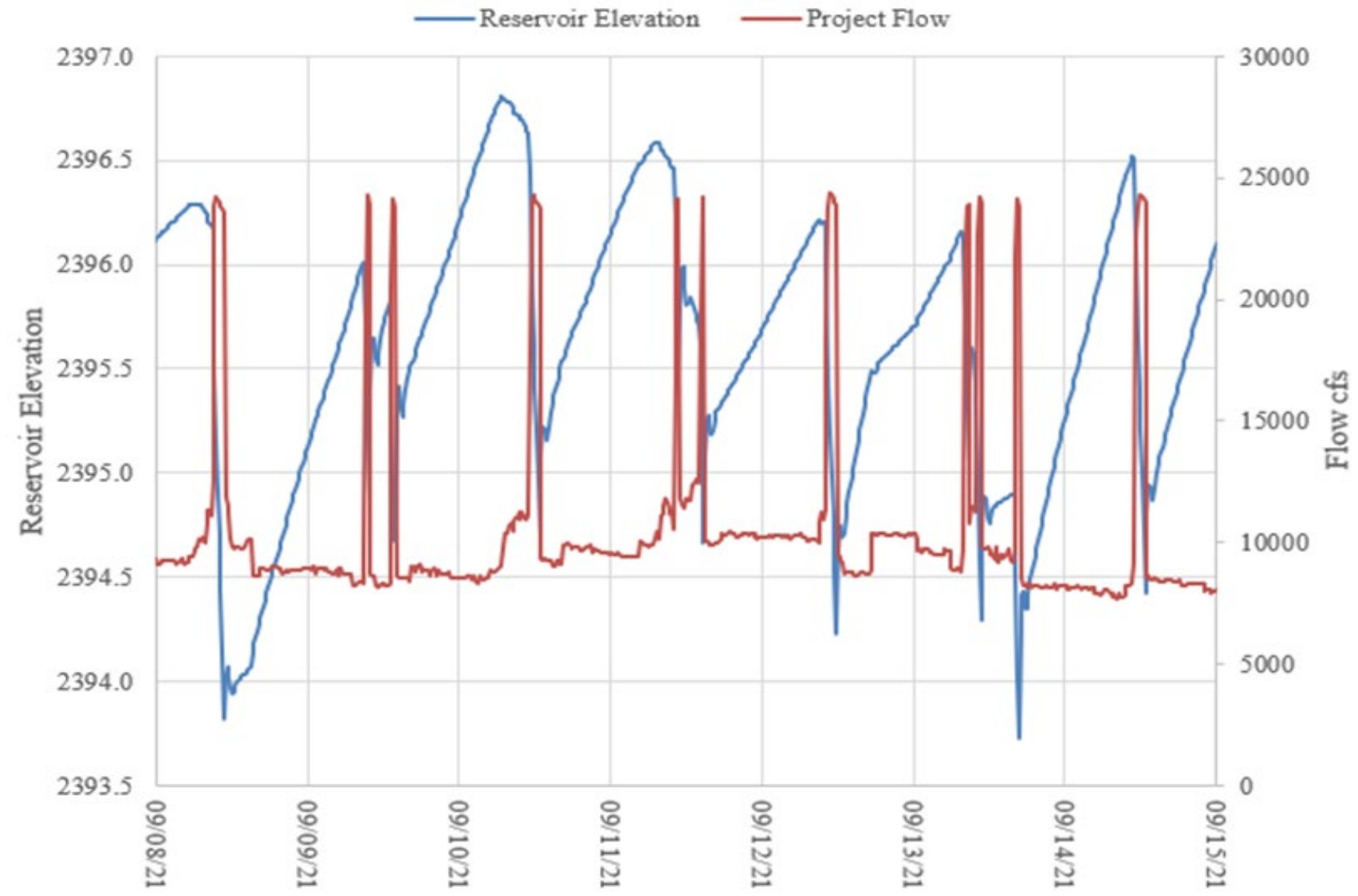
- Study Objectives
 - To simulate operational scenarios of flexible capacity at the project to determine plant generation outputs, rate, and degree of reservoir elevation changes.
- Study Description
 - Simulated operational scenarios of flexible capacity at the project.
 - Implemented in three phases with different levels of generation and corresponding reservoir elevation changes.
 - Minimum downstream flow of 6000 cfs.
 - Maintained reservoir between full pool and 2.5 feet below full pool throughout the study phases.



- Test conducted in three separate phases.
 - Phase 1 – low flexible capacity (20 MW)
 - Phase 2 – moderate flexible capacity (40 MW)
 - Phase 3 – maximum flexible capacity (max available)
- Each phase 7 days long.
- Minimum of 2 weeks break between phases.
- Minimum of two operations per day that would include an increase or decrease in flexible capacity for differing durations.
 - Flexible capacity “operations” are a prescribed increase or decrease in generation for a set duration (i.e., 20 MW increase for 90 minutes or 40 MW decrease for 30 minutes).
- A 4-hour static hold was maintained at each 0.5 feet reservoir increment throughout the full study.
- The full study completed during recreation season from July 1 to September 30 and with inflows under 23,000 cfs and over 6,000 cfs.



Reservoir Elevations and Discharge During Phase 3





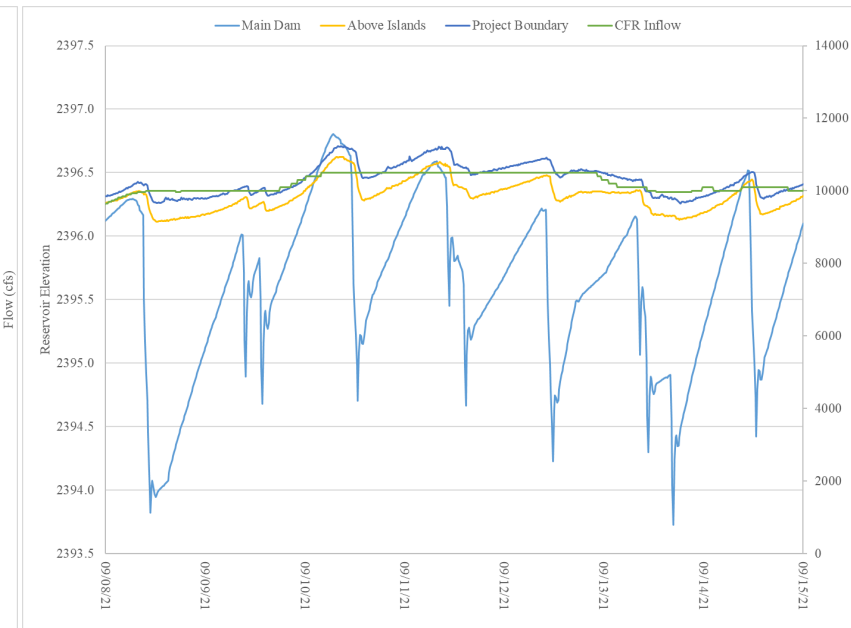
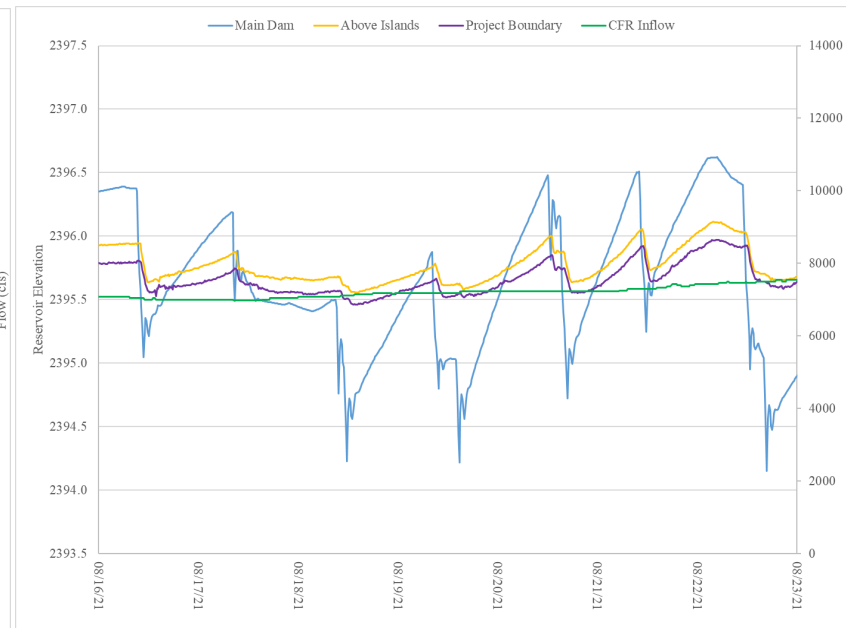
- Resource Areas Evaluated
 - Operations
 - Shoreline Stability
 - Riparian Habitats
 - Fisheries
 - Recreation & Aesthetics
 - Public Safety
 - Water Quality
 - Wetlands
 - Cultural Resources



Phase 1

Phase 2

Phase 3

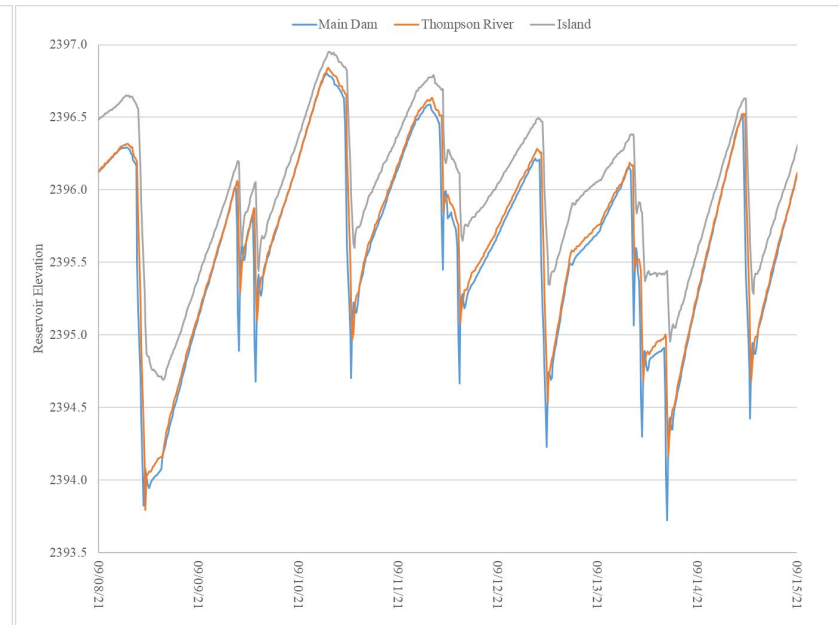
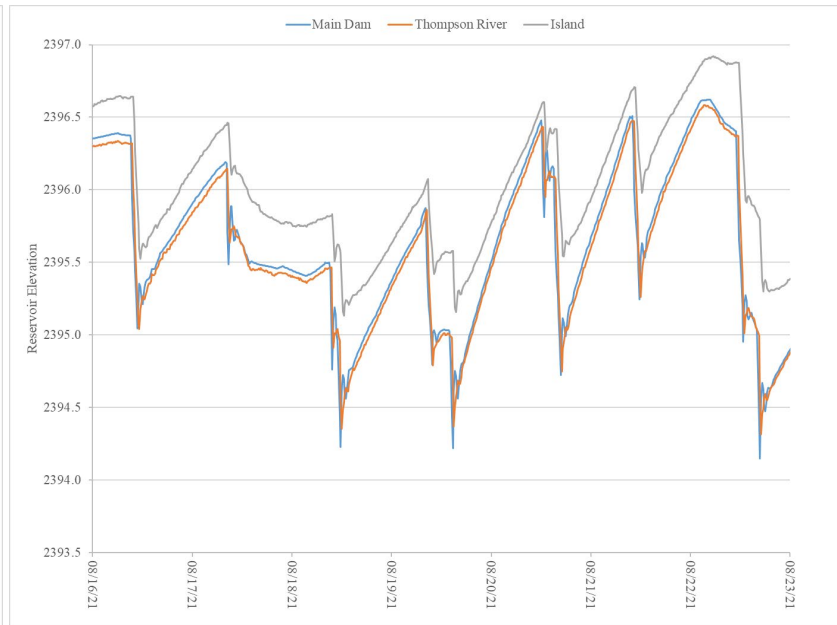




Phase 1

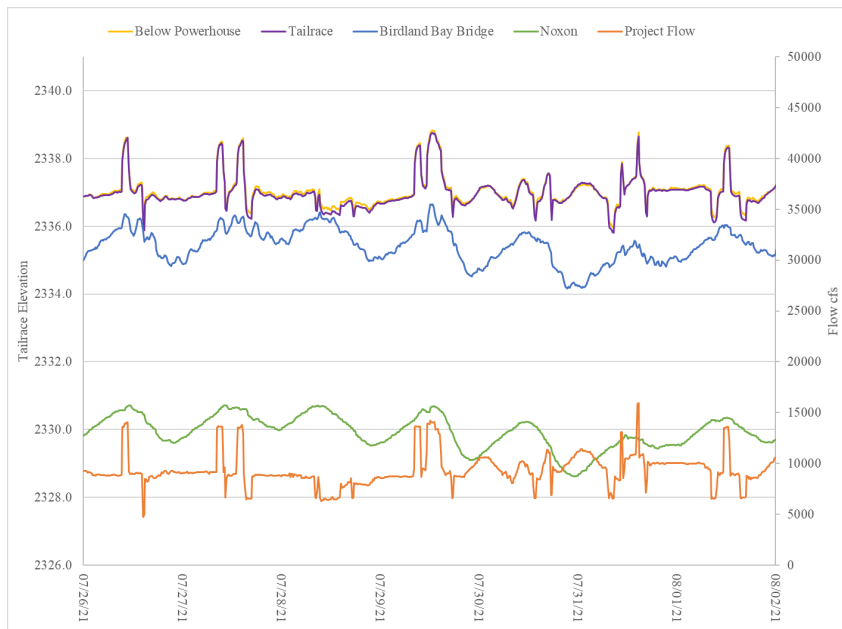
Phase 2

Phase 3

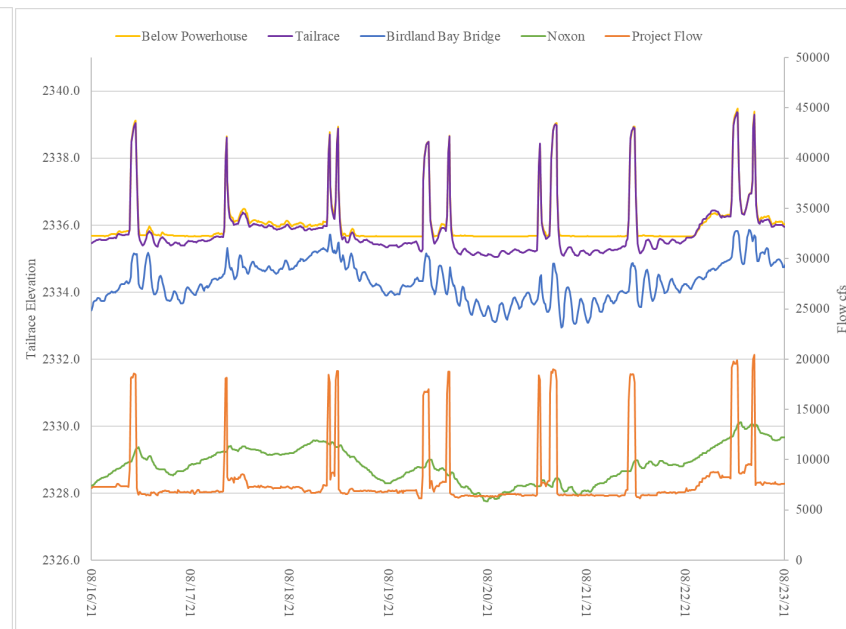




Phase 1



Phase 2



Phase 3



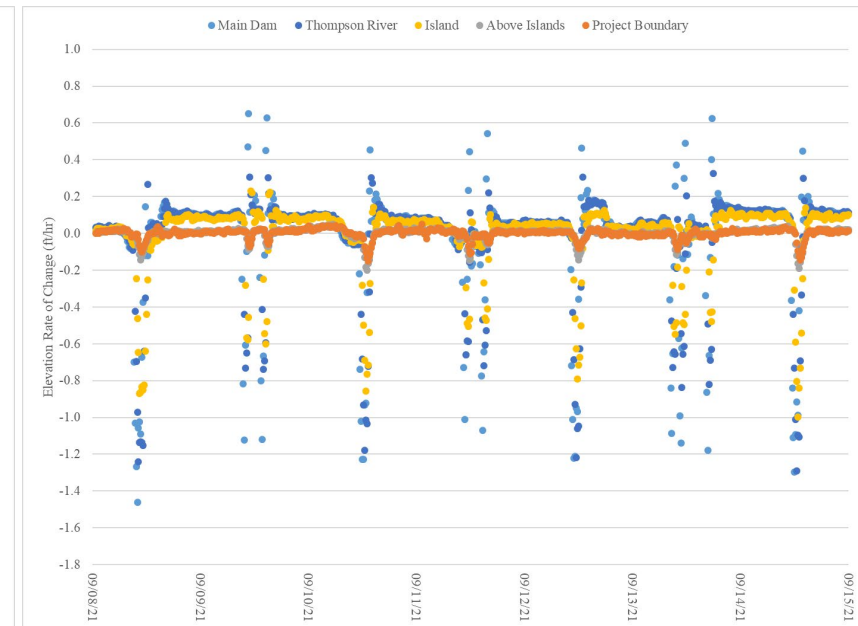
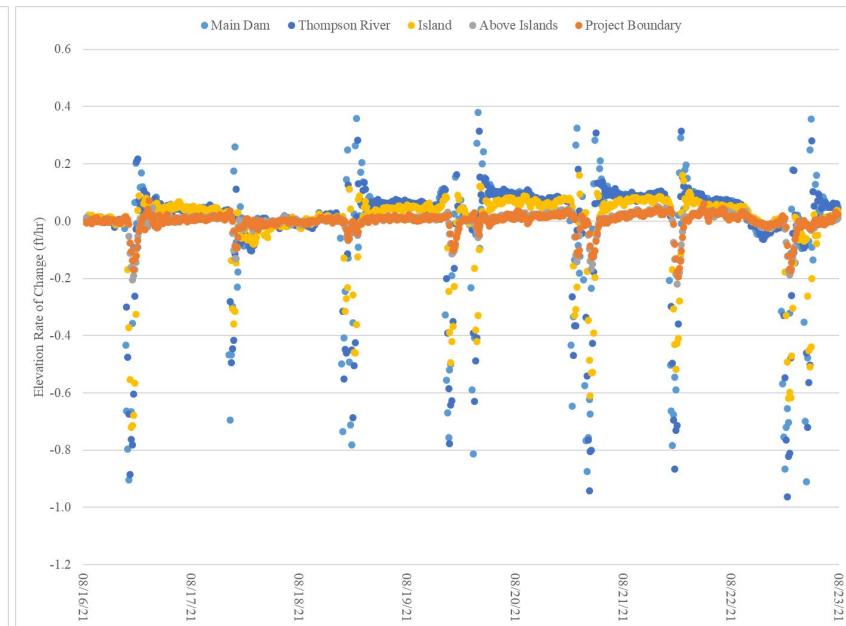
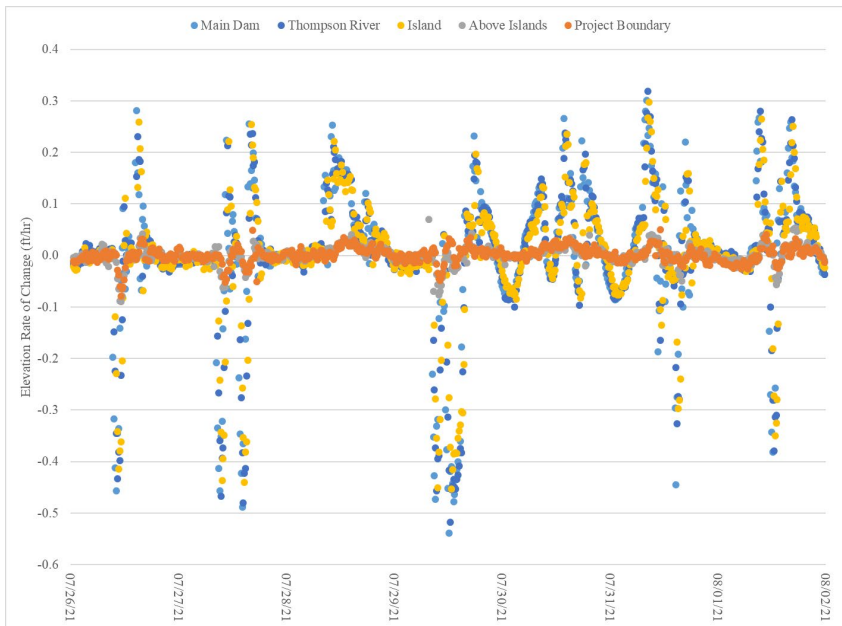


Hourly Rate of Elevation Change

Phase 1

Phase 2

Phase 3

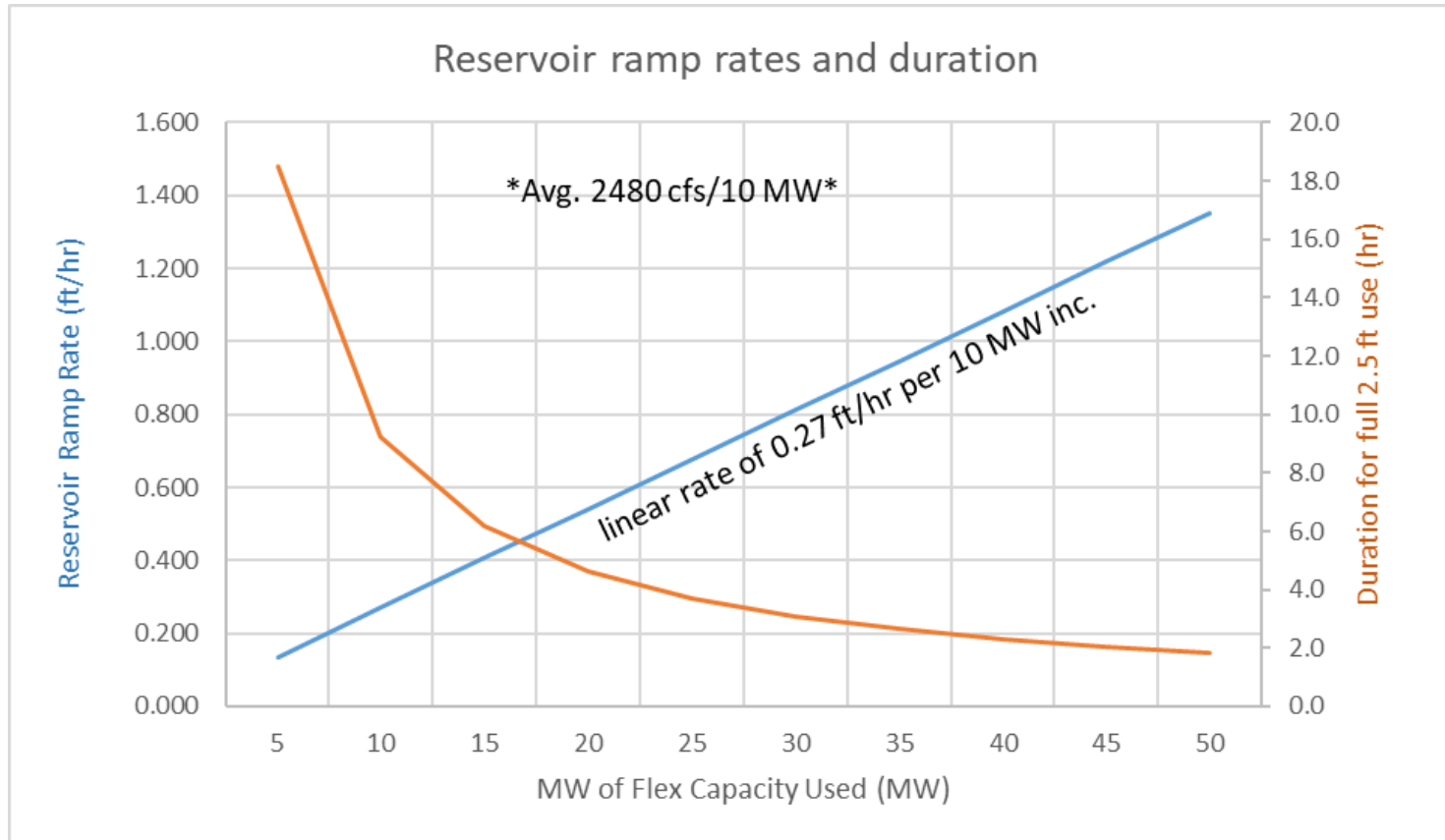




- Operations study tested the extremes of the project's flexible capacity capability.
 - Typical operations are 10-30 MW.
- Plant performed well mechanically and electrically throughout the test.
 - One controls and automation gap was identified to maintain minimum flows.
- Verified 101 MW-hrs of storage in the top 2.5 ft of reservoir.
 - Avg. 40.5 MW-hr of flexible capacity per foot of storage.
- Available generation capacity in the plant dictates reservoir ramp rates.
- Storage in the reservoir dictates durations of flexible capacity provision.
- Low baseflow conditions prevented testing of the higher decrease (DEC) operational moves.

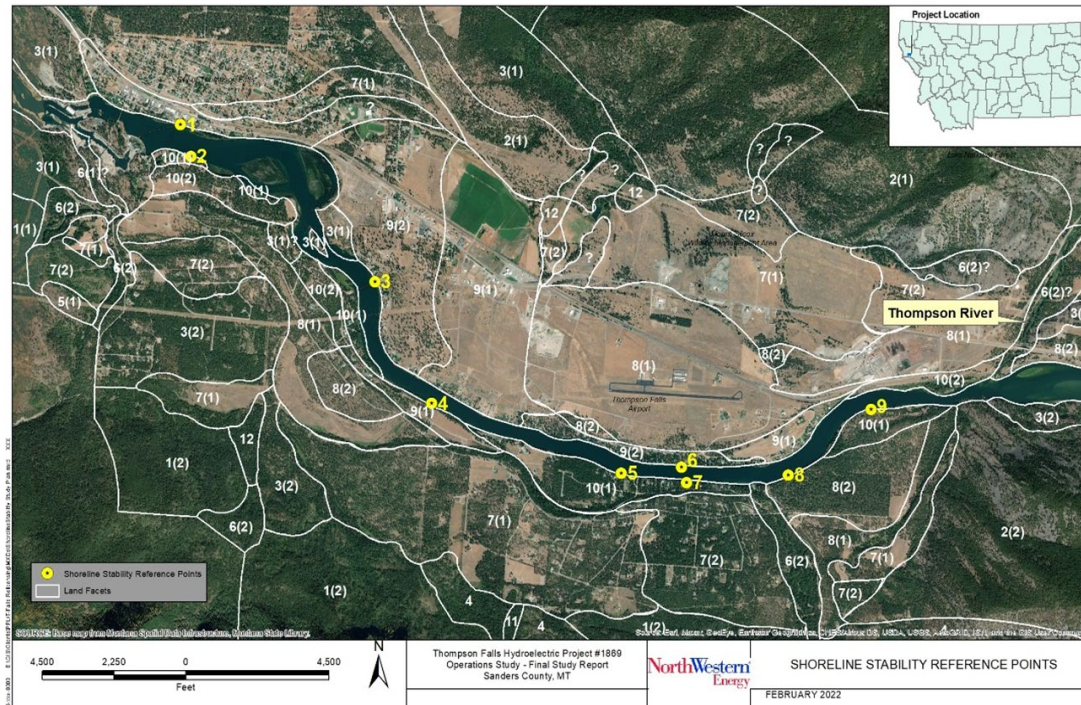


- Average ramp rate of 0.27 ft/hr per 10 MW
- Average flowrate change of 2480 cfs/10 MW





- Established nine reference points representing a diversity of soil types, slope, aspect, vegetation, and land use.
- Six monitoring events (10/2/2020, 4/19/21, 7/13/21, 8/6/21, 9/1/21 and 9/19/21).
- Documented the presence, type and magnitude of erosion, soil type, land management activities, and existing erosion control measures, if any.
- Photo documentation of each site visit.





- Fluctuating water levels did not decrease shoreline stability
- Shoreline armoring by rock, woody materials and aquatic/riparian vegetation maintained shoreline stability



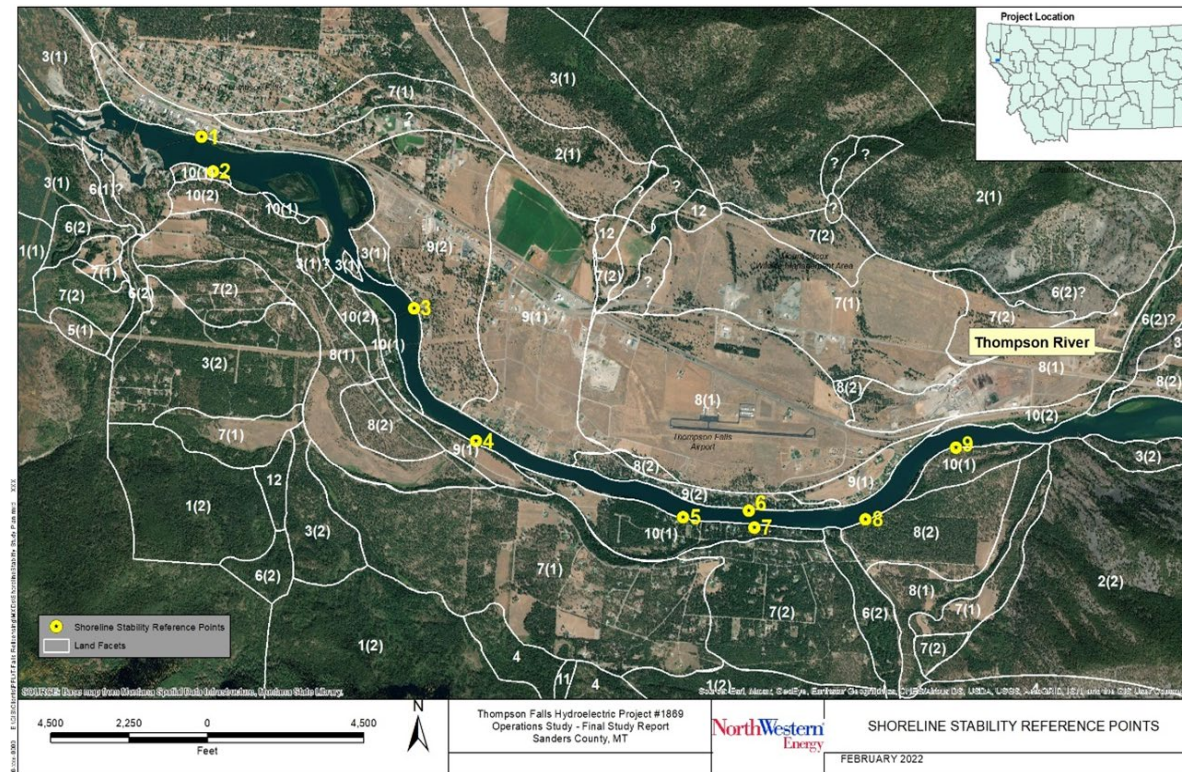


- Shoreline stability was impacted by other factors such as bank stabilization projects, spring runoff and windstorms.





- Monitoring included observations of riparian vegetation (above waterline), aquatic vegetation (emergent and submergent) and aquatic invasive species (AIS).
- Study includes nine reference points from Shoreline Stability Study, 3 reference points for the Wetlands Study and general observations of reservoir shoreline.





- A diversity of riparian and aquatic vegetation types and plant communities.
- No impacts to riparian habitats; riparian species adapted to fluctuating water levels.
- Submergent aquatic vegetation may have been mobilized into system by fluctuating water levels.





- Aquatic invasive species (AIS) are present and vary in density with yellow flag iris and flowering rush the most common species observed.
- No changes to AIS observed during study.





- Fish Stranding: Exposed islands and shoreline habitats in Thompson Falls Reservoir below Cherry Creek and near the islands above Thompson River.
- Habitat condition observations at the mouth of the Thompson River and Cherry Creek.
- Conditions within the fish ladder.





- Establish 200-foot transects in shallow habitats less than 2.5 feet deep at full pool (fluctuation zone).
 - Twelve total transects. Three on exposed mid-channel island areas and three transects along exposed shoreline habitats below Cherry Creek and near the islands above Thompson River.
 - Observers walked the transect recording species, total length, and weight of any fish observed within 15 feet on either side of the transect line.
- Established photo points at tributary confluence and 500 feet upstream to visually capture any changes in habitats.
- Level loggers deployed at tributary confluences and cross-sectional area measured.
- Fish passage facility operated as normal and observations made of pool water levels and operation of workstation.



Stranding Transects

Operations Phase #	Date	Reservoir Elevation (ft)	BBH	LMB	SMB	YP	NPM	PUM P	Total
1	7/28/2021	2396	-	-	-	-	-	-	0
	7/30/2021	2394.5	1	2	0	0	0	1	4
2	8/17/2021	2395.5	19	9	-	-	1	-	29
	8/19/2021	2395.0	3	1	-	-	-	-	4
3	9/8/2021	2394	89	9	2	4	1	-	105
TOTAL			112	21	2	4	2	1	142

Non-native Virile crayfish and American bullfrog





Cherry Creek and Thompson River Access



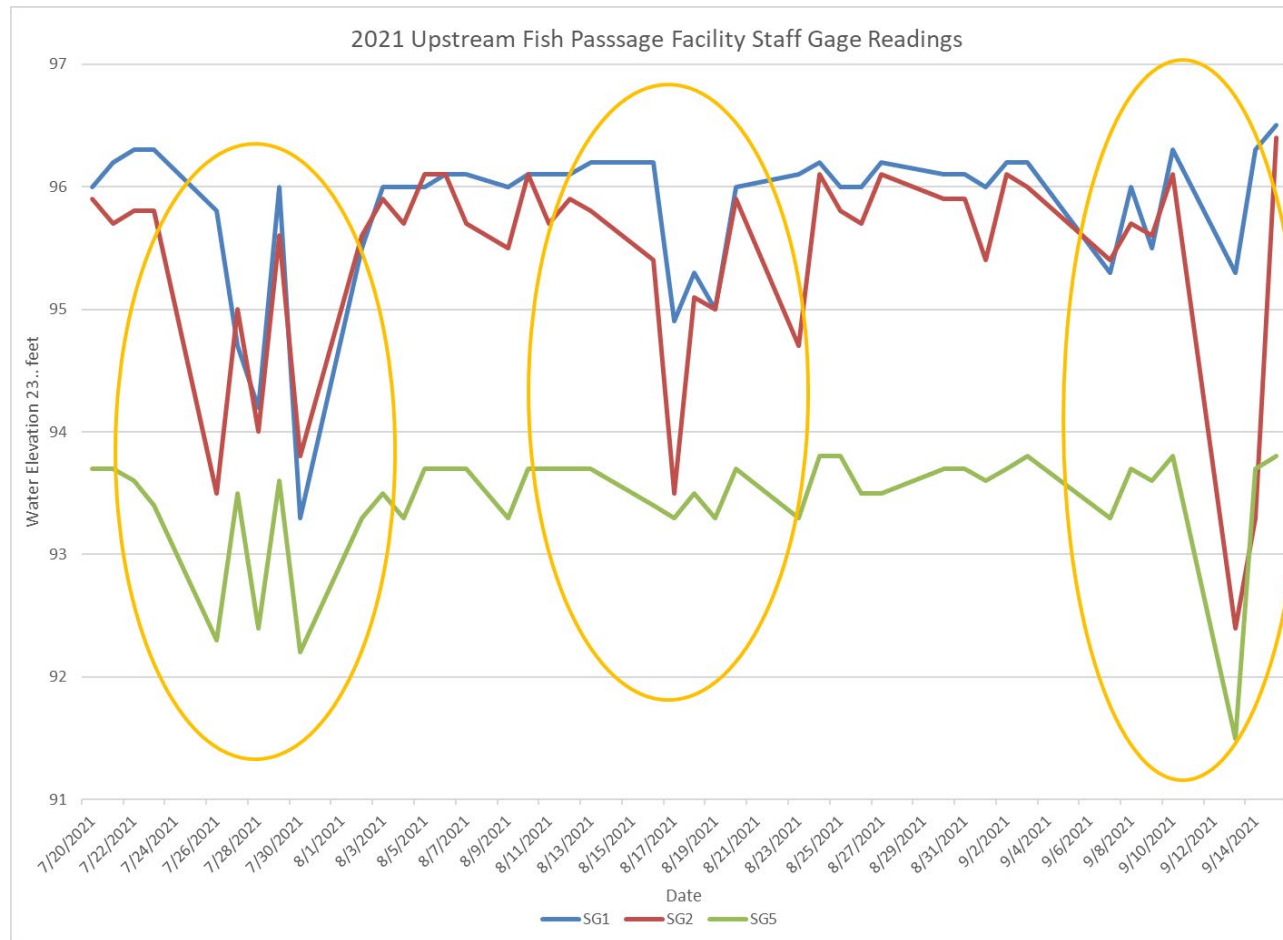
Cherry Creek at 2394 feet



Thompson River main channel access



Fish Ladder Operations



- 2,394.2' (2.3 feet below full pool) the HVJ, and sampling loop intermittently worked due to lack of water.
- Slightly reduced water depths in ladder pools as reservoir elevation decreased.
- Phase 3 testing pulled floating mats of aquatic vegetation into ladder screens and plugged operations.



Recreation and Aesthetics

Assessment of recreation impacts to docks, boat ramps, and Sandy Beach, as well as impacts to aesthetic qualities, at each half-foot increment* of reservoir elevation down to 2.5 ft below full pool.

- Subset of 39 representative docks identified; impacts documented and photographed.
- Depth of water measured at the end of submerged boat ramps.
- Water elevations documented at Sandy Beach, downstream of the original powerhouse.
- Changes in aesthetics at common public viewing areas were documented through photos and detection of odors.

**Modification from FERC-approved Study Plan, which stipulated monitoring only full pool and lowest elevation (-2.5 ft), not at each half-foot increment.*



Stationary dock structures were not impacted, but access to boats moored to them was substantially reduced at -1.5 ft elevation and lower. Waterway access from stationary docks was substantially impacted at -2.5 ft elevation.

Full Pool



Full Pool



-2.0'



-2.5'





Impacts to floating docks depended on location and configuration. Most (90%+) functioned adequately at -1.5 ft, 70% functioned at -2.0 ft, about 50% provided access at -2.5 ft elevation.



**North Shore
-2.5'**



South Shore -2.5'



Full Pool



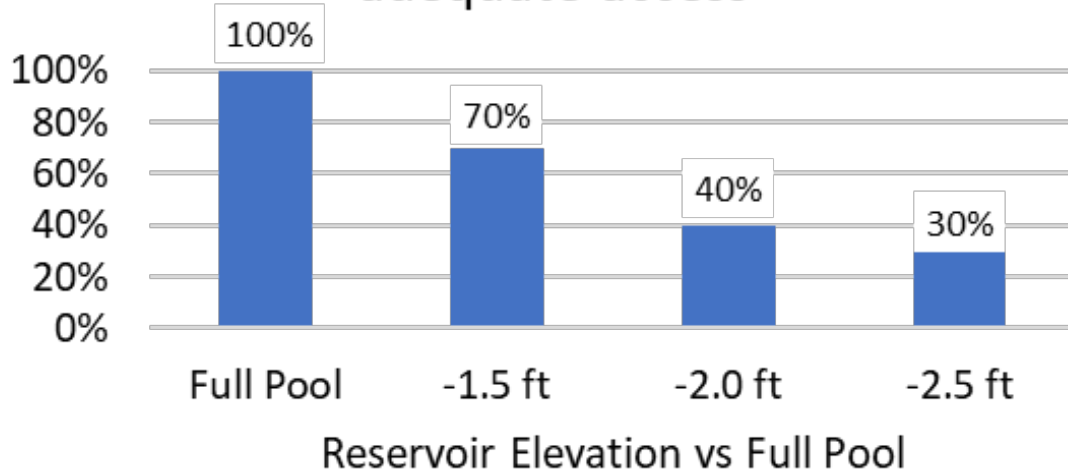
-1.5'



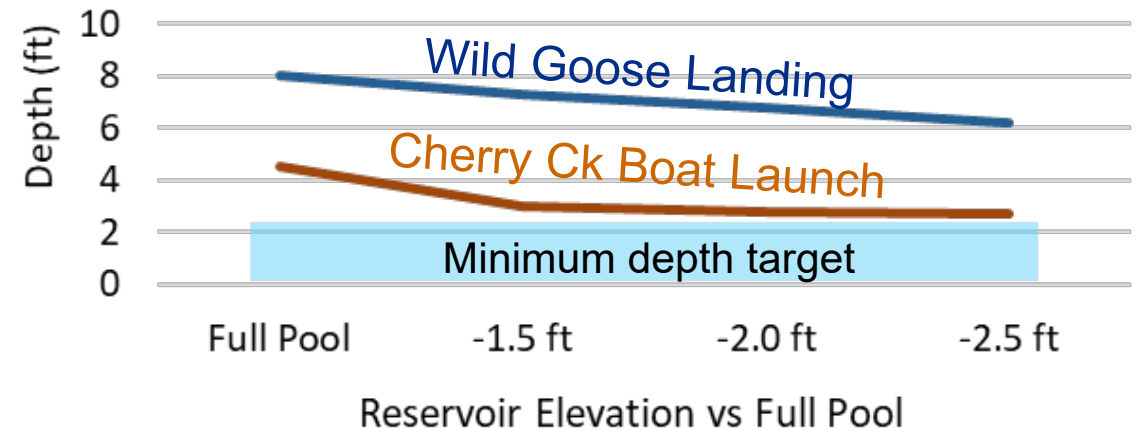
-2.5'



Percent of all docks providing adequate access



Water Depth at End of Boat Ramp



Sandy Beach recreation access not negatively impacted other than changing water levels.

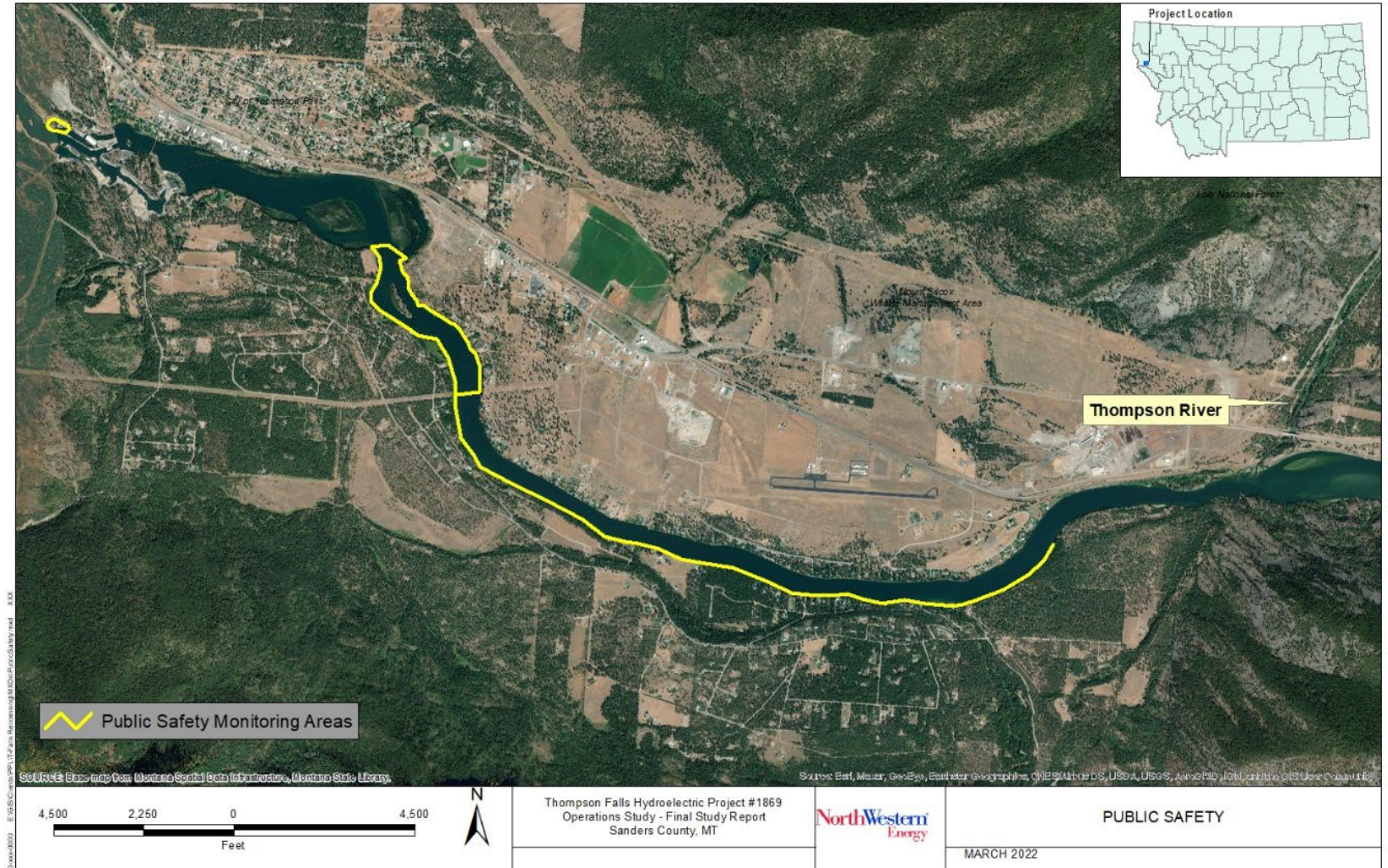
Aesthetic qualities (views and odor) were minimally impacted at -1.5 ft elevation or less.



Public Safety

Monitoring and observation of in-water hazards in high traffic areas at each half-foot increment of reservoir elevation.

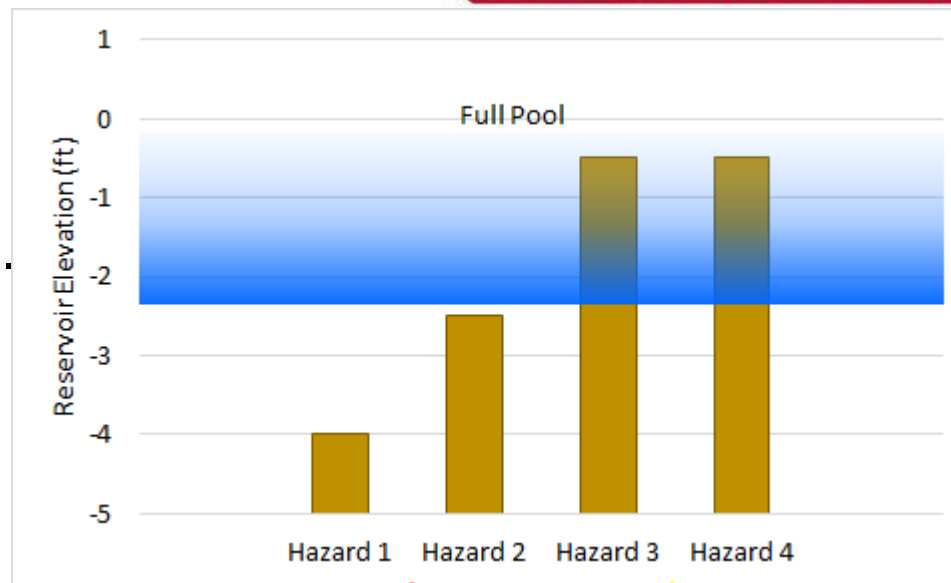
Assessment of public safety risk associated with changing water levels and flow rates at Sandy Beach, below the powerhouses.





Assessment Results:

- Risk of contact with stationary rock outcrops near Steamboat Island varies with water elevations. As the reservoir elevation lowers, Hazards 1 and 2 get higher in the water column but remain submerged so contact risk increases. Hazards 3 and 4 become more visible and risk is reduced at lower water elevations.
- Shoals and inundated islands remain visible at all elevations and contact risk is unchanged.
- Sandy Beach water elevations change as generation is varied, but flows are tempered by rock outcrops and gravel bars to protect swimmers and recreationists.



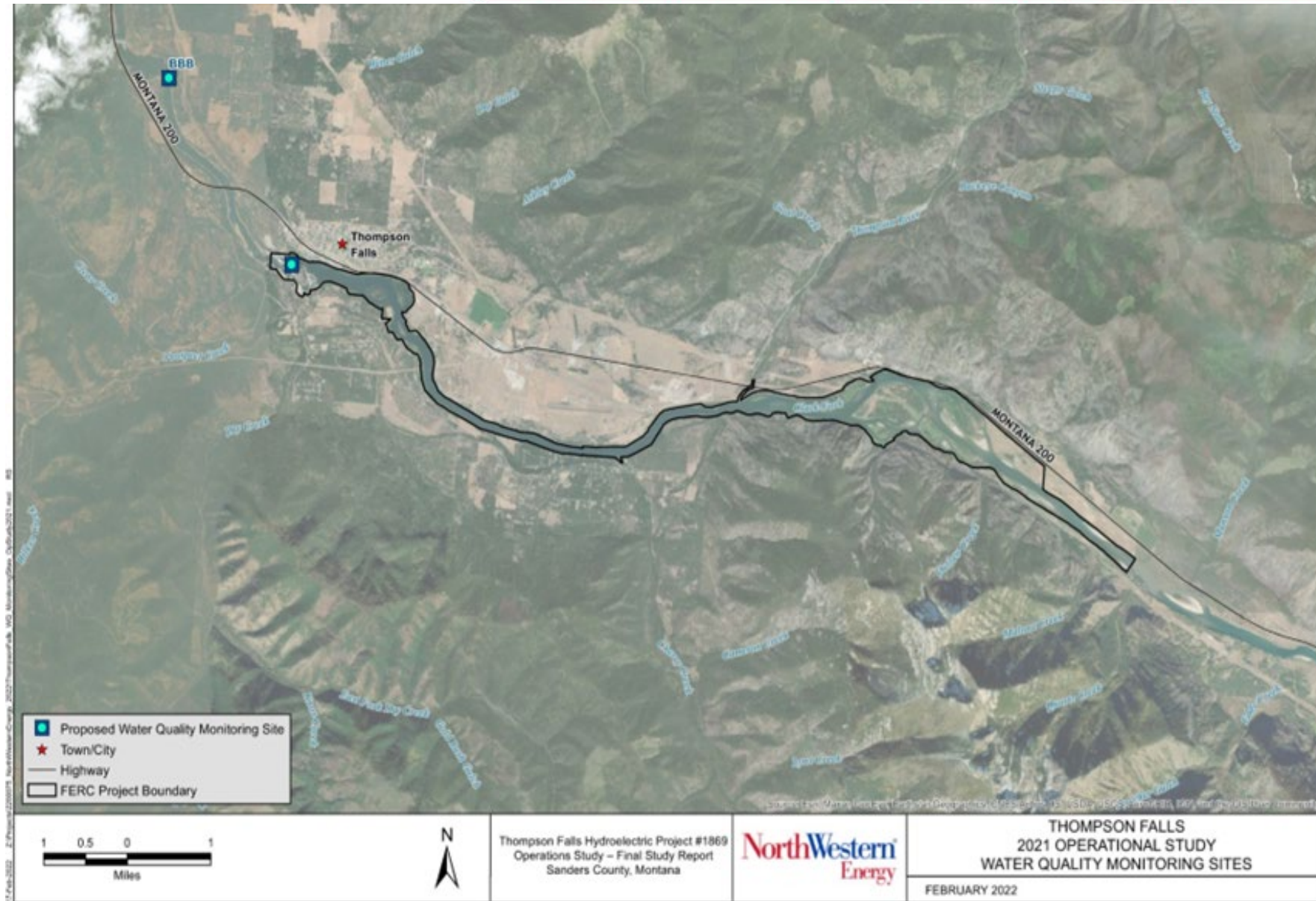


- Water quality was studied to determine if Project operations influence on downstream water quality.
- The monitoring site upstream of the dam characterizes the incoming upstream water quality from the reservoir.
- The Birdland Bay Bridge site captures the water quality leaving the Project before it enters Noxon Reservoir.





- Hydrolab HL7 water quality instruments were installed in two locations and measured water quality parameters at 15-minute intervals throughout the operations testing.
 - Upstream of the Dry Channel Dam
 - Birdland Bay Bridge
- Parameters
 - Turbidity
 - pH
 - Specific conductivity
 - Dissolved oxygen
 - Temperature
 - Depth



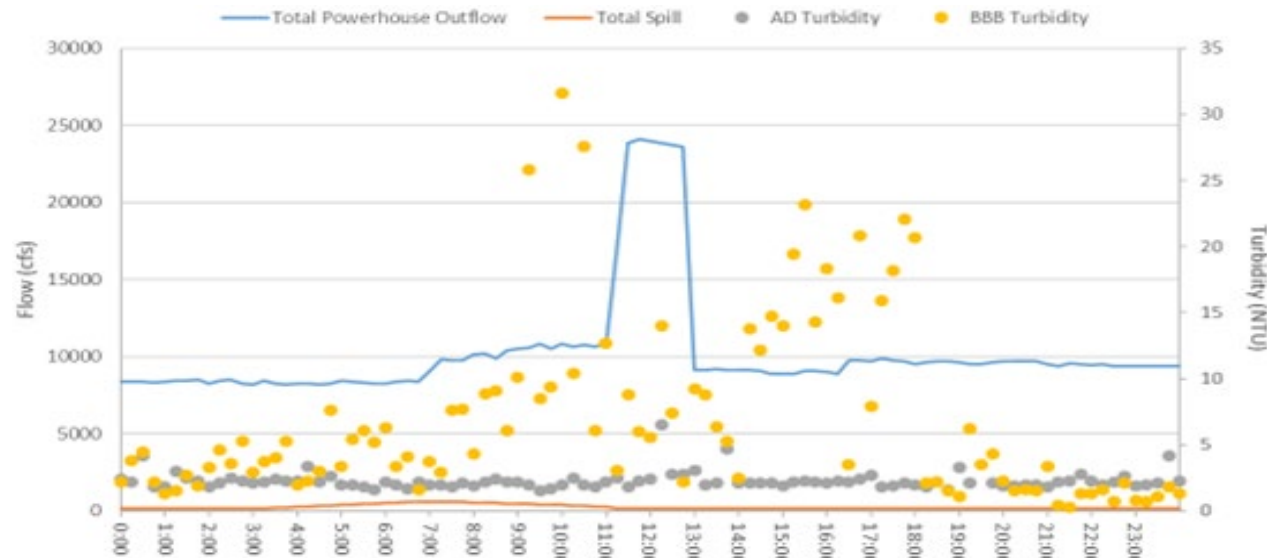
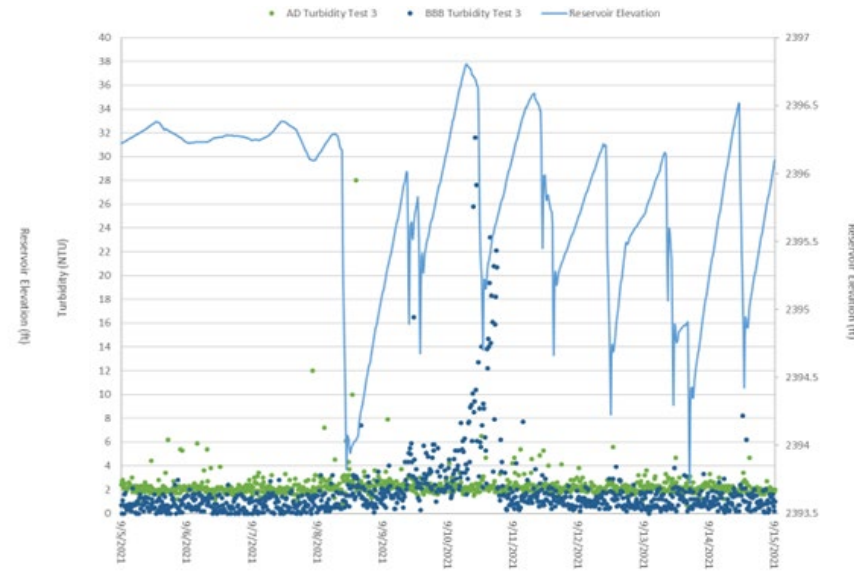
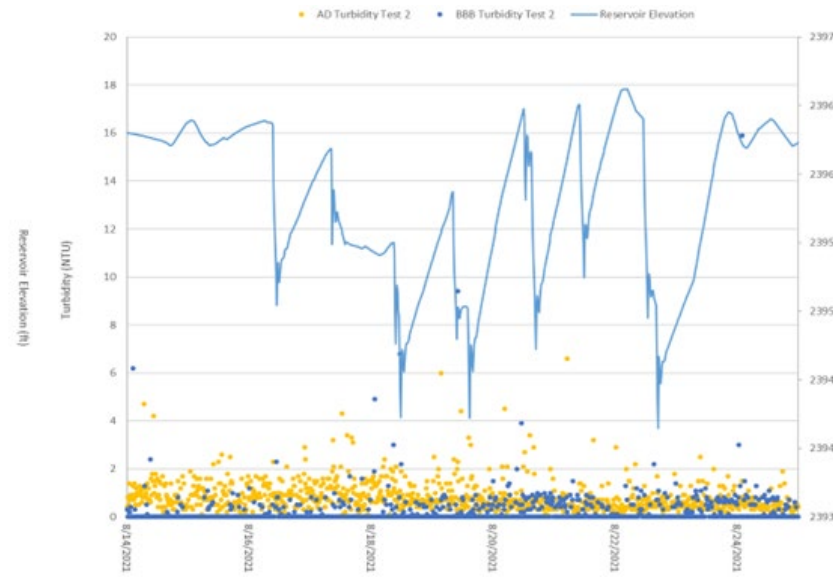
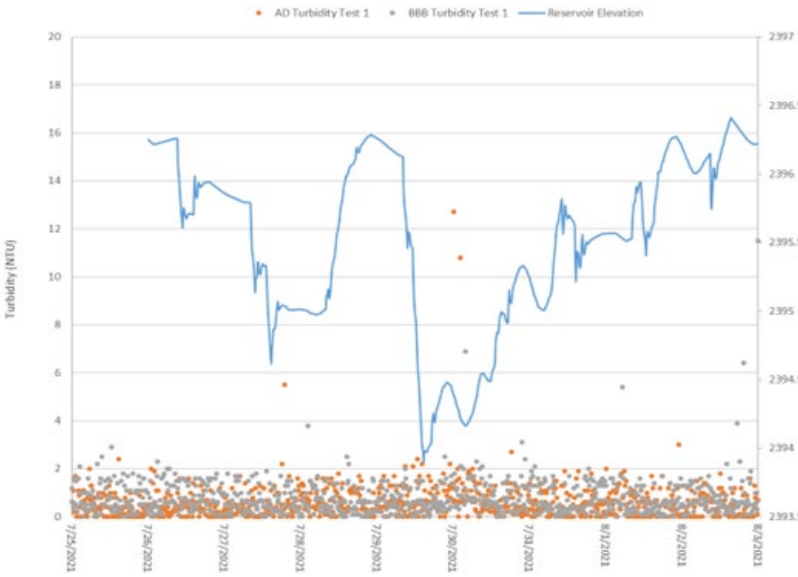


- Water quality data collected during all three phases show that the various flexible operation scenarios tested do not appear to have a significant effect on water quality within the reservoir and downstream in the Clark Fork River.
- Water quality appears to be independent of depth of drawdown, duration of drawdown, and drawdown frequency.



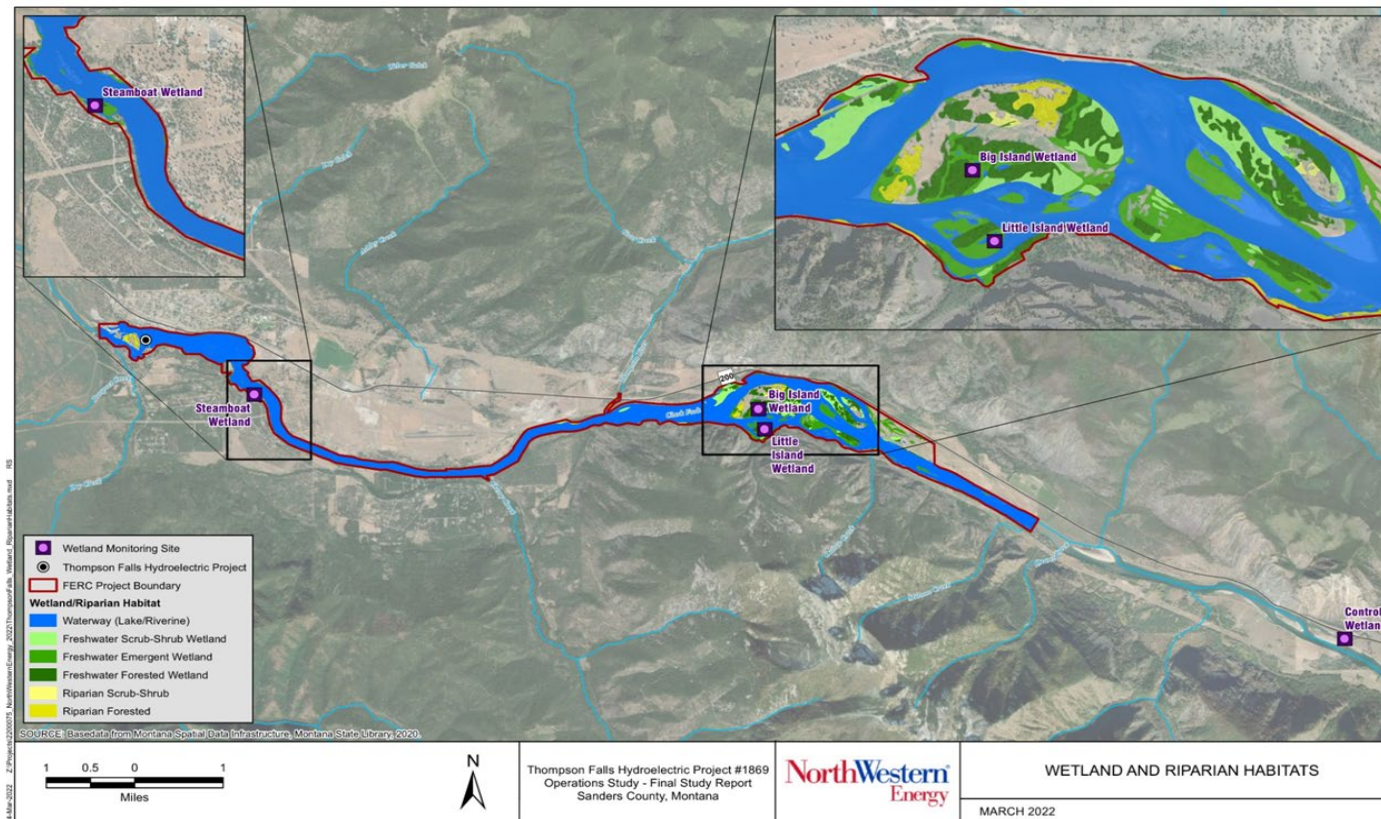
Operations Study Results

Water Quality





- Wetlands within the Project were studied to determine what impact (if any) there was from project operations.
- Three sites were selected in the reservoir as was one study control site upstream of the reservoir. The reservoir sites were focused on the area near steamboat island and at the island complex upstream of the Thompson River.
- Wetlands identified using Montana Spatial Data Infrastructure Wetlands Framework and ground-truthed in the field prior to final site selection.



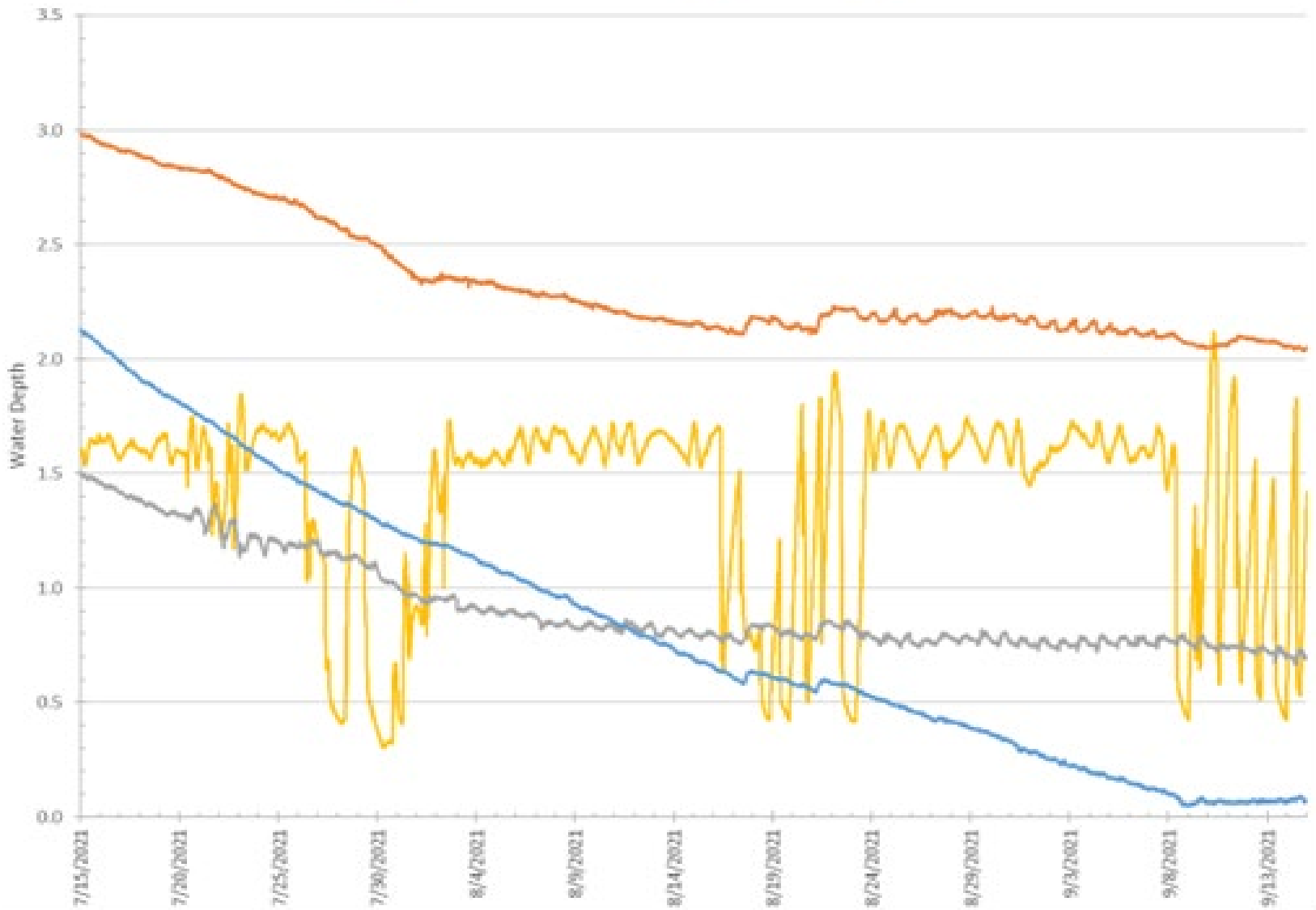


- Visual observations were conducted, and stage loggers were deployed to monitor changes in water levels at each wetland site.
- Potential risk of impact to each wetland ranked as high, medium, or low by evaluating:
 - Potential hydrologic connection alteration due to reservoir fluctuations
 - Soil type
 - Slope
 - Distance from ordinary high-water mark

Site Name	Site Description	Primary Wetland Classification	Secondary Wetland Classification	Potential Risk of Alteration from Operations
Wetland 1	Side channel near Steamboat Island in Lower Reservoir	Palustrine, Emergent, Temporarily Flooded	Riverine, Unconsolidated Bottom, Permanently Flooded	High
Wetland 2	On Large Island in Upper Reservoir	Palustrine, Aquatic Bed, Semi-permanently Flooded	Palustrine, Forested, Temporarily Flooded	Medium
Wetland 3	On Small Island in Upper Reservoir	Palustrine, Aquatic Bed, Semi-permanently Flooded	Palustrine, Emergent, Temporarily Flooded	Medium
Wetland Control	In Oxbow Upstream of Project Boundary	Palustrine, Aquatic Bed, Semi-permanently Flooded	Palustrine, Emergent, Temporarily Flooded	None (Control Site)



Wetland 1 Wetland 2 Wetland 3 Wetland Control



- Wetland 1 (side channel behind Steamboat Island) fluctuated in water level parallel to reservoir fluctuations from operational changes.
- All other wetlands studied mirrored the control site and were not affected by fluctuations in reservoir elevations.



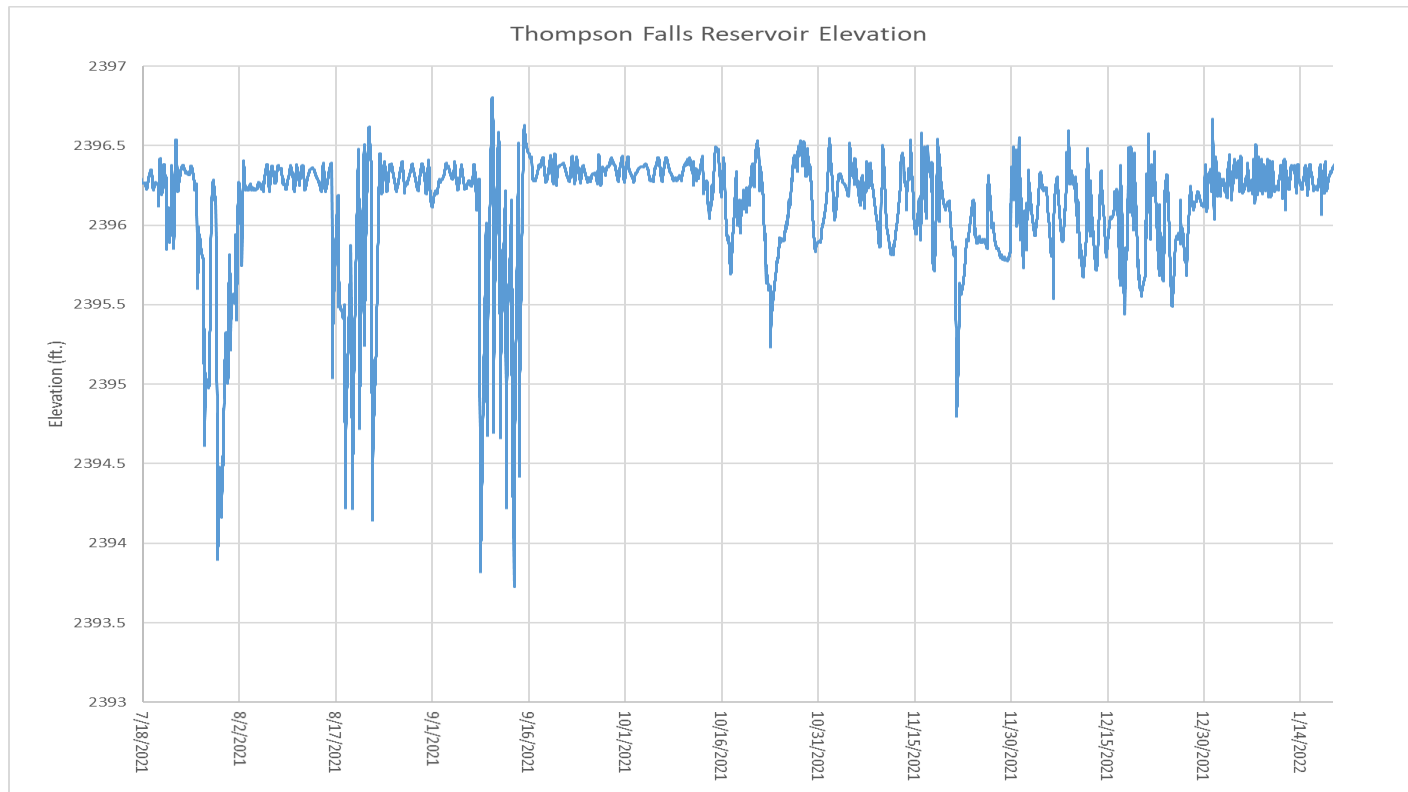
- Wetlands like Wetland 1 make up approximately 9.4 acres within the Project boundary.
- Further studies will be conducted in 2022 to determine if these other wetlands are also similarly impacted by Project operations.





- Study area consists of the locations of known archaeological properties at or near the reservoir high water line.
- 3 known properties
 - Salish House.
 - Prehistoric and historic artifact scatter.
 - Chinese railroad construction encampment.
- Methods
 - Observe effects of reservoir elevation changes at or near those locations during single drawdown.
 - Document observations on site monitoring forms.
- Results
 - No exposure of archaeological features or artifact concentrations noted.

- The first study season successfully tested the extent of flexible capacity available at the Project. However, the study tested the more extreme operational scenarios.
- NorthWestern is proposing a second season study to monitor and evaluate the effects of certain resources during actual (not simulated) baseload and flexible capacity operations.



- Operations will be used to provide grid regulation in real-time allowing NorthWestern to monitor and evaluate potential impacts of realistic operations in the current energy market.
- Focus on monitoring resource areas where impacts were identified during the first study season including:
 - Shoreline stability
 - Riparian habitats
 - Fisheries
 - Recreation and aesthetics
 - Wetlands
- Results of the Modified Operations Study will be filed as part of the Updated Study Report (May 10, 2023)

**Operations Study Report included in the Initial Study
Report filed on April 28, 2022.**

Link for download:

https://www.northwesternenergy.com/docs/default-source/default-document-library/clean-energy/environmental-projects/thompson-falls/thompson-falls-relicensing/p1869-isr-operations-study.pdf?sfvrsn=3481cbf3_9

- **One Speaker at a Time:** Limit side conversations to reduce noise distortion so everyone in the room and participating via Zoom can hear.
- **Order of Questions:** Questions from Zoom participants will be responded to first.
- **Guidelines for Asking a Question via Zoom:**
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NorthWestern[®] Energy

Delivering a Bright Future

Thompson Falls Hydroelectric Project No. 1869

**Hydraulic Conditions Study –
Initial Study Report Meeting**

May 5, 2022

- Study Background
- Task 1 – Bathymetric Survey
- Task 2 – CFD Modeling
 - Model Development
 - Model Results
- NorthWestern Response to Comments
- Next Steps



- Result of 2008 Biological Opinion requirement to conduct a scientific review of the passage facility.
- The scientific review panel recommended a hydraulics study in the near field downstream of the project and a fish behavior study.
- Flow modeling results will be compared to fish behavior data to provide information on effectiveness of passage facility and help describe fish behavior within the area.

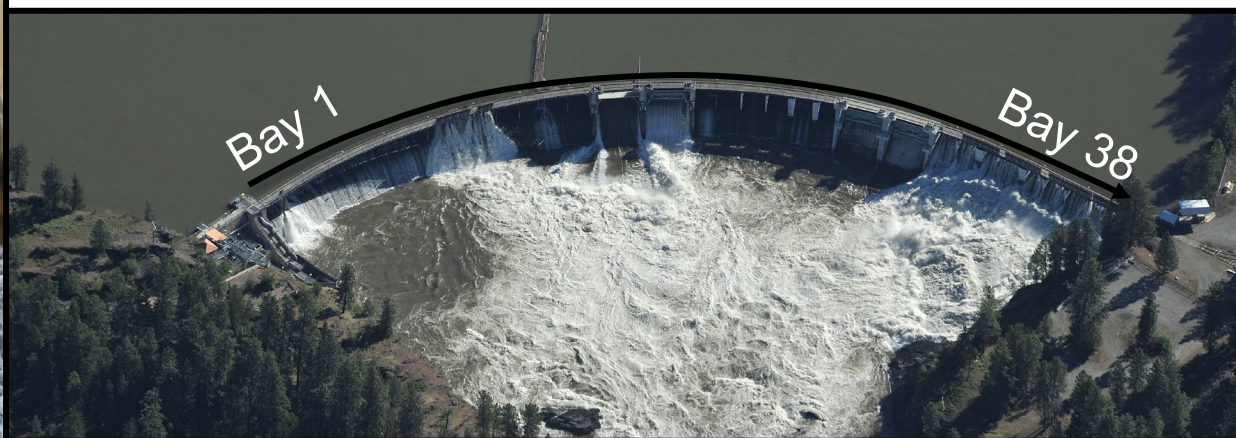




- 38 bays total
- 8 bays replaced with radial gates
- Varying widths due to pier sizes
- 6 removable panels per bay
- Opening schedule in Total Dissolved Gas Report (2010)



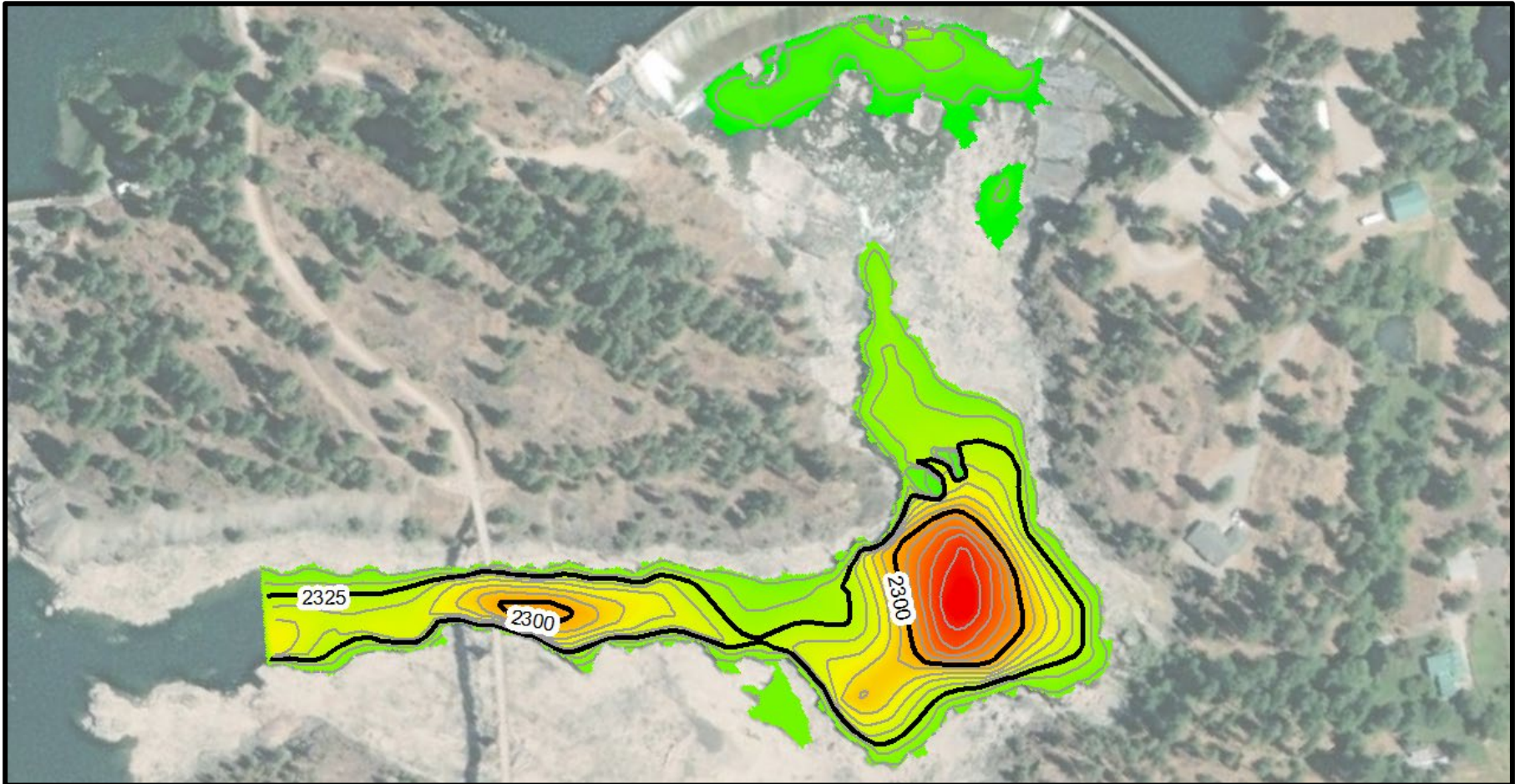
6 Panels per Bay



Study Area in the FERC-approved Study Plan



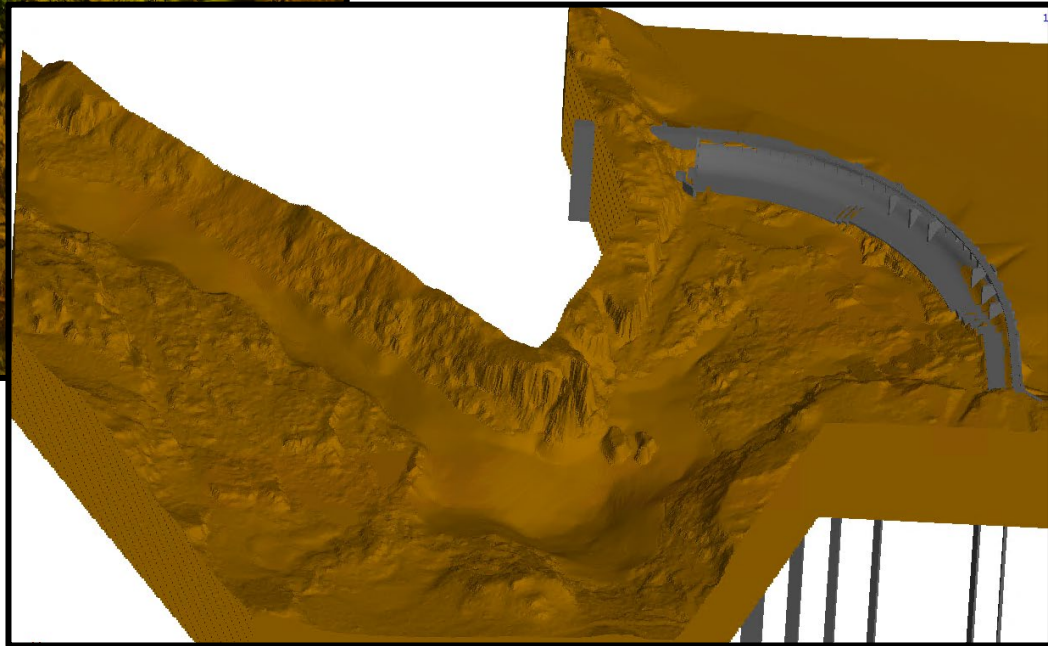
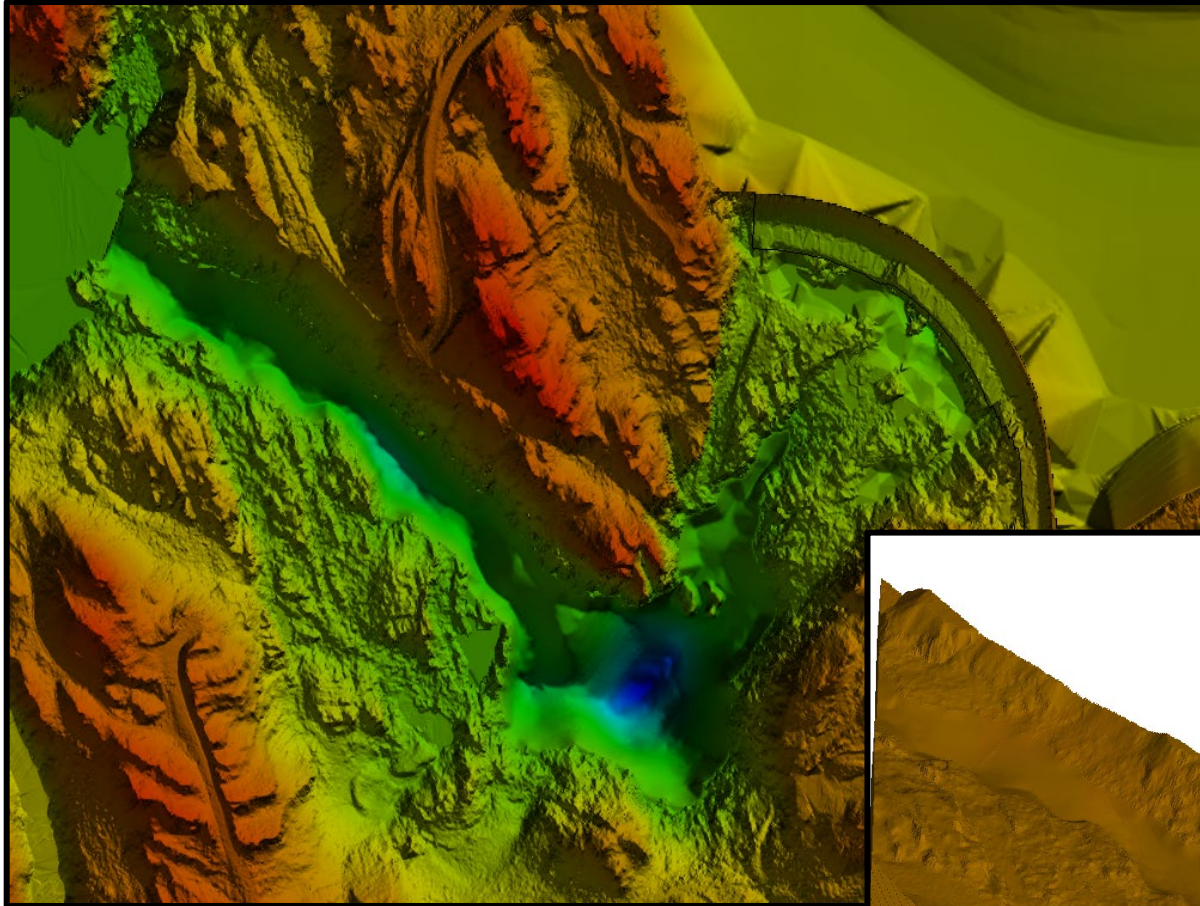
- Bathymetry from Morrison Maierle
- Additional survey from Northwestern Energy





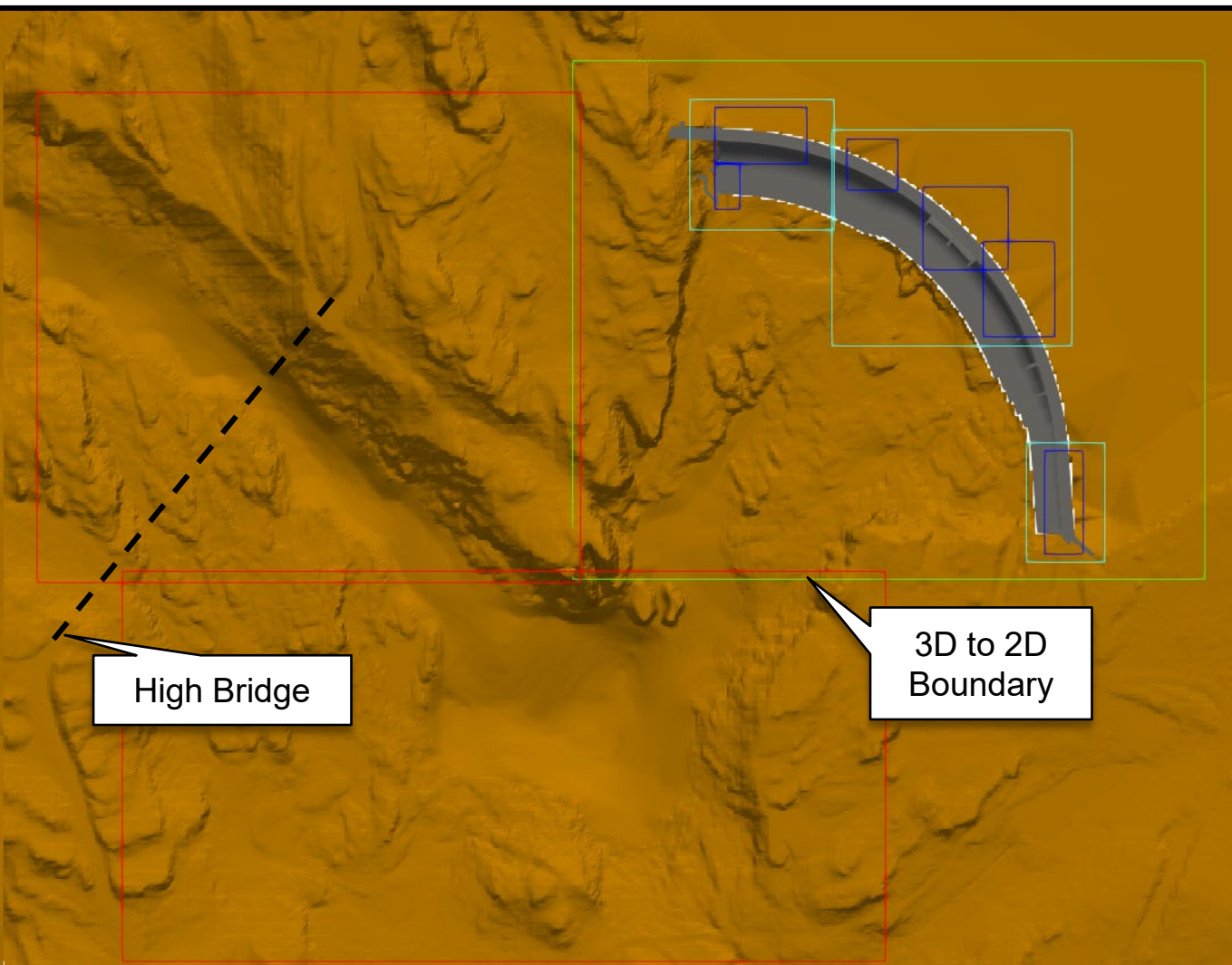
Task 2 – CFD Modeling Setup

- Combined Terrain Data





- Mesh block configuration

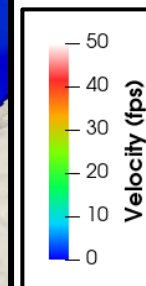
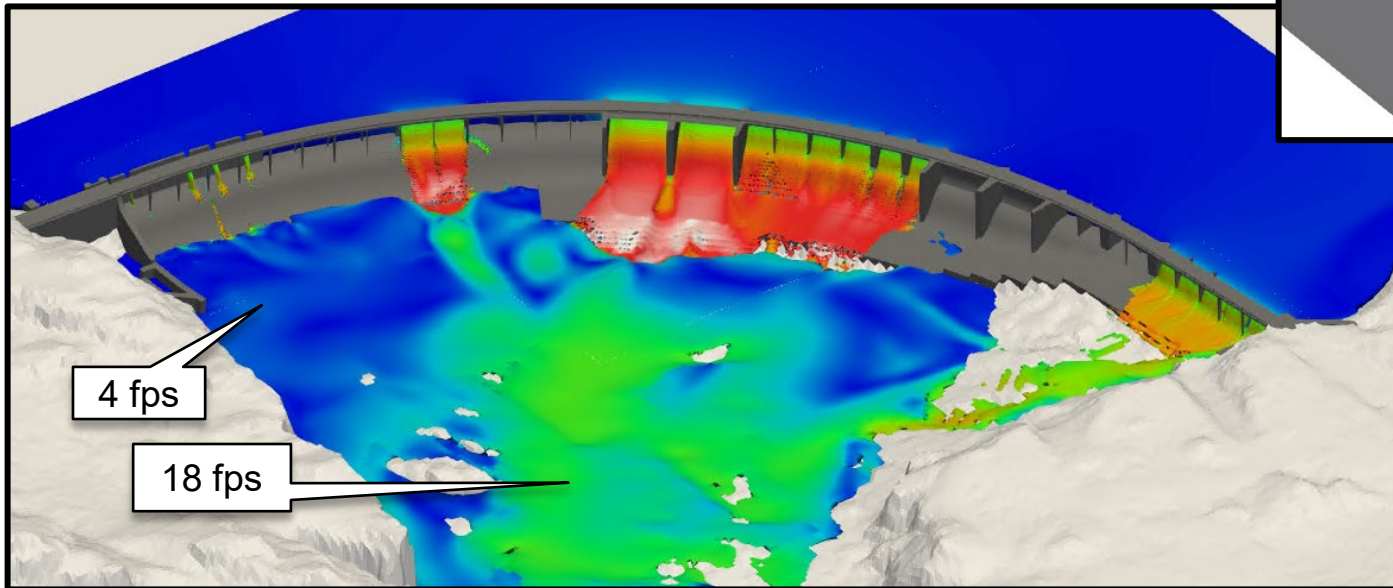
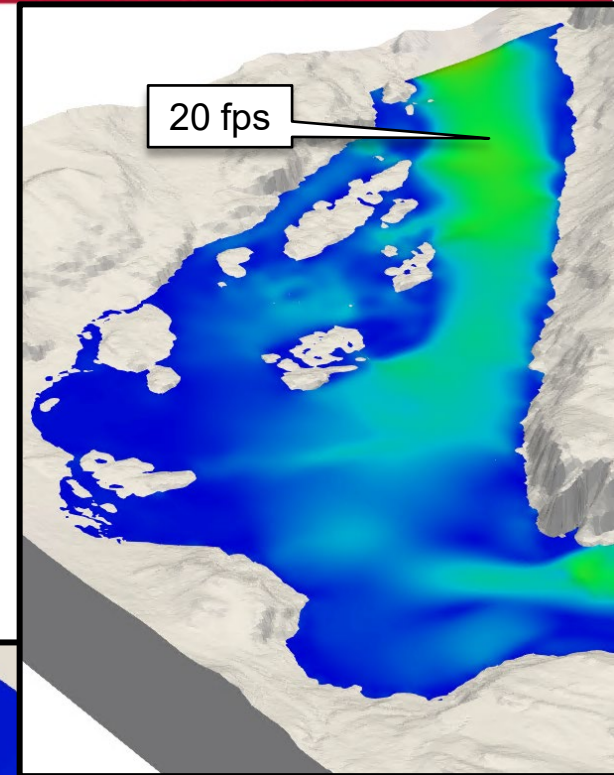
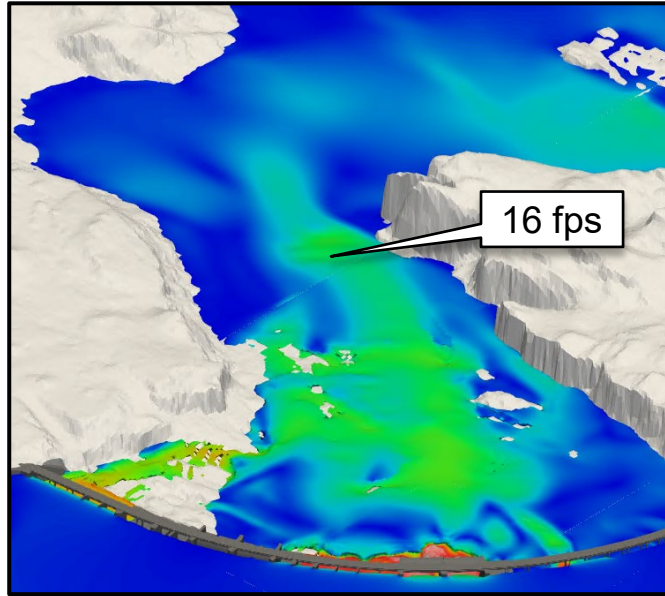


- 8 FT - 2D
- 4 FT - 3D
- 2 FT - 3D
- 1FT - 3D



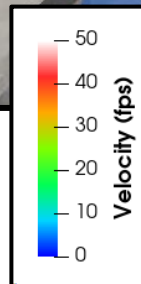
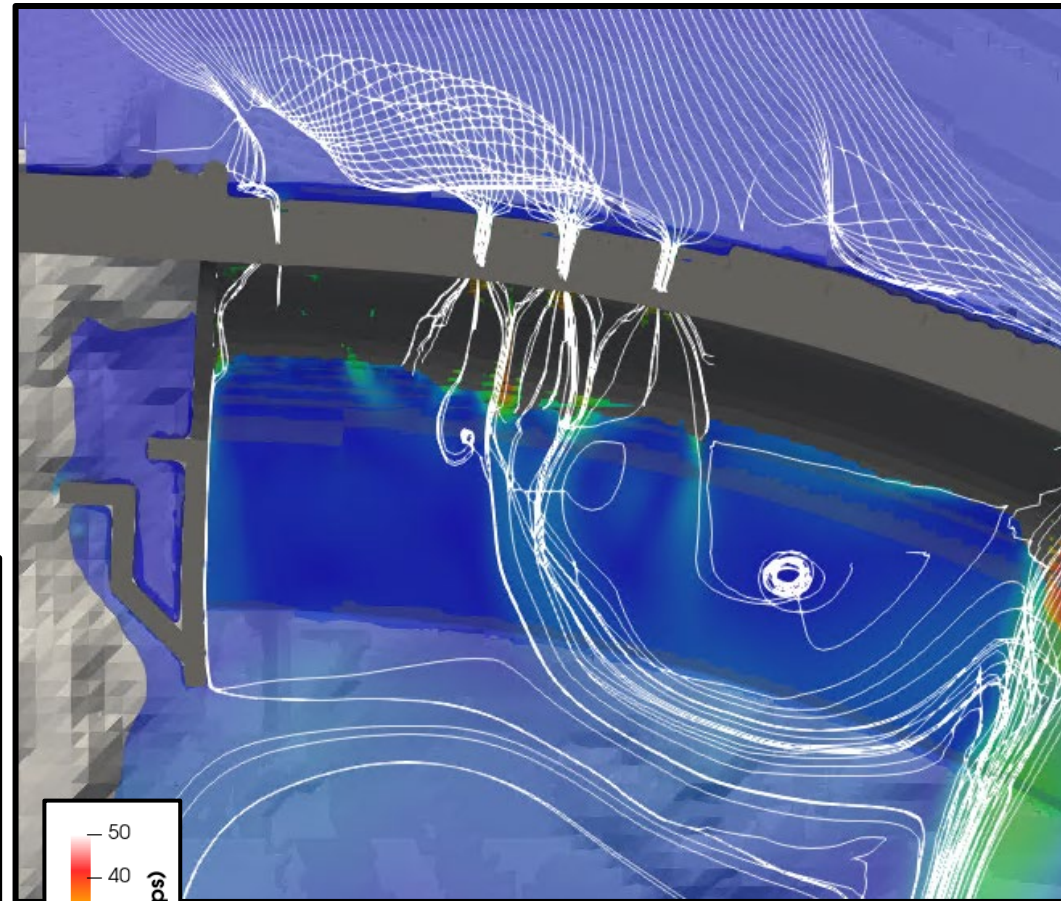
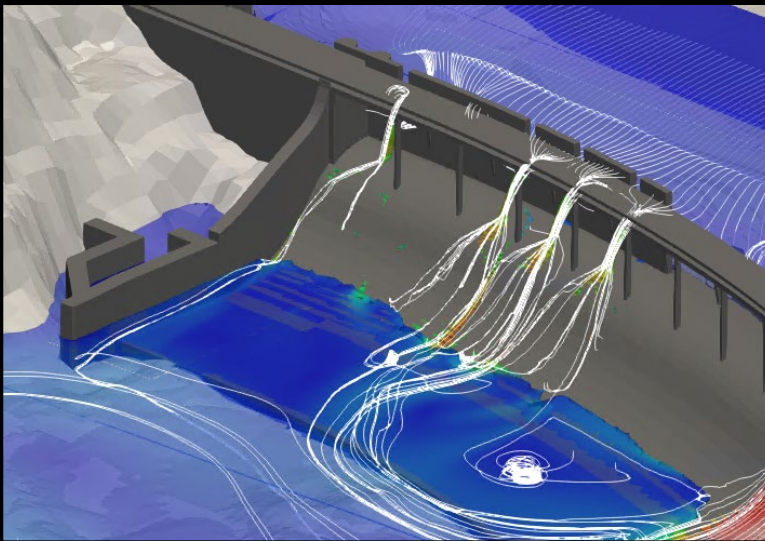
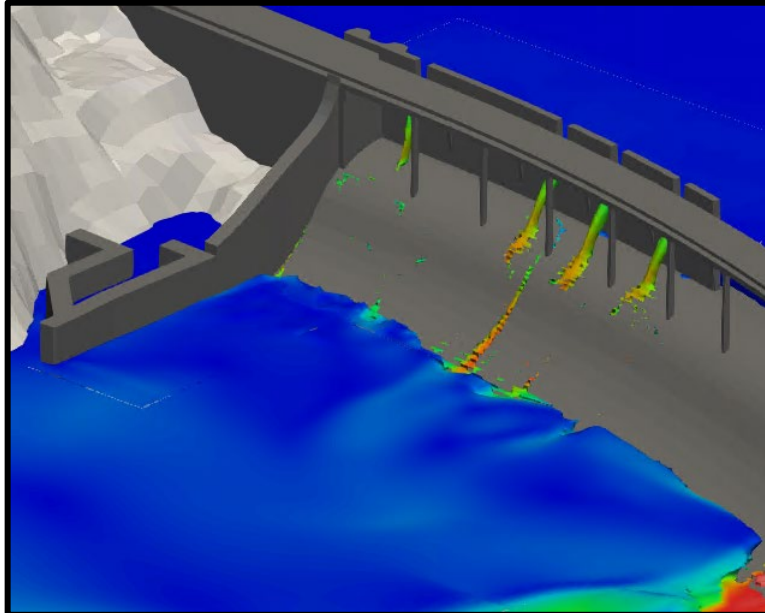
Task 2 – CFD Modeling Results

- 37,000 cfs (60,000 cfs total)



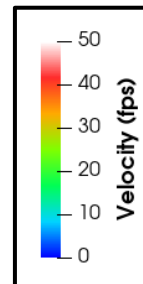
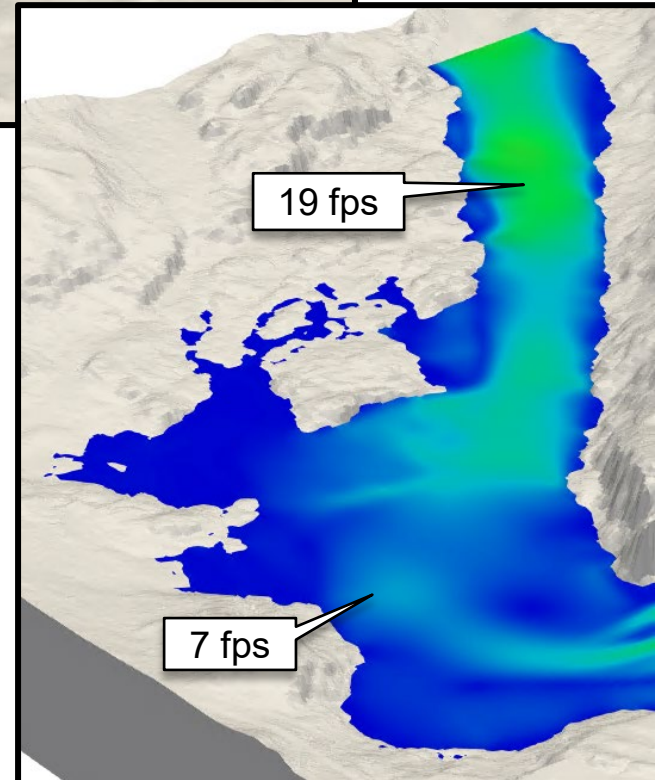
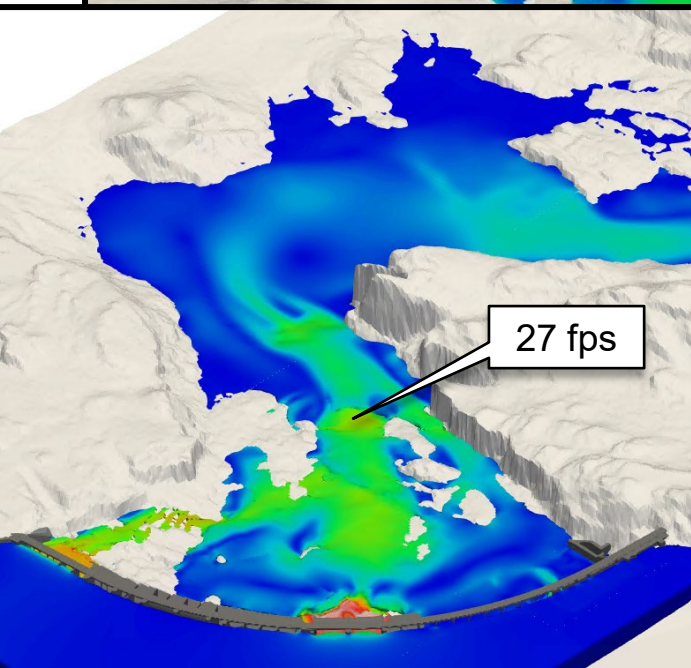
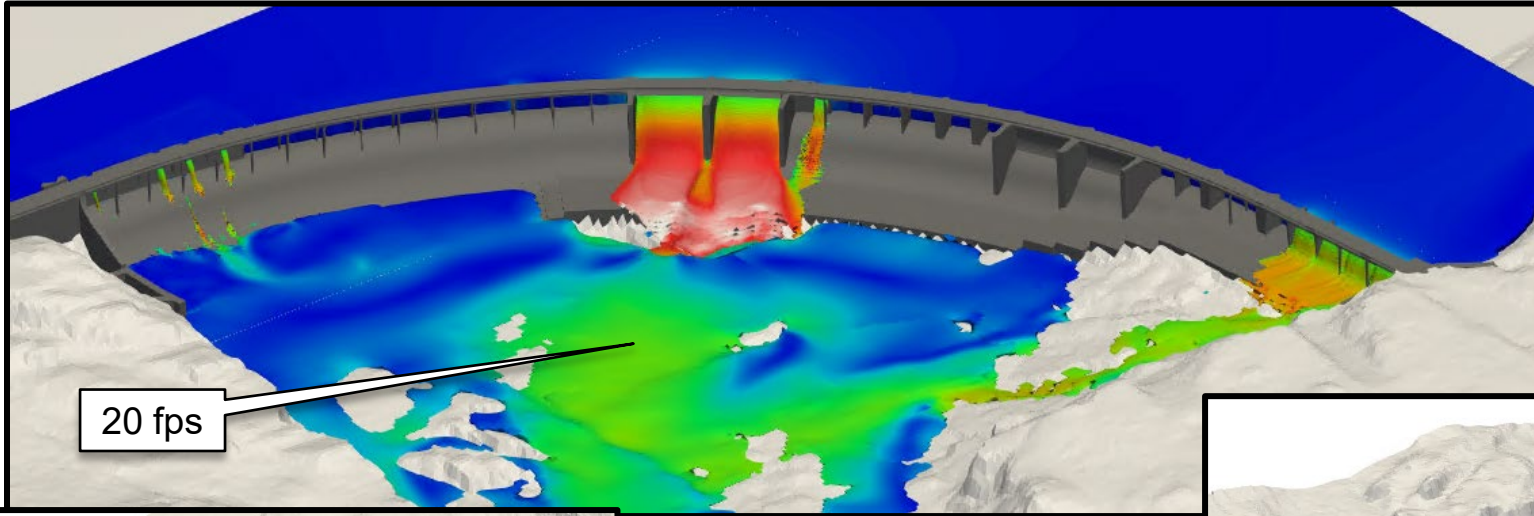
Task 2 – CFD Modeling Results

- 37,000 cfs (60,000 cfs total)

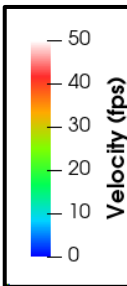
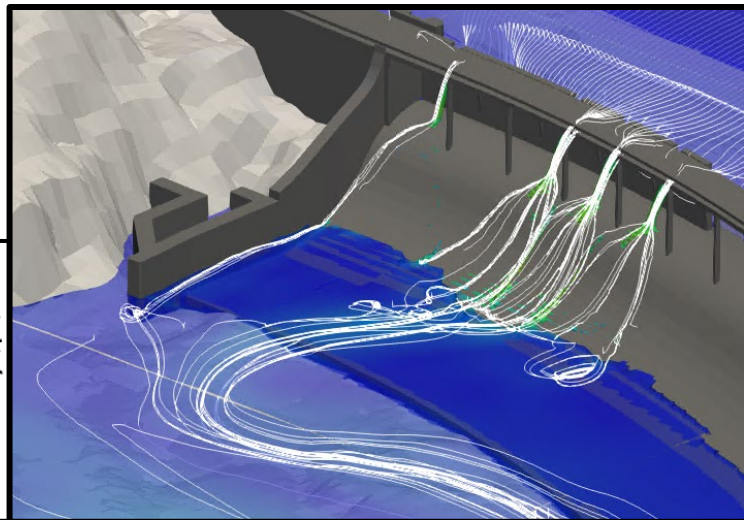
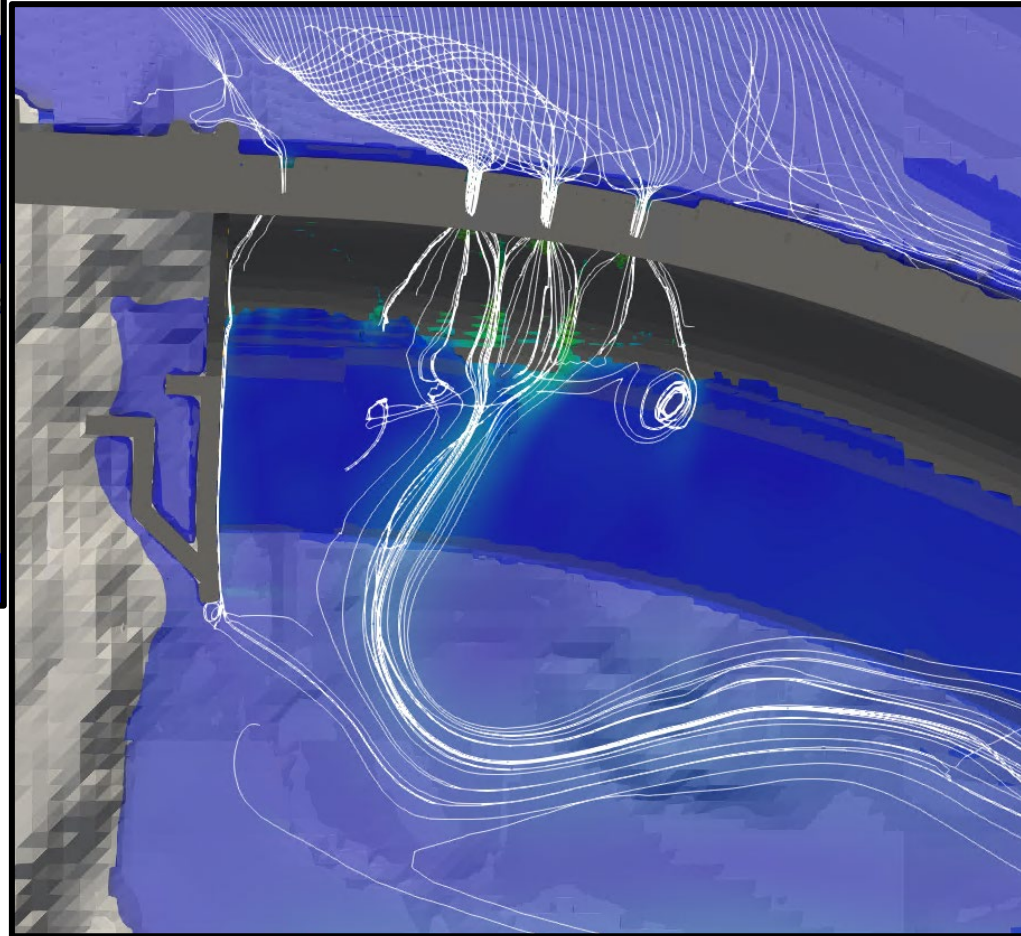
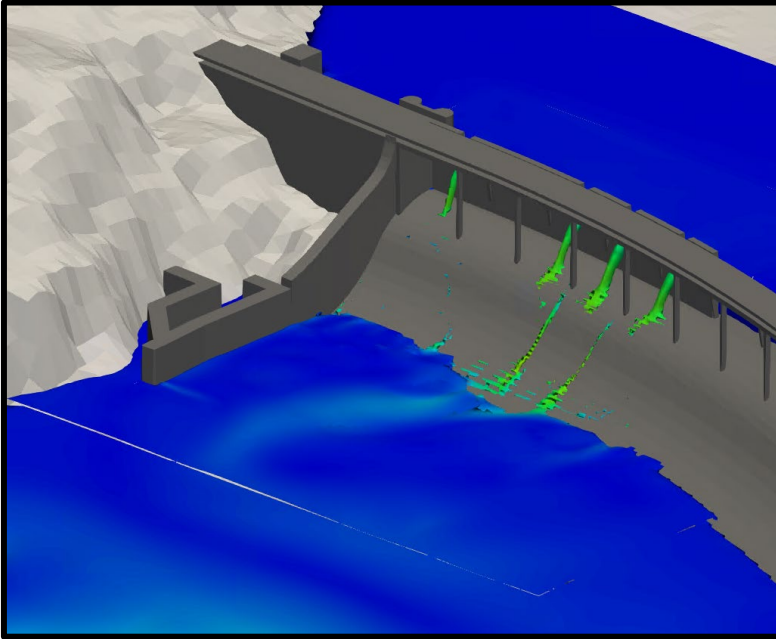


Task 2 – CFD Modeling Results

- 25,000 cfs (48,000 cfs total)

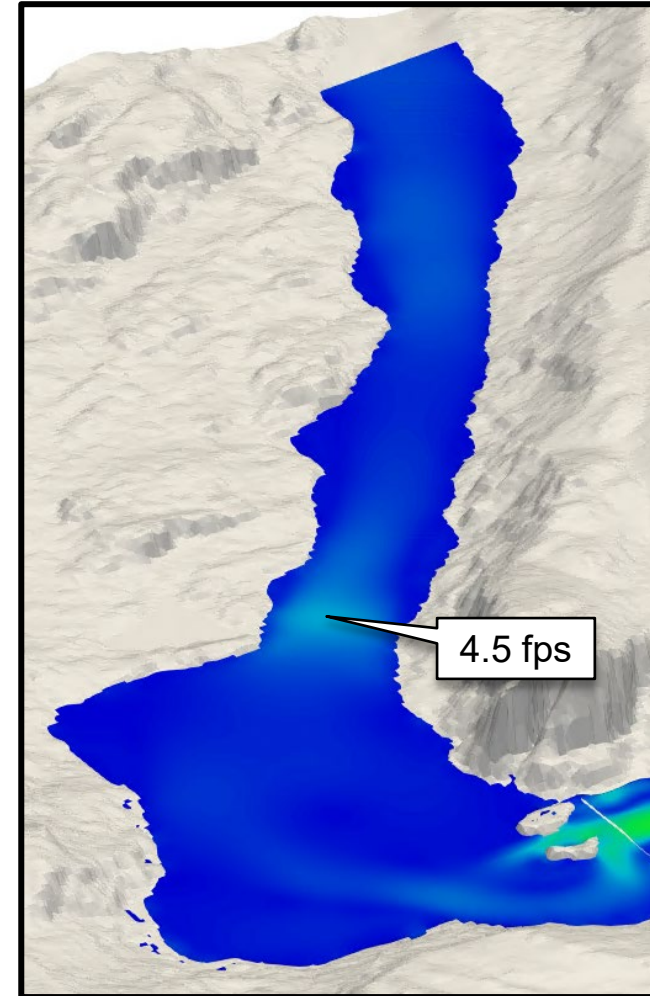
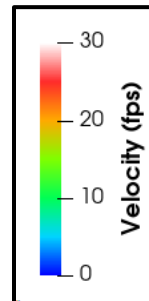
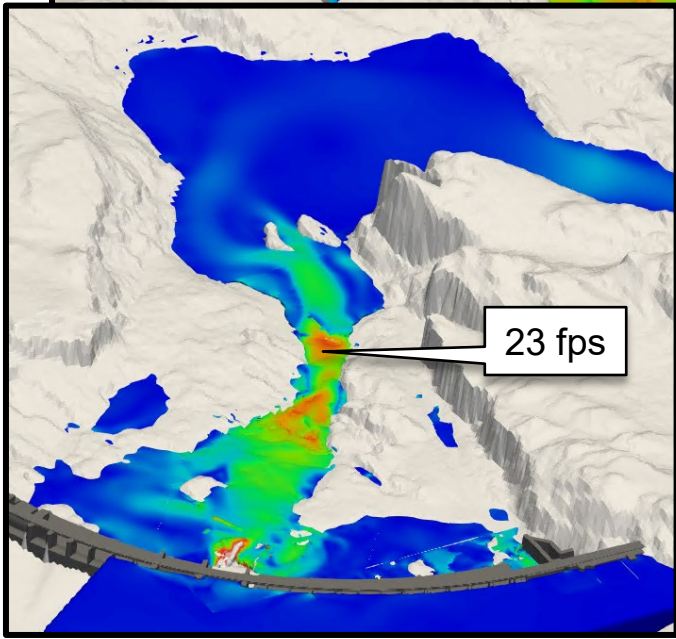
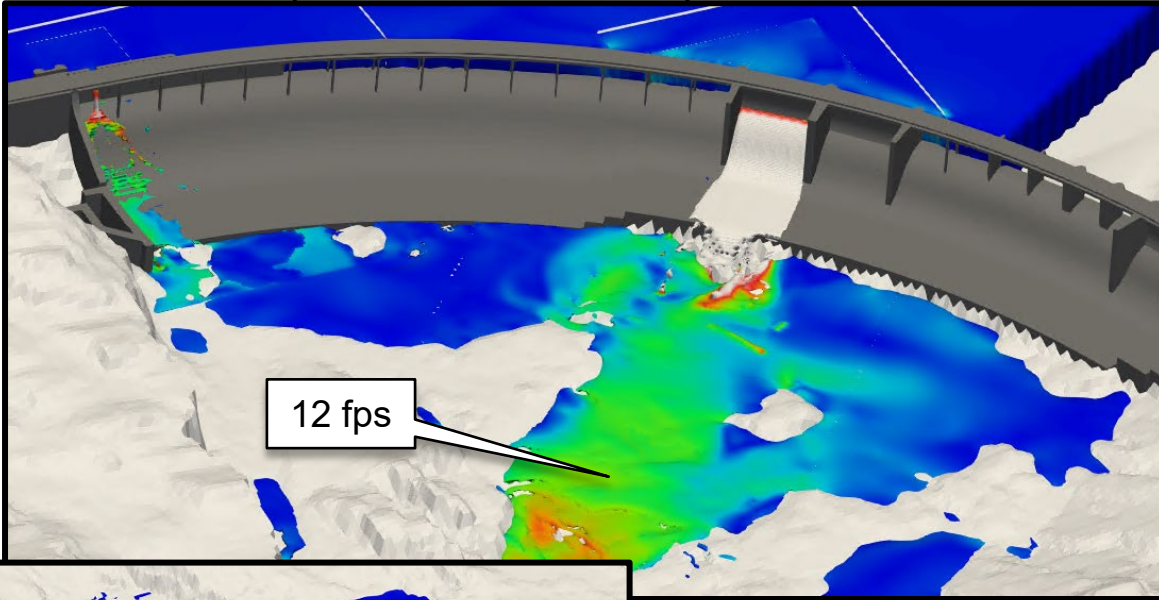


- 25,000 cfs (48,000 cfs total)



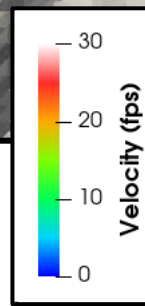
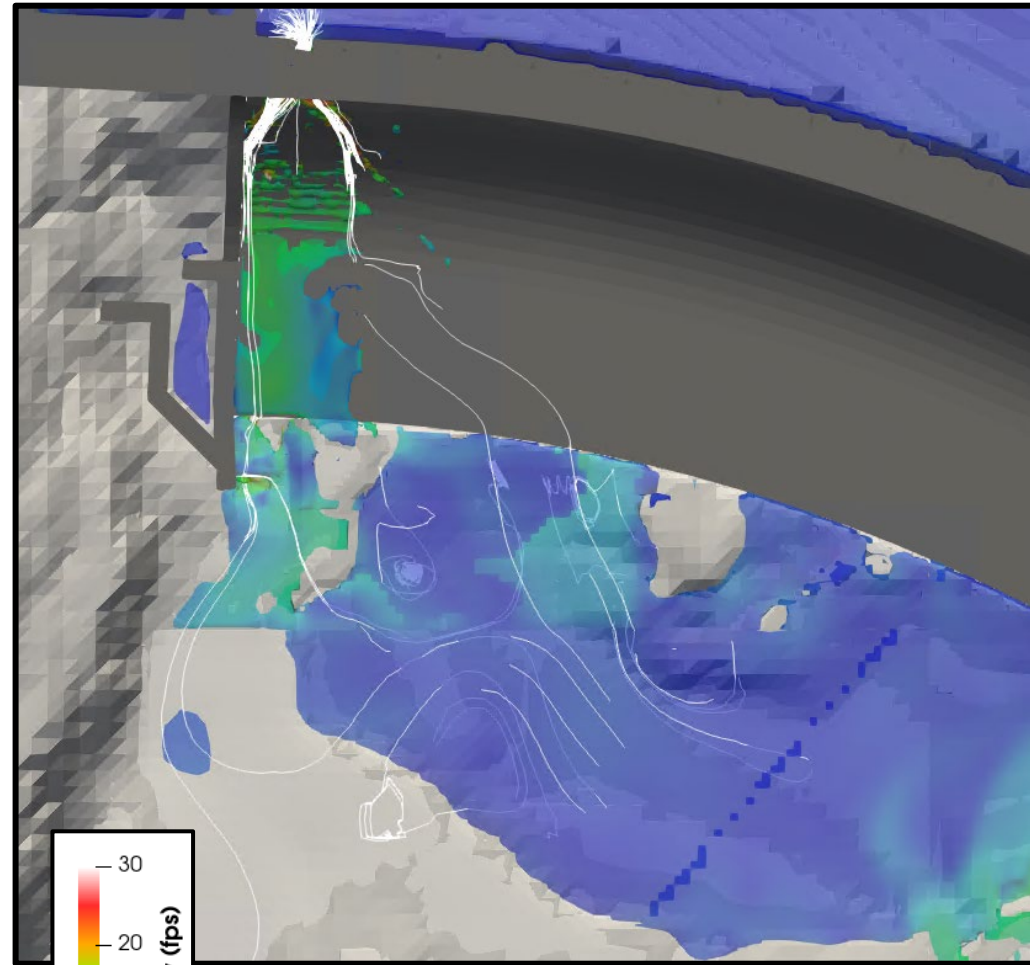
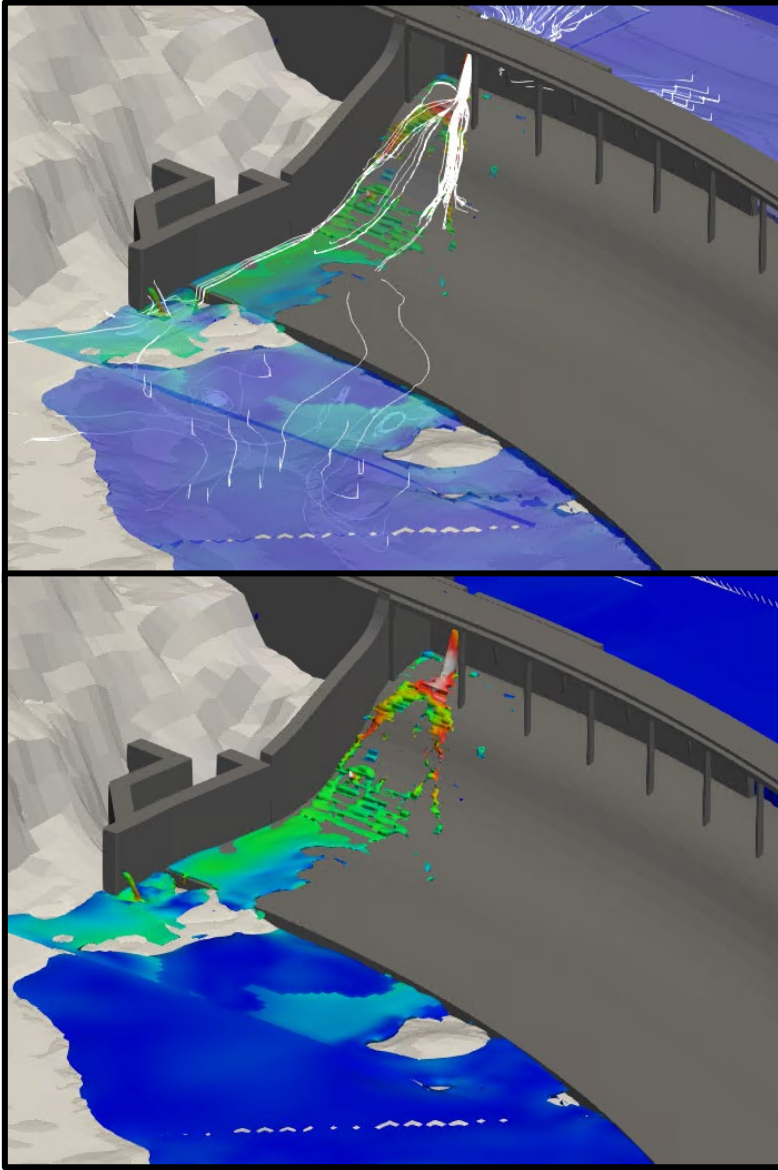
Task 2 – CFD Modeling Results

- 2,000 cfs (25,000 cfs total)



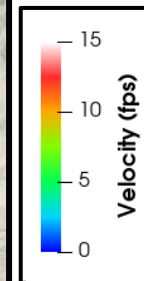
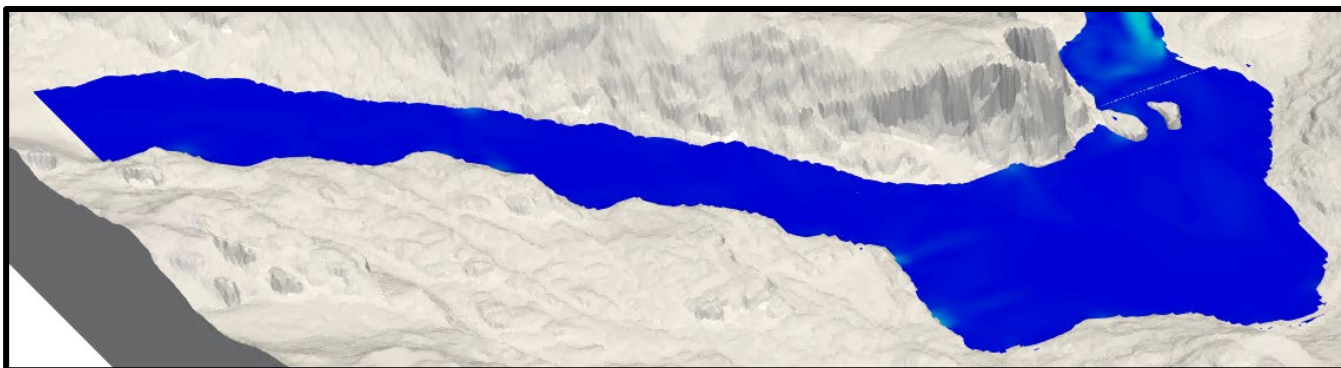
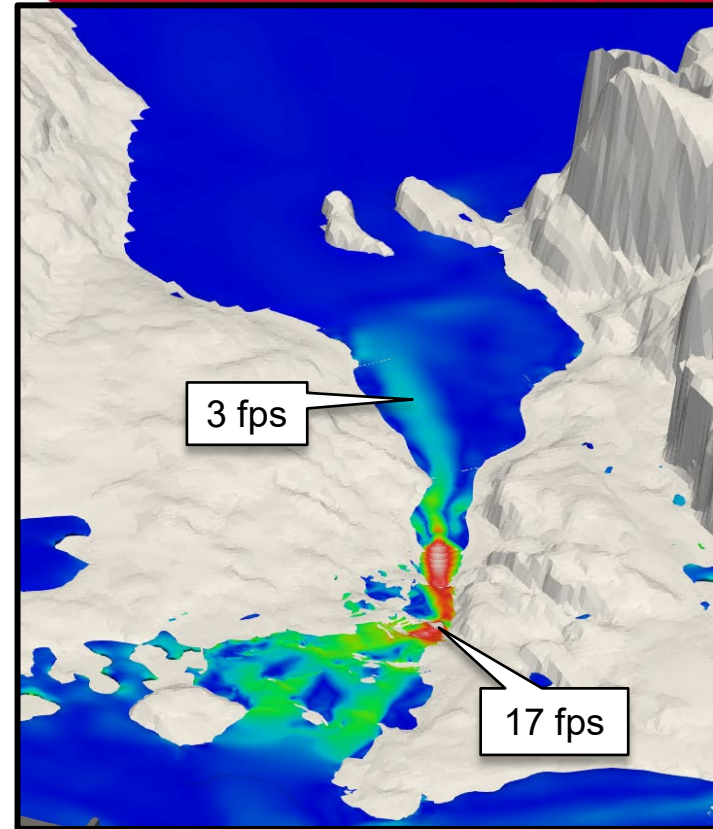
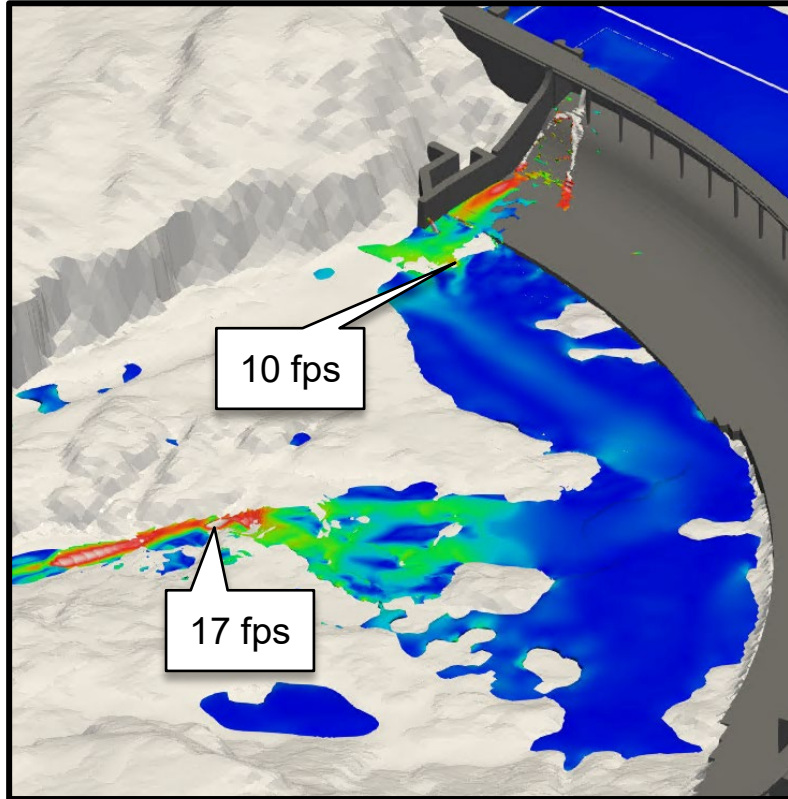
Task 2 – CFD Modeling Results

- 2,000 cfs (25,000 cfs total)



Task 2 – CFD Modeling Results

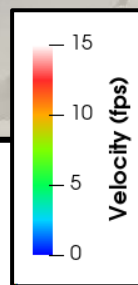
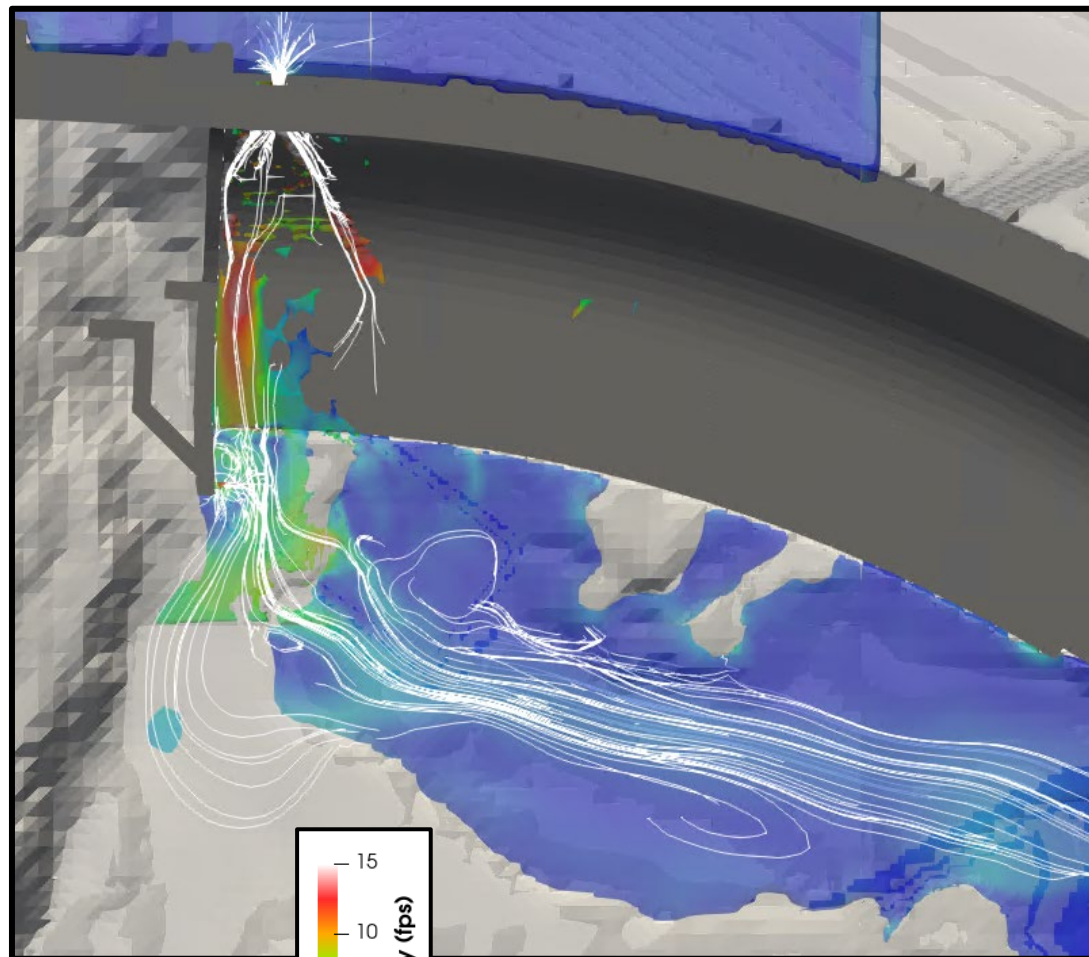
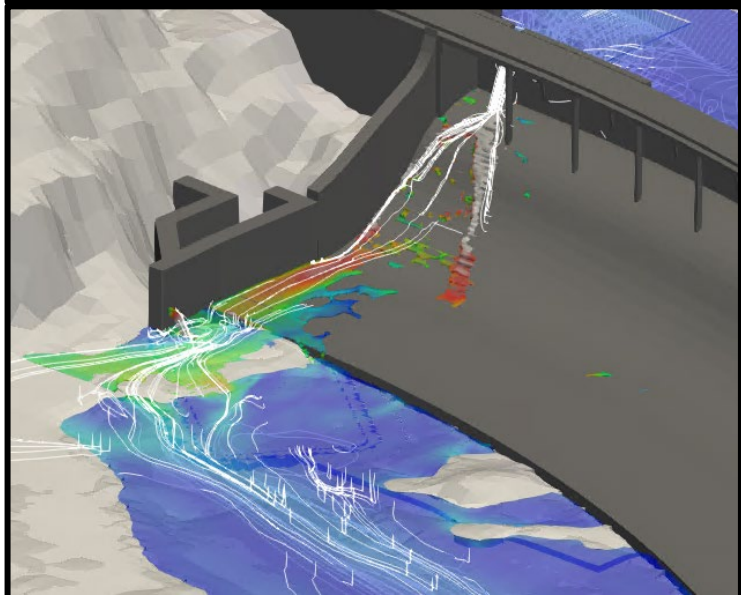
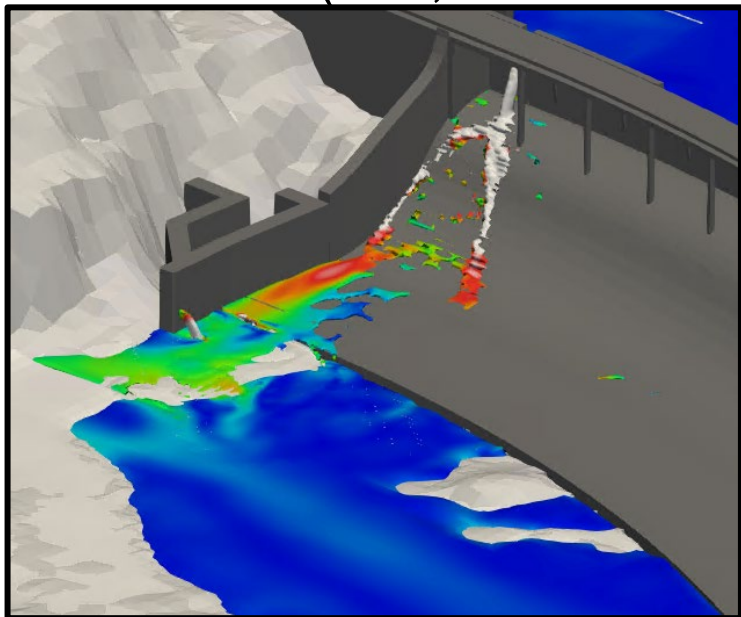
- 200 cfs (<23,000 cfs total)





Task 2 – CFD Modeling Results

- 200 cfs (<23,000 cfs total)



- Report submitted for comments (2/15)
- Meeting with Agencies (3/10)
- Comments received from FWP, the FWS, and USFS (3/17)
- Flows and modeling approach agreed upon for Phase II modeling
 - 37,000 cfs and 2,000 cfs (60,000/25,000 total cfs)
- Response to comments submitted as part of the filing (4/28)





- Begin Phase 2
 - Full 3D for 37,000 cfs and 2,000 cfs
- Final Study Report
 - May 2023



- **Guidelines for Asking a Question:**

- Click on the “Chat” icon and type your question; once recognized, please unmute yourself, introduce yourself, and ask your question.
- Click on the “Raise Your Hand” icon to be recognized; once recognized, please unmute yourself, introduce yourself, and ask your question
 - Phone controls for participants – *9 – to raise hand.
 - Phone controls for participants – *6 – to toggle mute/unmute.

- **Video and Audio**

- Keep OFF, unless you are asking a question or responding to a question.



- **One Speaker at a Time:** Limit side conversations to reduce noise distortion so everyone in the room and participating via Zoom can hear.
- **Order of Questions:** Questions from Zoom participants will be responded to first.
- **Guidelines for Asking a Question via Zoom:**
 - Click on the “Chat” icon and type your question; once recognized, please unmute yourself, introduce yourself, and ask your question.
 - Click on the “Raise Your Hand” icon to be recognized; once recognized, please unmute yourself, introduce yourself, and ask your question
 - Phone controls for participants – *9 – to raise hand.
 - Phone controls for participants – *6 – to toggle mute/unmute.
- **Video and Audio:**
 - Keep OFF, unless you are asking a question or responding to a question.
- **Guidelines for Asking a Question In-Person**
 - Raise your hand to be recognized; once recognized, please speak up to ask your question.



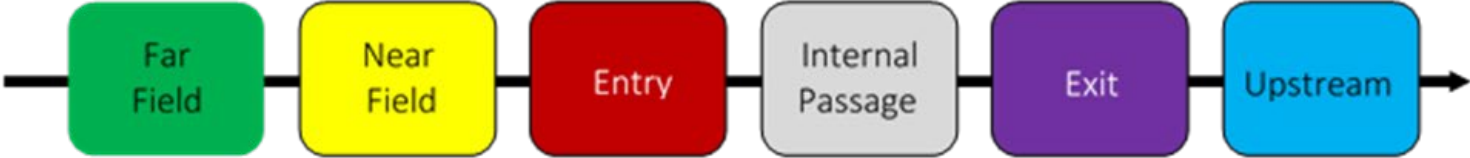
Thompson Falls Hydroelectric Project No. 1869

**Initial Study Plan Meeting – Fish Behavior Study
May 5, 2022**

- Current FERC License and Biological Opinion required NWE in collaboration with the TAC to form a scientific panel to evaluate the fish passage facility, with emphasis on Bull trout
- One data gap identified by the panel was a quantitative evaluation of the proportion of motivated fish entering the zone of passage (ZOP) and finding the passage facility entrance
- Study is a result of the Thompson Falls Scientific Review Panel recommendation (2020)

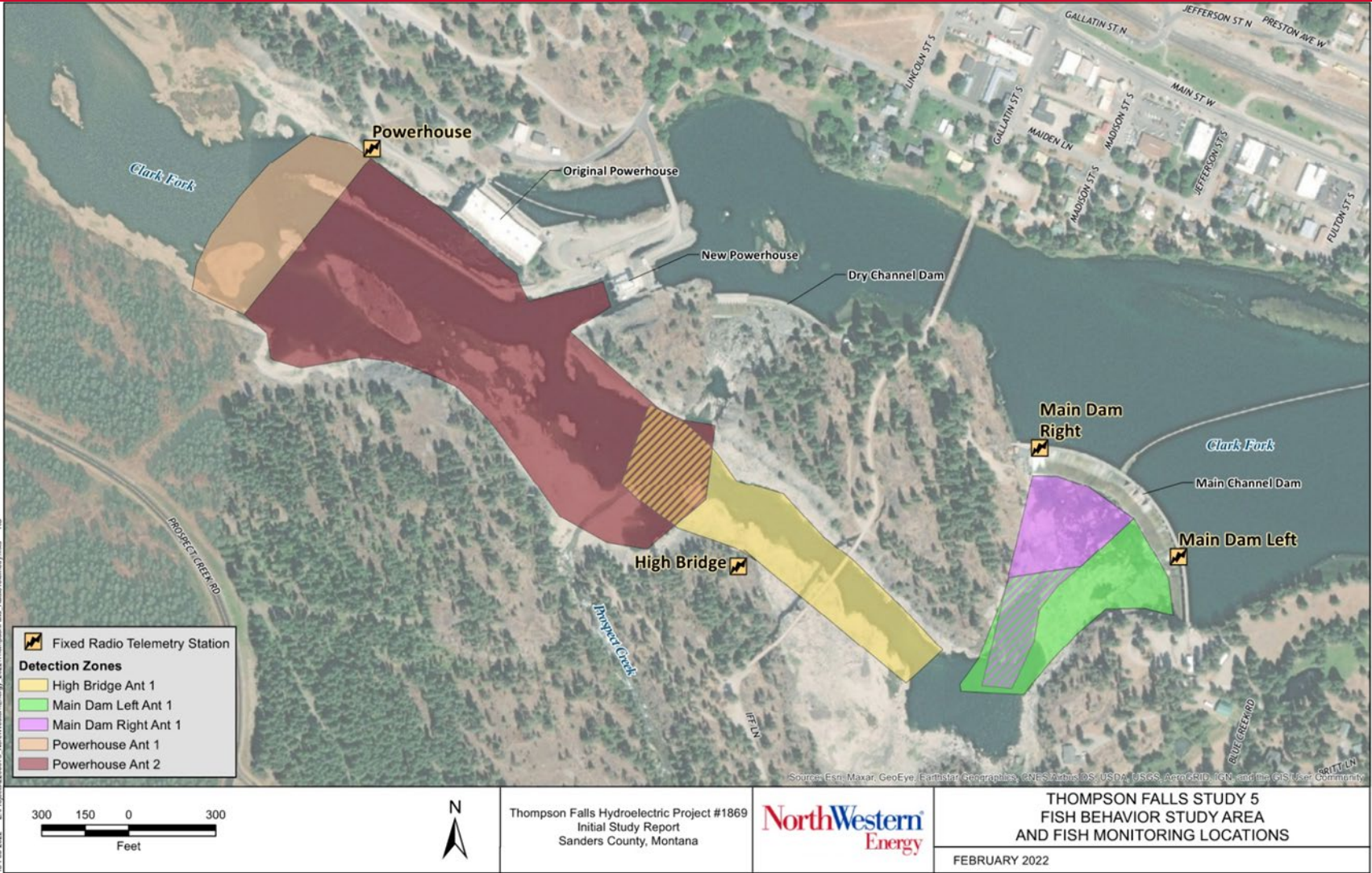
- Evaluate proportion of radio tagged fish that enter the ZOP and find the fish passage facility entrance.
- Measures the duration of time and pathway(s) of these movements during various flow conditions
- Includes a literature review of relative swimming capabilities of minnow, sucker, and salmonid species recorded at the fish passage facility

Fish Behavior Study – Zone of Passage (ZOP)





- The telemetry monitoring efforts focused on assessing fish movement, including
 - Travel time from the far field to the near field.
 - Movement patterns (e.g., left bank, right bank) in the near field (Main Channel Dam area).
 - Travel time from the near field (the falls area) to the entrance of the fish passage facility.
 - Proportion of fish that enter the ZOP and locate the entrance of the fish passage facility entrance.
 - Locations where fish hold within the ZOP.



The Powerhouse and High Bridge fixed receiver stations represent the far field and the Main Dam Right and Main Dam Left represent the near field. The fish passage facility entrance is located along the right abutment of the Main Dam.



- Radio and PIT tag up to 50 Brown Trout and 50 Rainbow Trout captured
 - Clark Fork River upstream of Thompson Falls Project
 - Upstream Fish Passage Facility
 - Thompson River
- Radio tags have depth and activity sensors.
- Tagged fish released at Flat Iron Boat Launch (4 miles downstream)





- Combining the behavioral data and hydraulic modeling data to help identify potential project influences (e.g., velocity fields) in the near field that may affect conditions for upstream fish passage.
- Complete a literature review of the relative swimming capacities and behaviors of salmonids to gain further understanding of combining the behavioral and hydraulic modeling results and included as part of this fish behavior study.



Results

- 16 radio tagged for 2021
- 13 in spring collected from E-fishing mainstem (0.5 CPUE)
- 3 collected in fall from passage facility

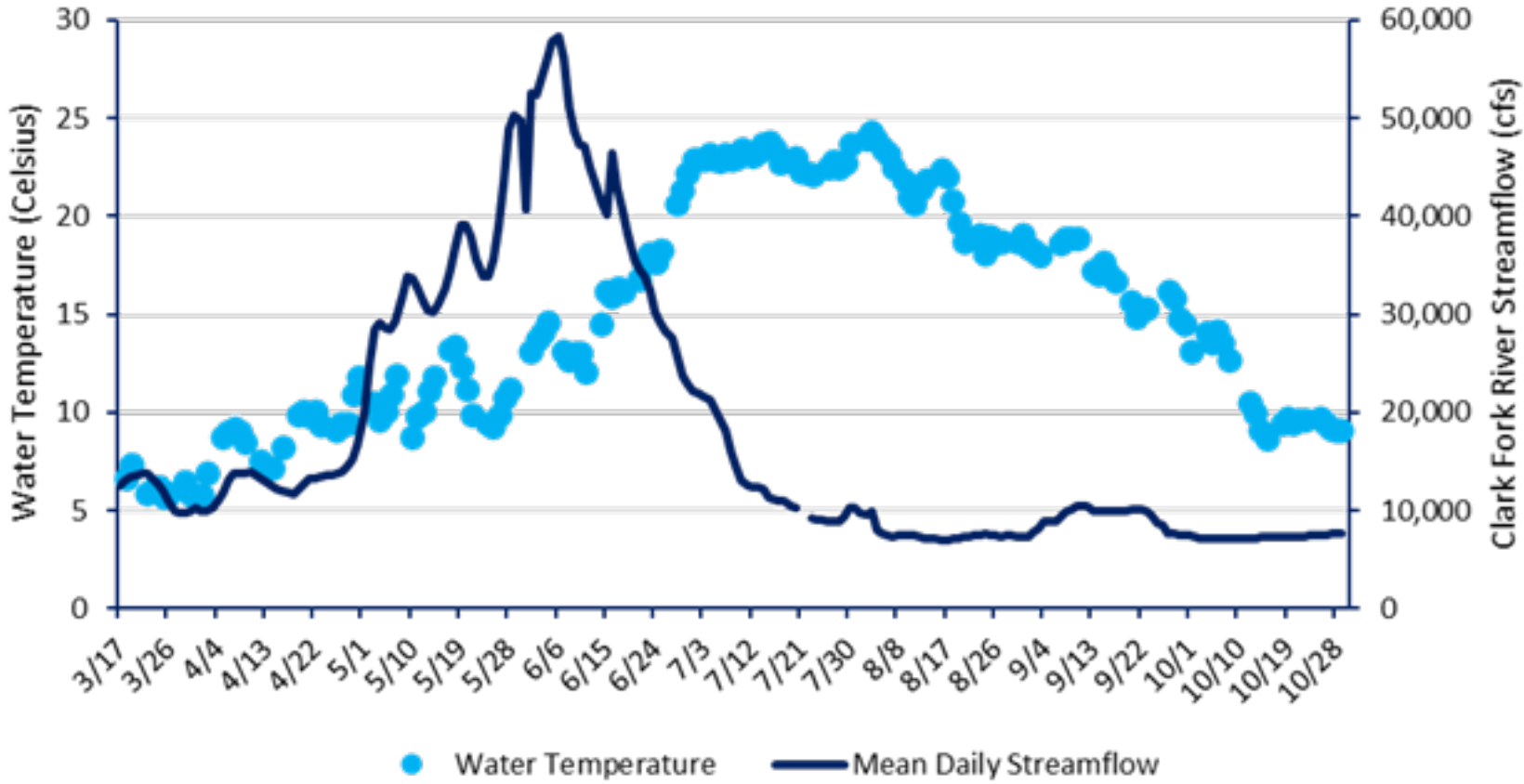
2021 Season	Date	Method	Location	Water Temp °C	Effort (Hours)	RB	RB CPUE	LL	LL CPUE
Spring	2-Jun	Electrofishing	MCFR	13.7	1.9	1	0.5		
	3-Jun	Electrofishing	MCFR	14.4	2.0	2	1.0		
	7-Jun	Electrofishing	MCFR	13.1	2.5				
	8-Jun	Electrofishing	MCFR	12.7	1.1	2	1.8		
	8-Jun	Angling	TR	12.7	8.0				
	9-Jun	Electrofishing	MCFR	12.7	3.5	1	0.3		
	11-Jun	Electrofishing	MCFR	12.1	1.5				
	14-Jun	Electrofishing	MCFR	14.5	1.0	1	1.0	4	3.9
	16-Jun	Electrofishing	MCFR	15.9	1.6			2	1.3
Spring Summary	8 days	Electrofishing	MCFR		15.2	7	0.5	6	0.4
	1 day	Angling	TR		8.0	0	0	0	0
Fall	29-Sep	Ladder	Ladder	14.8	NA			1	NA
	1-Oct	Ladder	Ladder	13.7	NA			2	NA



- 7 Rainbow trout
- 9 Brown trout (6 spring, 3 fall)
- Water temperatures hit 16° C by mid June, and ceased tagging

Date Tagged & Transported	Species	MCFT3 Tag (g)	Length (mm)	Weight (g)	Radio Tag #	PIT TAG ID ⁵
6/2/2021	RB	11	383	682	58	3212832
6/3/2021	RB	11	398	862	49	3212788
6/3/2021	RB	11	457	1052	51	3212871
6/8/2021	RB	11	534	1304	52	3211820
6/8/2021	RB	11	502	1328	56	3211805
6/9/2021	RB	11	409	616	54	3212869
6/14/2021	RB	11	433	705	55	3212787
6/14/2021	LL	11	436	896	39	3212850
6/14/2021	LL	11	444	959	48	3212806
6/14/2021	LL	11	506	1501	59	3212840
6/14/2021	LL	11	392	623	60	3212798
6/16/2021	LL	11	379	574	46	3212853
6/16/2021	LL	11	472	917	47	3212794
9/29/2021	LL	6.8	483	996	28	3212709
10/1/2021	LL	6.8	334	326	26	3212719
10/1/2021	LL	6.8	406	616	27	0300297

2021 River Conditions



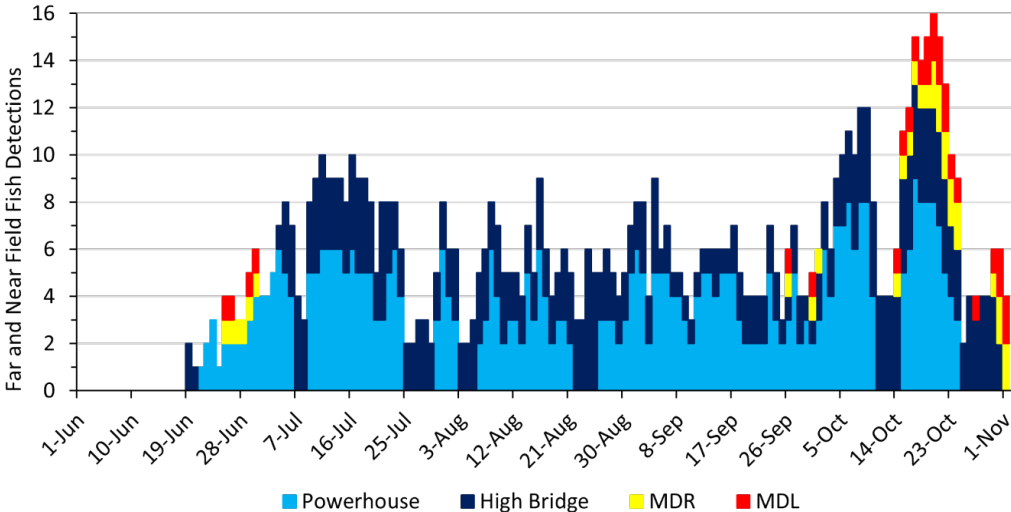


Fixed Receiver Stations

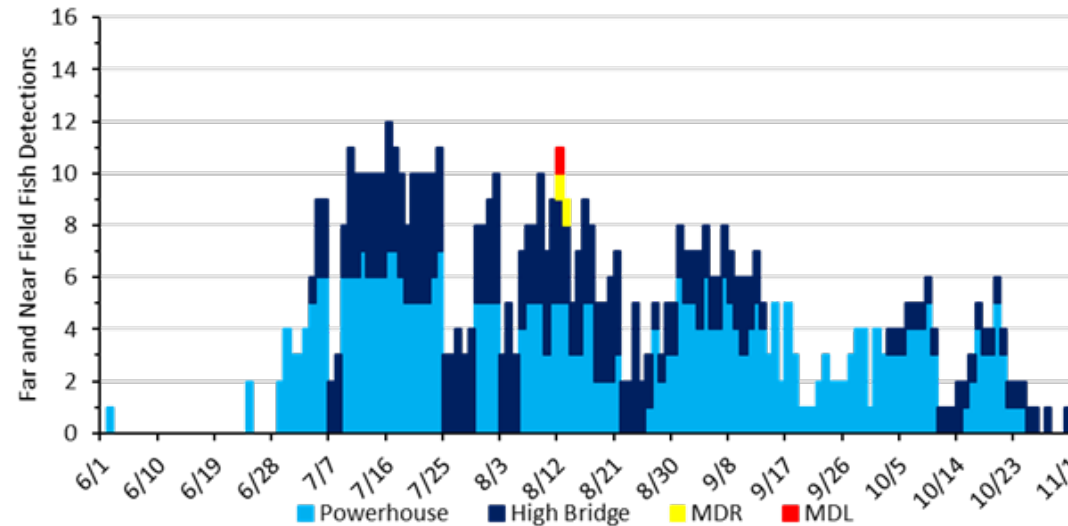
Species	# of Fish	Far Field		Near Field		ZOP Detections
		PH	HB	MDR	MDL	Total Records
RB	7	420,026	1,430,526	1,611	23	1,852,111
LL	9	803,148	1,038,564	148,511	12,155	2,002,378
Total Records	16	1,223,174	2,469,090	150,122	12,178	3,854,564

- All 16 fish detected in the ZOP
- 5 fish (4 LL, 1 RB) detected in the near field
- 3 LL entered the passage facility entrance, and 2 ascended to the top

2021 Brown Trout



2021 Rainbow Trout





Travel time from far field to the near field

- Ranged from 2-114 days for spring tagged fish
- Ranged 1-17 days for fall tagged LL
- Three LL made two separate forays

Collection Time 2021	Radio Tag #	Species	Travel Time (days) Far to Near Field	Date Fish Entered Near Field
Spring	52	RB	37	8/12
	39	LL	101	9/30
	47*	LL	114 5	10/14 10/31
	60	LL	2 88	6/29 9/26
Fall	27*	LL	17 1	10/19 10/27

Travel time from near field to the fish passage entrance

- Three of the 5 detected in the entrance (PIT array)
- All 3 were LL and spent 1-4 days in the near field before being detected at the entrance

Collection Time 2021	Tag #	Species	Date First Near Field Detection	Travel Time (days) Near Field to Fish passage facility Entrance	Date of First Fish passage facility Entrance Detection
Spring	47	LL	10/14	1	10/15
	60	LL	6/25	4	6/29
Fall	27	LL	10/19	3	10/22

Near Field Movement

- 160,000 fixed station detections
- 4 LL and 1 RB
- MDR recorded 92% of detections
- When present in near field fish were detected in short duration (hours or days)

Species	Near Field Detections	
	MDR	MDL
RB	1,611	23
LL	148,511	12,155
Total Records	150,122	12,178



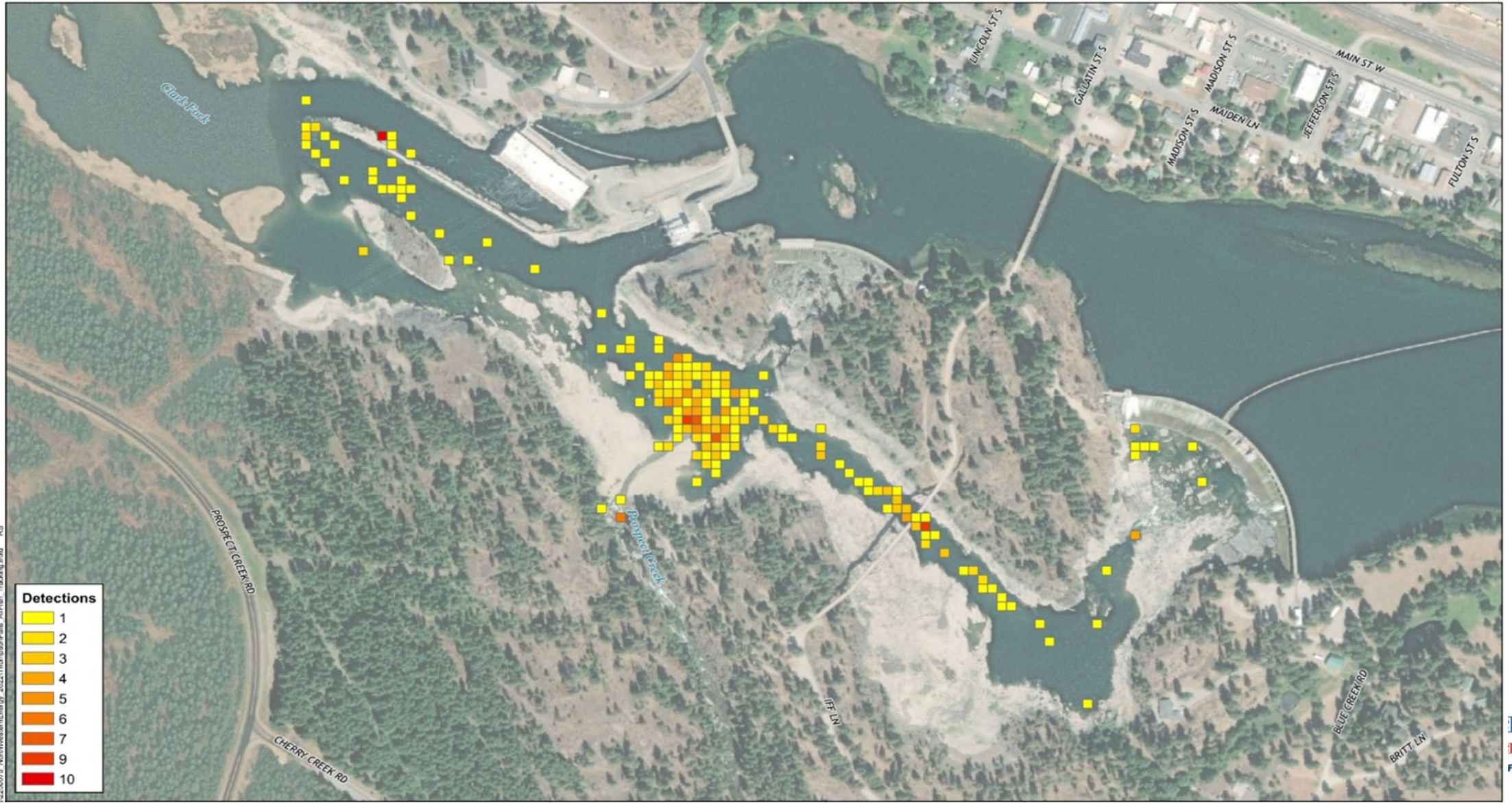


Proportion of fish that enter ZOP and locate the fish passage entrance

- Determined using PIT arrays at fish passage entrance
- 3 of 16 that entered the ZOP; 19%
- 3 LL entered the facility. 2 ascended in October, 1 entered but did not ascend in June



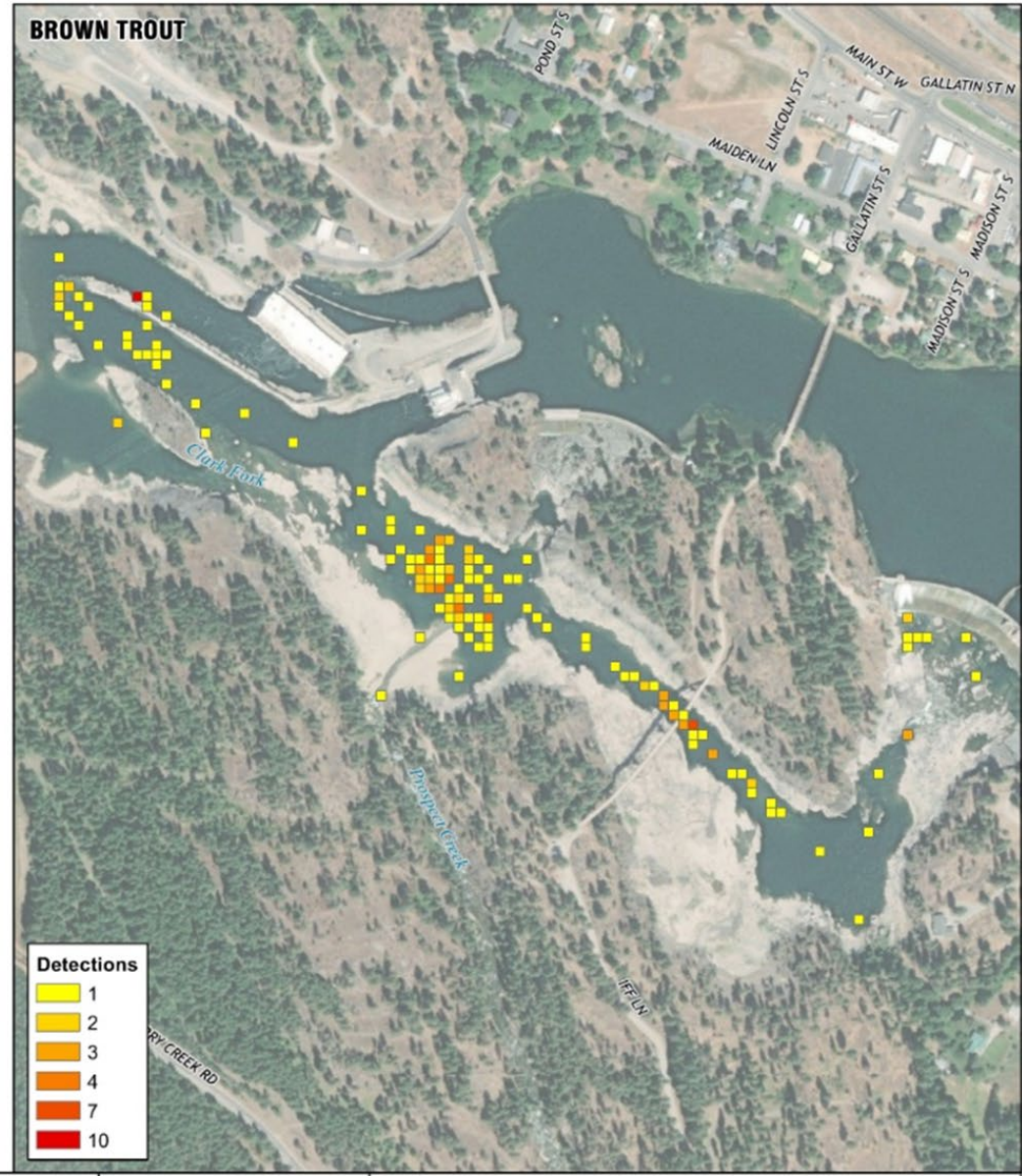
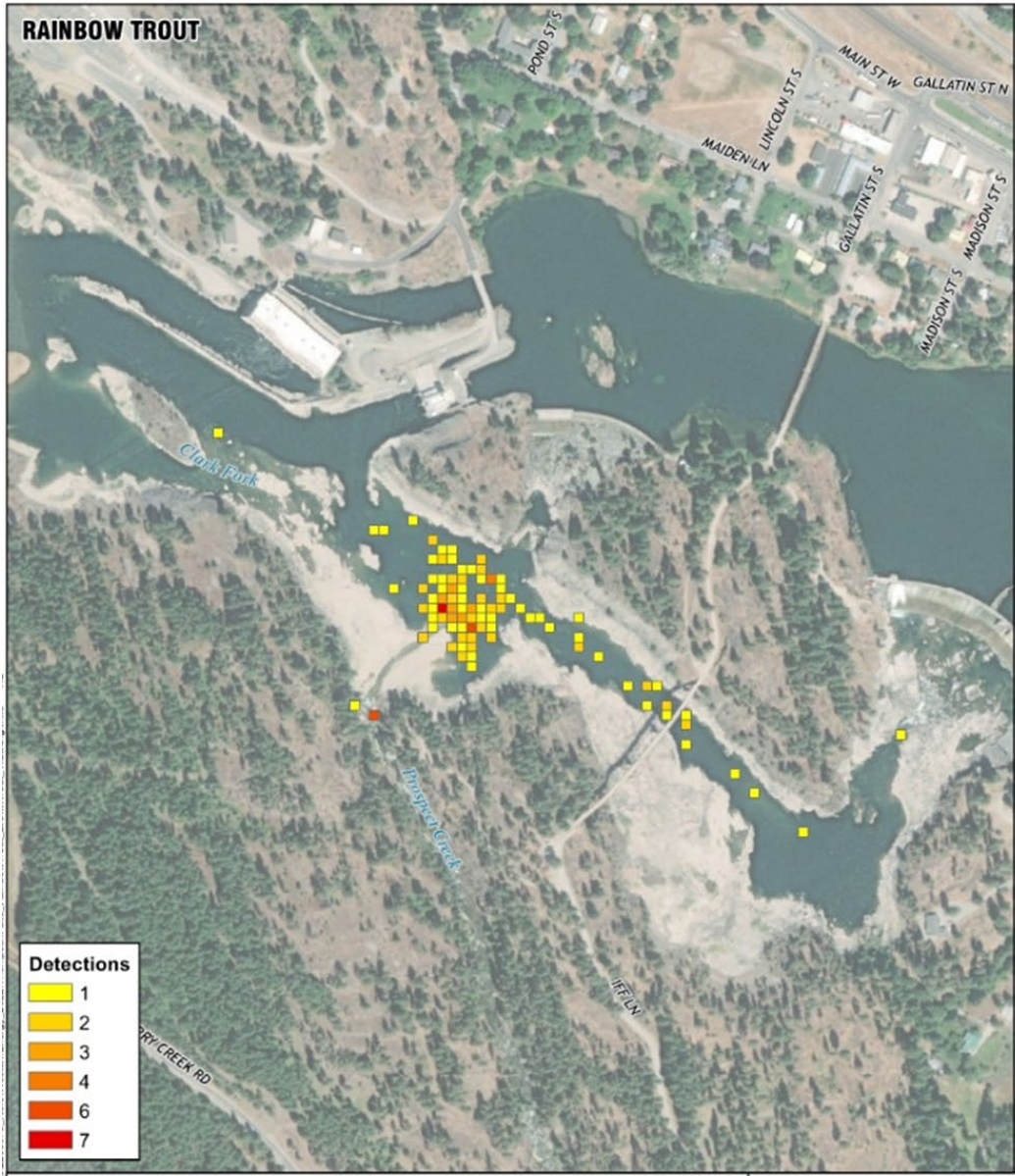
All 15 tagged fish June-October



42300075_NorthWesternEnergy_2023ThompsonFalls_AirFish_Tracking.mxd RS



Fish Behavior Locations within ZOP



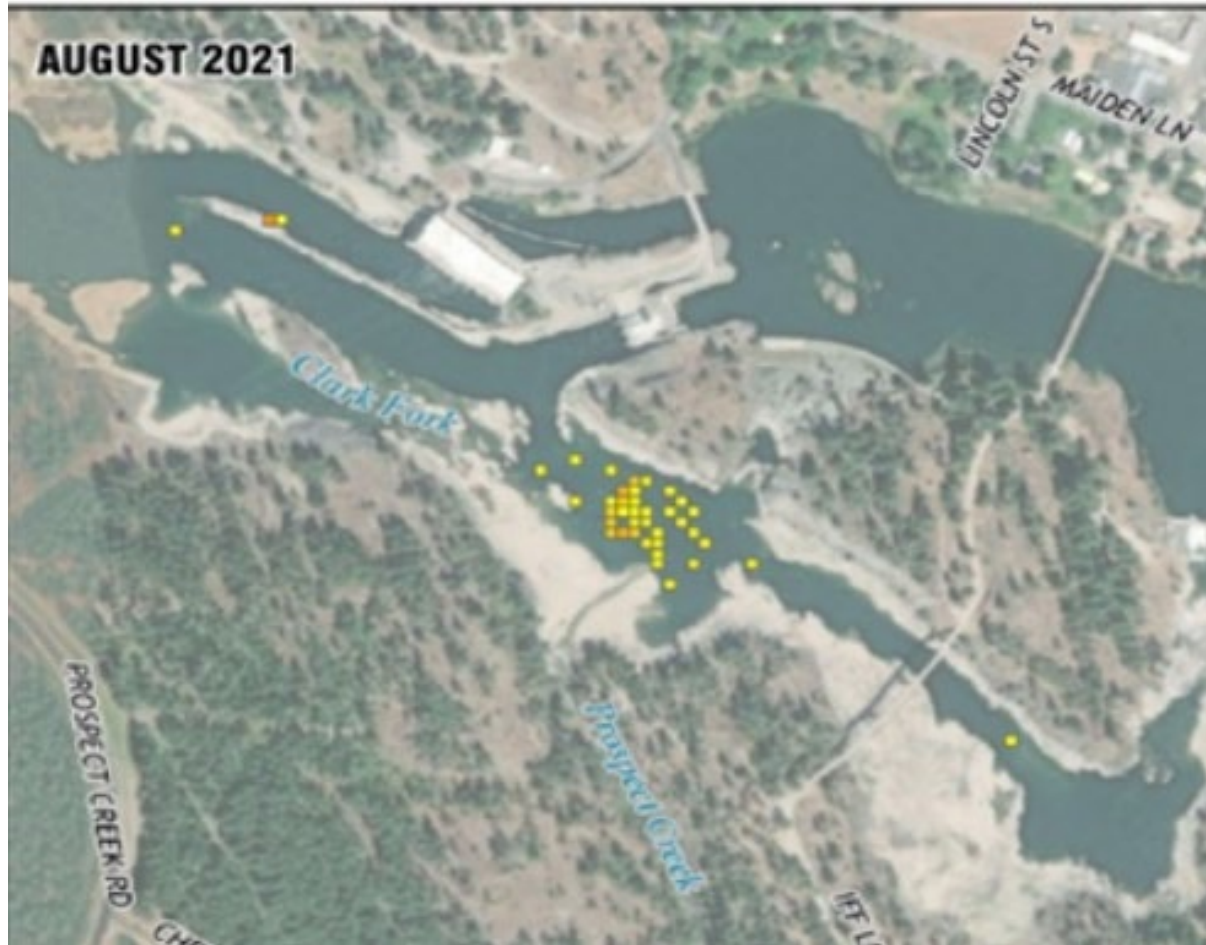


LL locations by month





LL locations by month



LL locations by month





RB locations by month



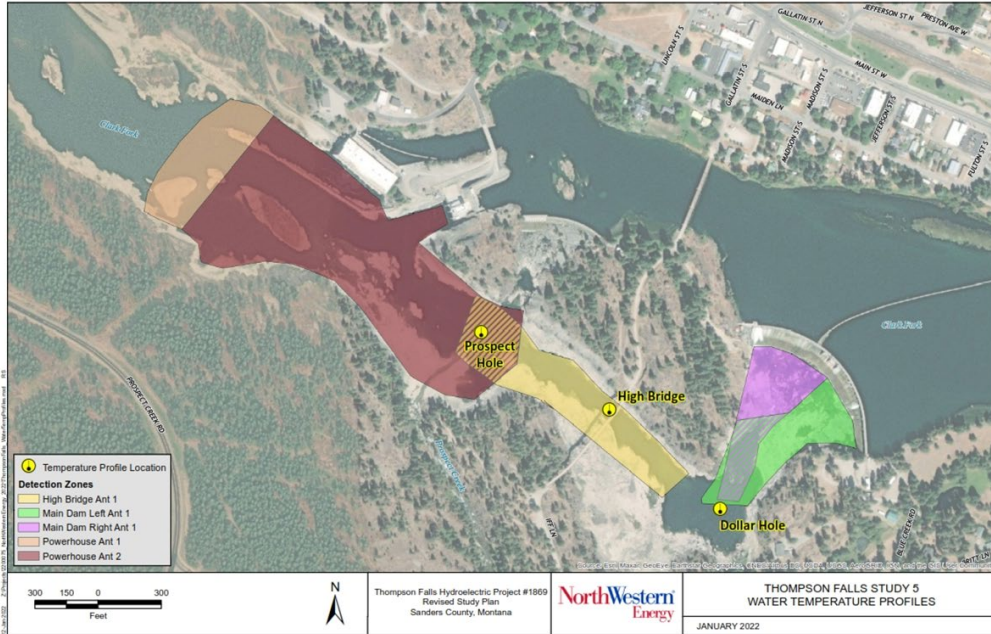


RB locations by month

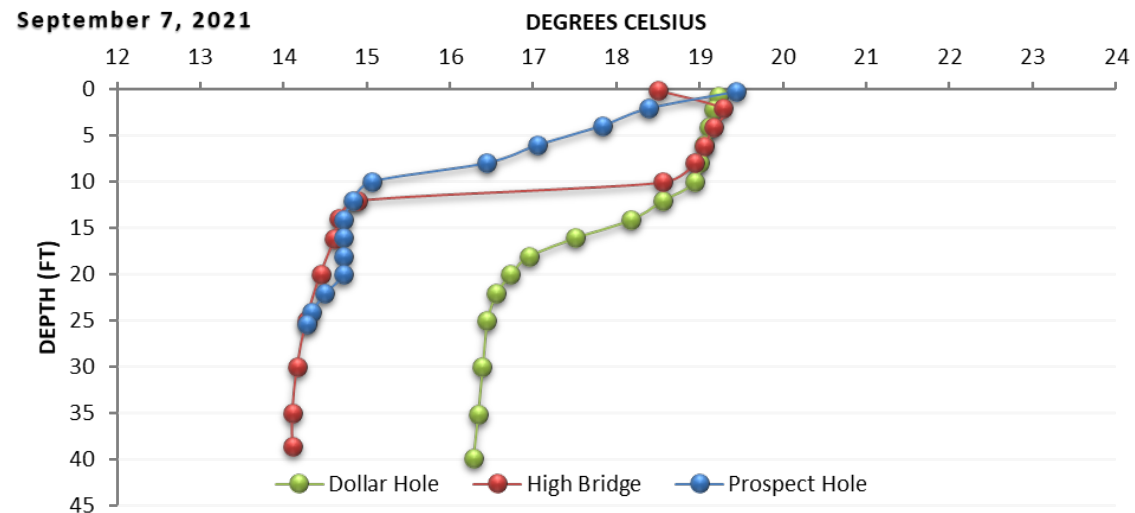
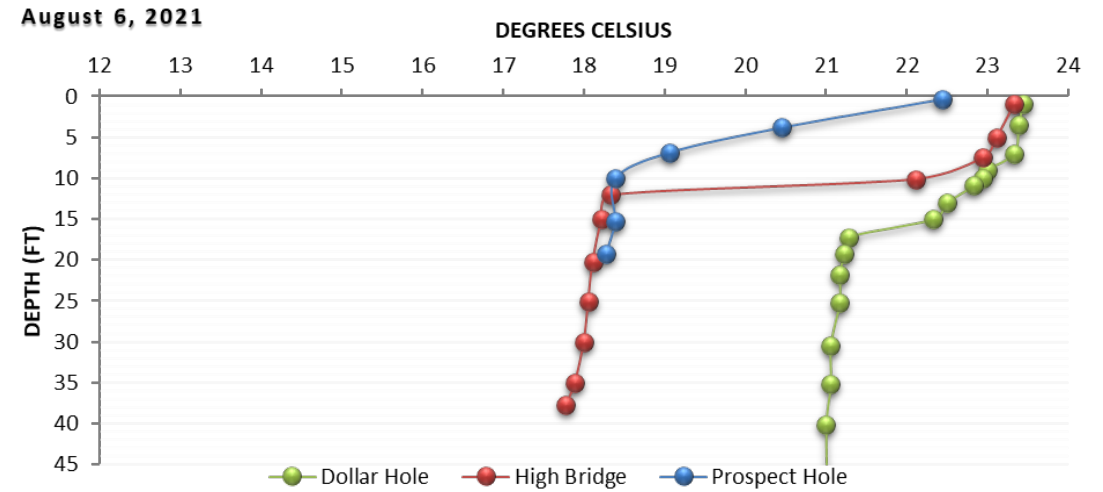


RB locations by month



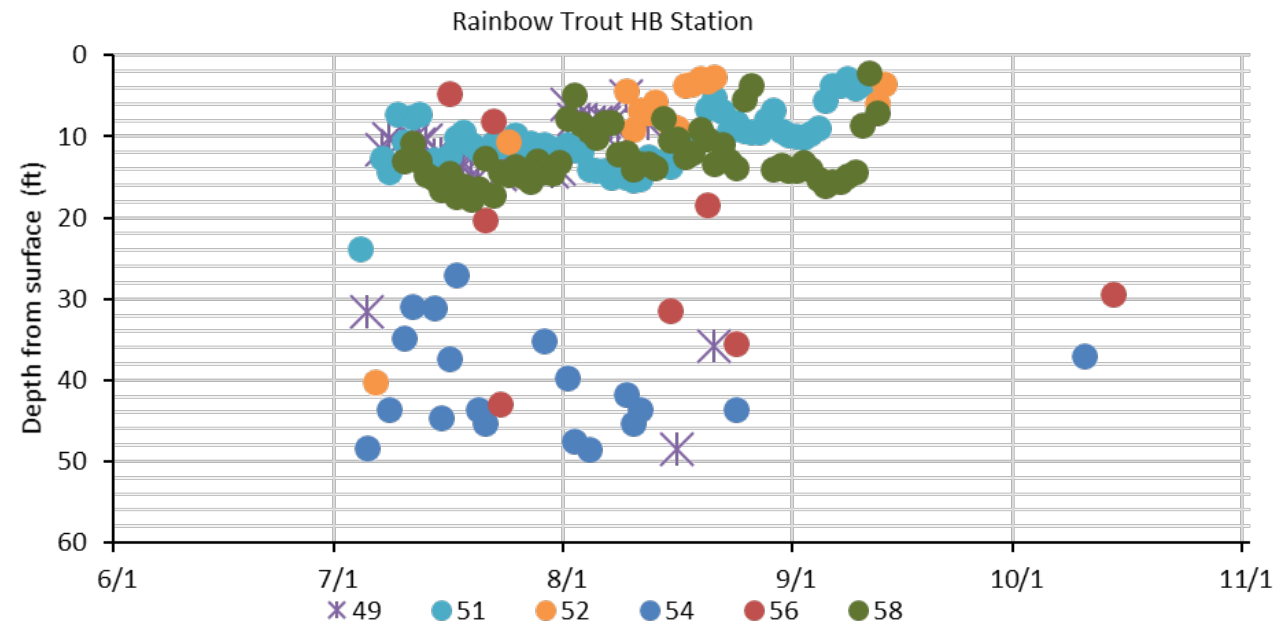
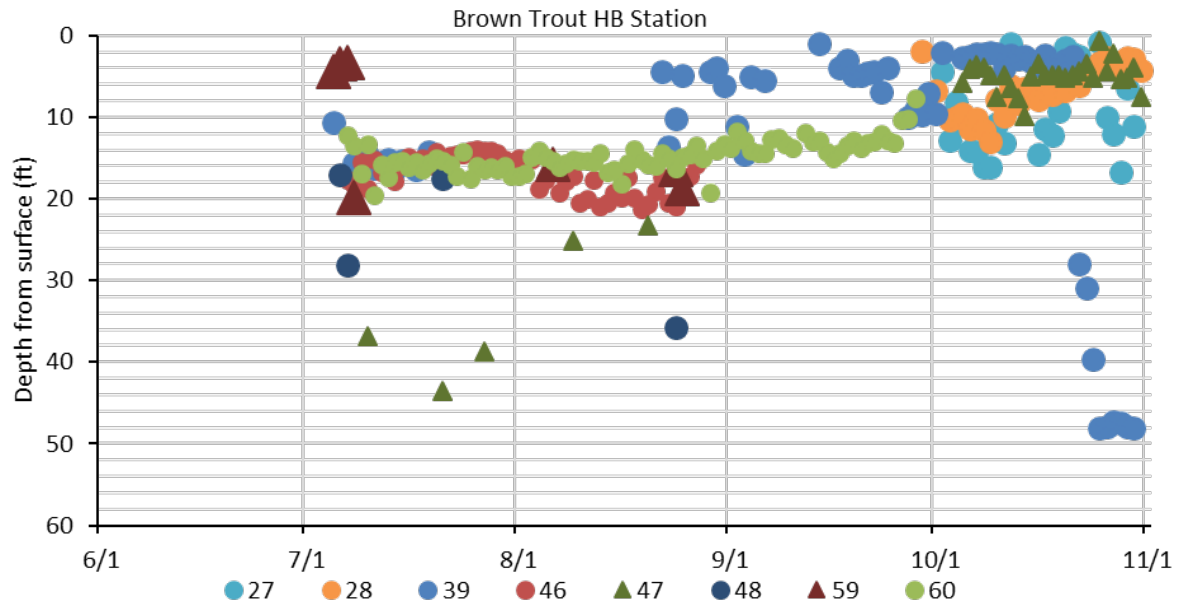


- Thermocline at High Bridge and Prospect Hole
- Surface 22-23 C, 4-5 degrees cooler ten feet deep





Fish depth use within ZOP





Fish Swimming Ability Review

Common Name	Prolonged Speed (fps)	Burst Speed (fps)
MINNOW	1.3 - 2.4	2.4 - 4.4
Northern Pikeminnow	1.3 - 3.8	
SUCKER	1.3 - 2.5	2.2 - 3.2
Longnose Sucker	2.0 - 4.0	4.0 - 7.9
Largescale Sucker	1.6 - 1.9	
SALMONIDS	2.3 - 4.0	4.5 - 7.5
Westslope Cutthroat Trout	1.6 - 6.4	3.3 - 13.50
Rainbow Trout	1.6 - 4.0	3.4 - 20.3
Mountain Whitefish	1.3 - 5	2.6 - 10
Bull Trout	1.3 - 2.8	3.6 - 7.5
Brown Trout	1.6 - 7.7	4.2 - 13.2
Brook Trout	1.4 - 8.2	6.4 - 13.5

- Sustained – purely aerobic effort used for long periods of travel at low speeds (more than 200 minutes)
- Prolonged – combination of aerobic and anaerobic effort used for short periods of travel at high species (from 20 seconds to 200 minutes)
- Burst – purely anaerobic effort used for maximum swimming speed, inducing fatigue (less than 20 seconds)

Rainbow Trout

- June/early July movement into ZOP. Most when flows <30,000 cfs, one fish entered around 52,000 cfs
- Summer congregation near mouth of Prospect Creek. Unfavorable thermal conditions may be a large driver of fish behavior within the ZOP during this timeframe. Got hot early and stayed hot.
- Collection timing (June) likely targeted post-spawned RB. Factors that may have impacted behavior and motivation levels.

Brown Trout

- Spring tagged LL were detected in the ZOP when flows were less than 38,200 cfs
- 3 of 4 LL detected in the near field entered the passage facility, 2 of these ascended to the top
- Fish oriented to the MDR (near ladder) as opposed to the left side



- Fish moved up the main river channel and spent little time near the powerhouse areas
- Fish spent considerable time near the mouth of Prospect Creek and made brief forays upstream to the main dam
- Fifteen of the 16 radio-tagged fish remained in the ZOP the majority of the study season, five fish (4 LL, 1 RB) entering the near field and three fish (3 LL) entered the ladder
- 2022 study season will increase sample size, start earlier in the year, and final report will integrate hydraulic modeling results with fish behavior and swimming capability results



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Thompson Falls Hydroelectric Project No. 1869

**Initial Study Plan Meeting – Downstream
Fish Passage Literature Review**

May 5, 2022

- In 2007, the previous Licensee prepared a Literature Review of Downstream Fish Passage Issues at Thompson Falls Hydroelectric Project.
- Survival estimates in 2007 Literature Review:
 - 94% through the new powerhouse (Kaplan turbine),
 - 85% through the original powerhouse (Francis turbines),
 - 98% through the spillway.
- Combined survival estimates for trout measuring > 100 mm was estimated 91 to 94%.

- Fish can migrate downstream via the spillways, outlet works, or through the turbines.
- During non-spill periods, the primary means of downstream passage is through the turbines.
- Generally, passage via spill poses less risk than via turbine.
 - Fish mortality is typically 0 to 2 percent for standard spill bays and
 - 5 to 15 percent for turbine passage, with
 - Kaplan turbines generally at the lower end of this mortality range and
 - Francis turbines generally greater (Whitney et al. 1997).
- Mortality can vary depending on the configuration of the turbines and spillways and type and timing of fish being passed.

Study Area - Downstream Fish Passage Literature Review



Provide updates to estimates of downstream passage survival of various size classes of fish, with respect to current Project configuration and operations.

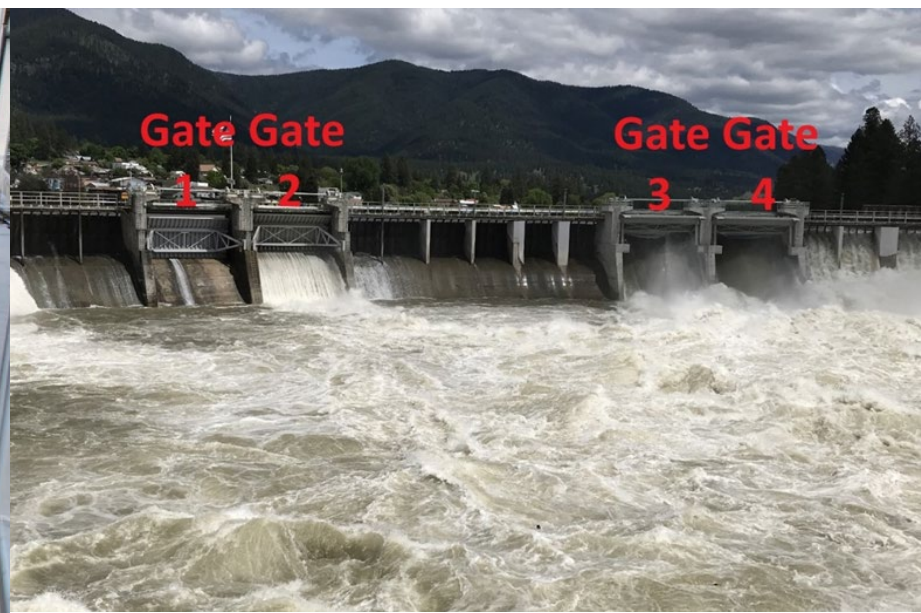


- Focused on literature published since 2007.
- ProQuest and EBSCO database searches.
- Literature screened for relevance for species and size classes of fish and turbine configurations found in the Project area.
- Project configuration updates.
- Documentation of downstream passage at the project- fish ladder recaptures.



Two operational updates since 2007 Literature Review

1. Installation of upstream fish passage facility 2010
2. Radial gates 3 & 4 installed in 2020



- Upstream passage facility
 - All intakes are screened, and additional 100 CFS of flow provided from a half panel along the main dam.
 - Given the low proportion of water moving through the fish ladder in relation to the Clark Fork River and screens as mitigative measures it is not anticipated that a measurable amount of downstream juvenile passage occurs through the fish ladder. Screens prohibit adult downstream passage.

- Radial gates 3 & 4
 - Each gate passes approximately 10,000 CFS. Capacity is similar to the previous gate panels but is now automated for spilling scenarios.
 - Not anticipated to impact downstream survival given similarities to previous manual gates.



- Recaptures of tagged fish - successful passage upstream and downstream of the Project.
- Some fish make the loop multiple times.
- 264 out of 2,644 PIT-tagged fish released upstream of the dam returned and ascended the fish passage facility as many as 6 times.
- Species include Bull Trout, Rainbow Trout, Brown Trout, Westslope Cutthroat Trout, Rainbow x Westslope Cutthroat hybrids, Mountain Whitefish, Northern Pikeminnow, Smallmouth Bass, and Largescale Sucker.
- Average of 8% of the salmonids PIT-tagged each year, return to the fish passage facility the following year.



Results - Downstream Fish Passage Literature Review

- 5 relevant documents reviewed in-depth.
- Other reports lacked relevance to Thompson Falls turbine configurations, dam characteristics, species similarities, and fish lengths or juvenile and adult age classes.
- Kaplan units are significantly safer for fish than Francis type units.
 - Kaplan turbines juvenile survival Atlantic Salmon and Brown Trout 100% to 99%.
 - Francis turbine juvenile survival 88% to 91%.



- Large variability in downstream adult survival.
 - Varies by site-specific characteristics of each location.
 - Lower adult survival than juvenile survival common in the literature.
- Direct comparisons to Thompson Falls Project challenging.
- Some literature indicate low survival rates for adults (19-44%) but these are for larger turbines and greater discharge than Thompson Falls units.
- Survival rates for Atlantic Salmon kelts on the Penobscot River were estimated at 15 project sites and indicated adult survival was typically greater than 75 percent at most sites.



Conclusion - Downstream Fish Passage Literature Review

- Generally consistent with previous estimates of downstream fish survival.
- Further resolution of downstream passage survival based on the size and species specific to the Clark Fork River at the Thompson Falls Project is limited in the available literature.
- As PIT tagging indicates downstream adult survival is common.
- Higher rates of survival obtained with smaller fish going through larger openings over lower heads, and slower moving units with laminar flow.

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Thompson Falls Hydroelectric Project No. 1869

Initial Study Plan Meeting – Total Dissolved Gas Study

May 5, 2022



- Purpose of the Study:
 - Collect background (incoming) TDG concentrations in the Clark Fork River upstream of the dams.
 - Collect downstream (outgoing) TDG concentrations in the Clark Fork River below the main dam and at Birdland Bay Bridge.
 - Test configurations of radial gates on the main dam for TDG entrainment downstream.
- TDG Control Plan for Thompson Falls operations was approved by Montana DEQ in 2010.
- Since the approval of this Plan, two new radial gates have been installed on the main dam.
- More information is needed on TDG production with the new radial gates to update the TDG Control Plan.





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Gate Gate

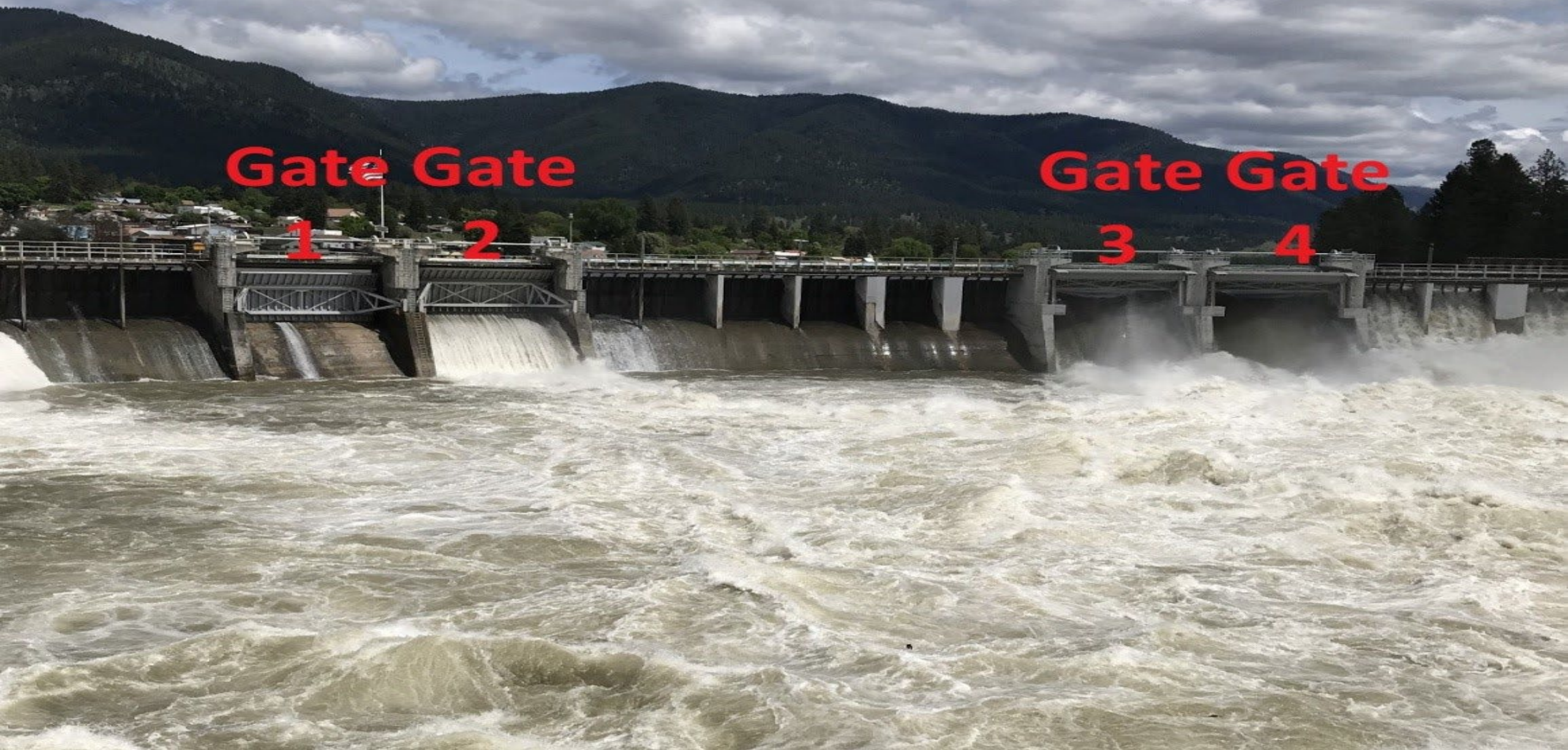
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Gate Gate

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- TDG is measured in three locations
 - Above the powerhouse
 - Below the main dam
 - Birdland Bay Bridge (downstream of the Project)
- Hydrolab instruments provide TDG readings at 15-minute intervals.
- Instruments are calibrated bi-weekly to ensure that the sensors are operating properly and accurately.



Main Channel Dam

Dry Channel Dam

High Bridge

Above Dam

New Powerhouse

Old Powerhouse

Prospect Creek

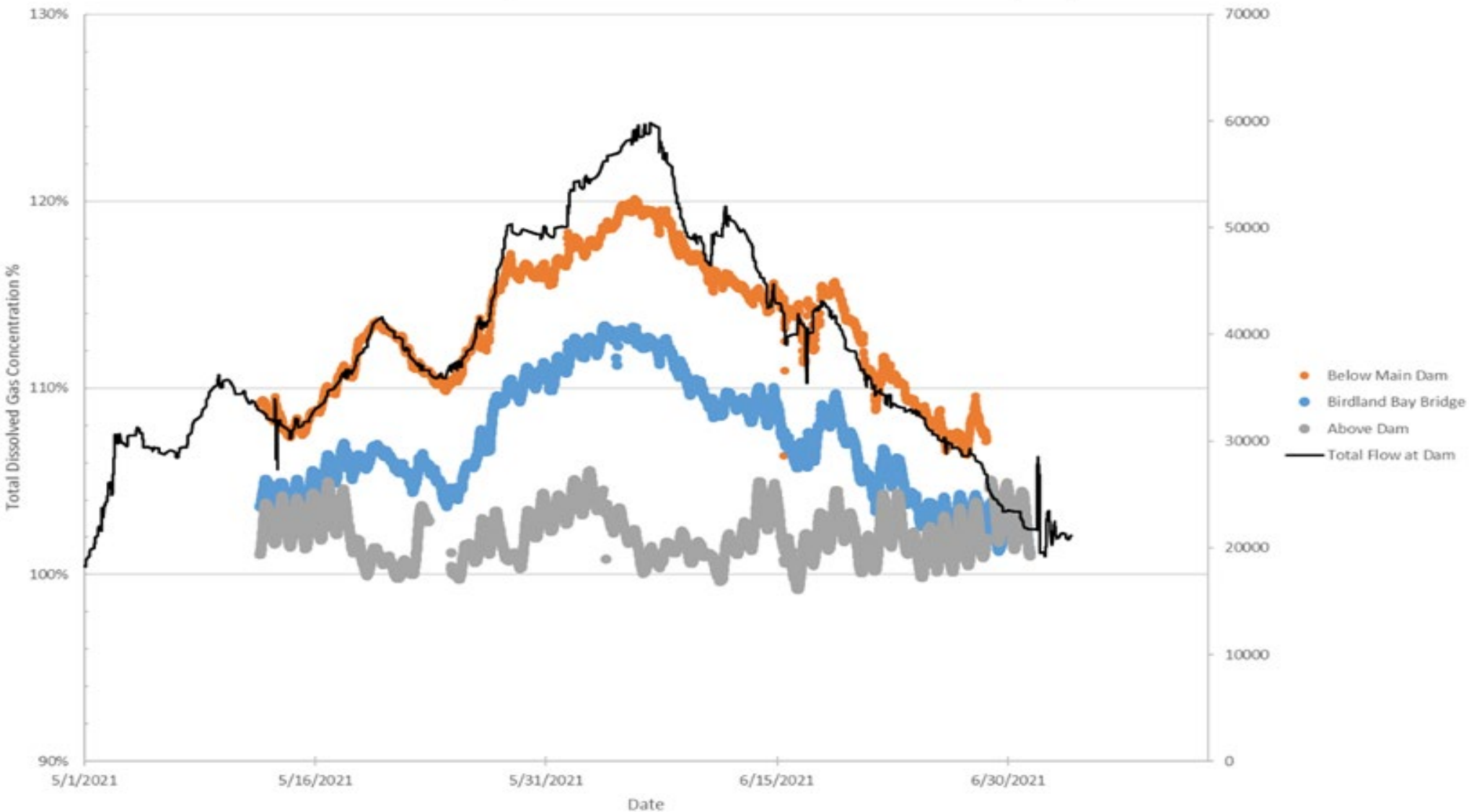
Birdland Bay Bridge



- TDG monitoring was conducted from May 12 through July 1 in 2021.
- On June 30, Clark Fork River flows had reduced to the point where the entirety of the river flow was passed through the powerhouses, so TDG levels were greatly reduced due to the lack of spillway flow.
- Peak discharge at Thompson Falls Dam occurred on June 6, 2021 and was estimated at 59,801 cfs.
- The peak concentrations of TDG occurred on June 5, 2021 at 120.1 percent TDG directly downstream of the Main Channel Dam, which equated to a peak of 113.3 percent TDG at Birdland Bay Bridge downstream. The influence of water from the powerhouses reduces the total amount of TDG observed at Birdland Bay Bridge, which is approximately where the upstream end of the Noxon Reservoir pool is located.



2021 Thompson Falls Total Dissolved Gas Concentrations (TDG)





- During the study period, radial gate testing was conducted to monitor the TDG concentrations in response to different spill configurations.
- Low peak flows in the Clark Fork River in 2021 were less than optimal for testing TDG at the Project.
- Radial gate testing occurred on the descending limb of the hydrograph at approximately 5,000 cfs intervals from 40,000 cfs down to 30,000 cfs, which is near the point when spill operations ceased for the year.



Total Dissolved Gas (TDG) Results

Total Flow Range (cfs)	Max TDG at HB (% saturation)	Gate Setting at Max TDG	Min TDG at HB (% saturation)	Gate Settings Min TDG
30,000-35,000	112.5	1 full open, 2 4' open	107.5	4-partially open
40,000-45,000	114.4	1 and 2 open	111.7	1 and 4 open
45,000-50,000	118.8	1 and 4 open	116.2	2 and 4 open
55,000-60,000	121.6	3 and 4 open	119.6	1 and 2 open
65,000-70,000	122.7	3 and 4 open	119.8	1 and 3 open
75,000-80,000	123.1	3 and 4 open	121.2	2 and 3 open



NorthWestern's study conclusions to-date, are:

- Radial gate testing at flows above 80,000 cfs was not conducted in 2021. NorthWestern will monitor TDG again in 2022. Data will be collected at flows above 80,000 cfs as conditions allow.
- Operating non-adjacent radial gates in combination with each other will generally reduce the amount of TDG entrained in the river downstream at river flows less than 80,000 cfs, although operation in this manner may not always be possible due to dam safety considerations.
- For the 2022 study season, the aging Hach Hydrolab DS5 instruments will be replaced with new Eureka Water Probes Manta instruments.
- The instrumentation change will be an upgrade to a newer technology, which allows for greater instrument reliability and precision. Results between the Hach and Eureka probes are expected to be comparable, as the QA/QC and instrument calibration procedures will remain the same.

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Thompson Falls Hydroelectric Project No. 1869

Initial Study Plan Meeting – Visitor Use Survey

May 5, 2022



Administered at 9 recreation sites associated with the Thompson Falls Hydroelectric Project. 60 randomly selected days during the peak recreation season (May 28-September 6, 2021). Sampling days dispersed throughout the days of the week and hours of the day, representative of the peak recreation season of Memorial Day through Labor Day.

Goal: determine if Project-induced recreation is adequately being met.





Visitor Survey Sampling:

Sampling occurred from 8 am to 9 pm.

Reasonable attempts were made to include one randomly-selected individual from each recreating group present at the site during the sampling event.

Survey conducted as an interview; responses entered into a tablet computer by a survey technician.

Strategy:

Began at randomly-selected recreation site.

Interviewed all groups recreating at that site.

Technician moved to the next site in rotation.

Continued in this manner until the end of the daily sampling timeframe.





Visitor Volume Monitoring:

Visitor volume was collected via automatic traffic and trail counters to monitor patterns of use at six sites included in the visitor survey:

- Wild Goose Landing Park
- Island Park
- Powerhouse Loop Trail, including Sandy Beach
- South Shore Recreation Area
- Cherry Creek Boat Launch

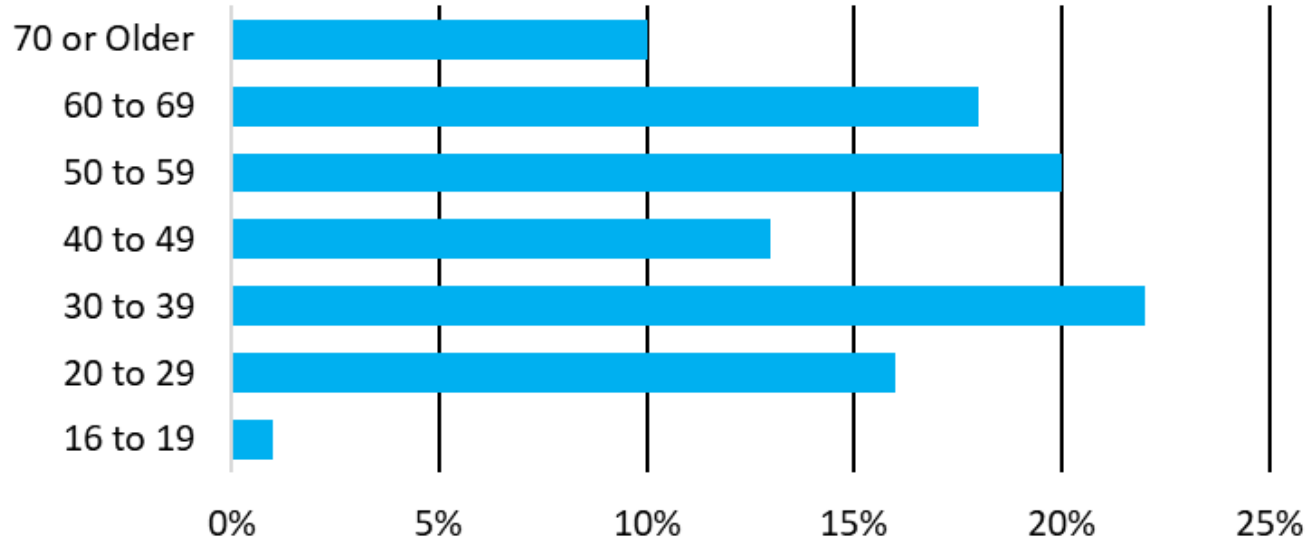
Supplementing visitor survey data with visitor volume and use patterns provides a more comprehensive analysis of recreation visitation.

Enhancement to the FERC-approved study plan.

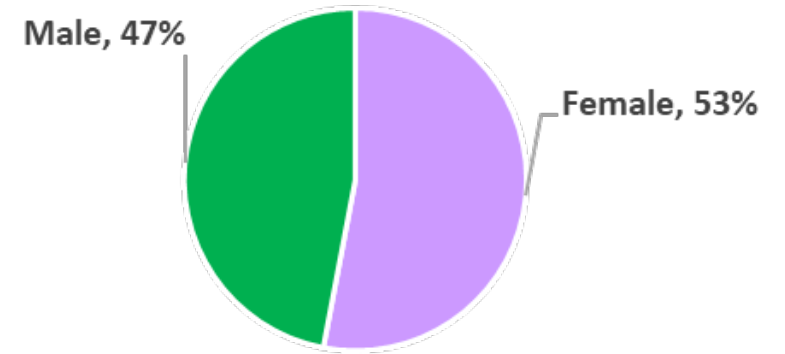




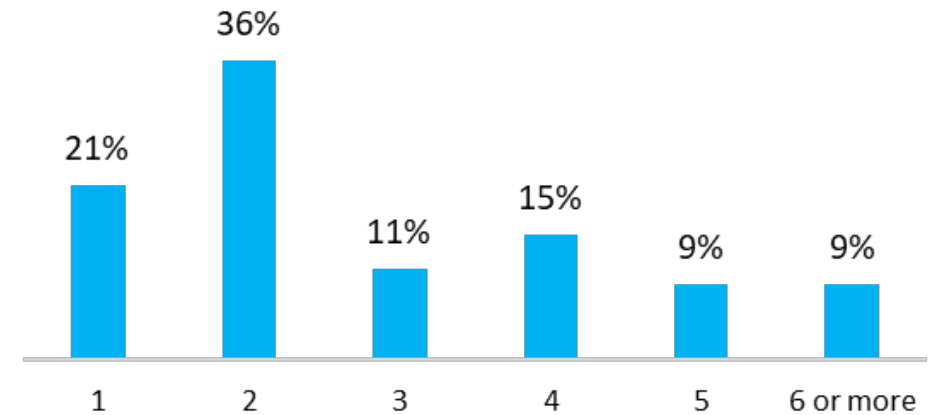
Visitor Age, Median = 48 years



Gender of Group Members

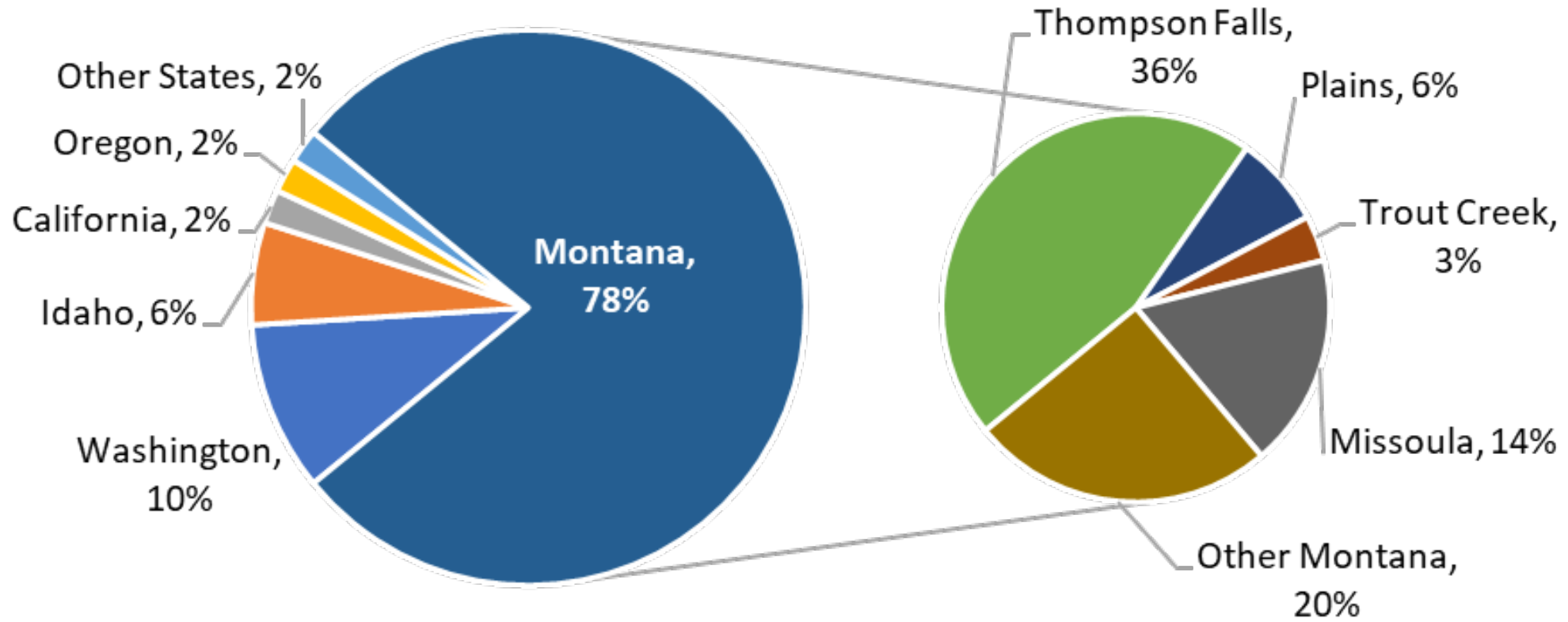


Group Size, Median = 2 people



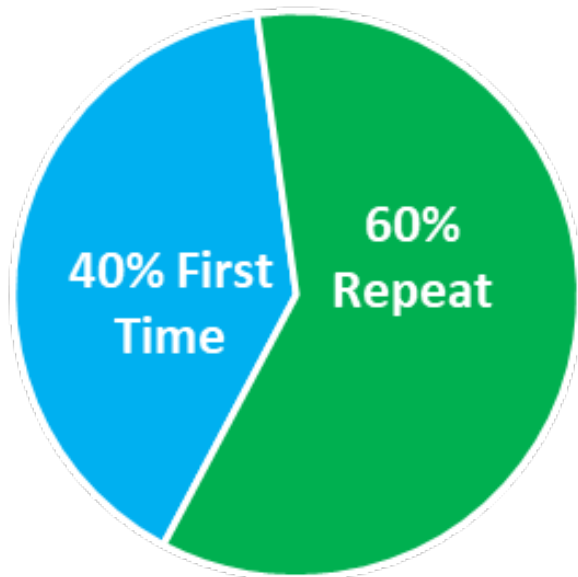


Visitor Origin





First Time vs Repeat Visitors



Past Trip Experience

	<u>Mean</u>	<u>Median</u>
Years Visiting	10.3 years	5 years
# Days Per Year	12.6 days	5 days
Length of Stay	2 hours	2 hours

Impression of Recreation Development

Leave it as is	99%
Prefer changes	1%

Length of Stay on This Trip

Mean	1.7 hours
Median	1.0 hours



Reason to Participate in Outdoor Recreation

	Not at all Important 1	Not very Important 2	Somewhat Important 3	Very Important 4	Extremely Important 5
To enjoy nature				X	
To be with friends or family				X	
To be outdoors				X	
For excitement			X		
To find some solitude				X	



Satisfaction with Site and Site Amenities

Not at all Satisfied 1 | Not very Satisfied 2 | Somewhat Satisfied 3 | Very Satisfied 4 | Extremely Satisfied 5

	1	2	3	4	5
Overall Site Satisfaction				X	
Picnic area conditions		X			
Boat dock/launch conditions				X	
Quality of interpretive/educational info				X	
Maintenance of facilities				X	
Cleanliness of area				X	
Condition or degree of naturalness				X	
Behavior of other people				X	

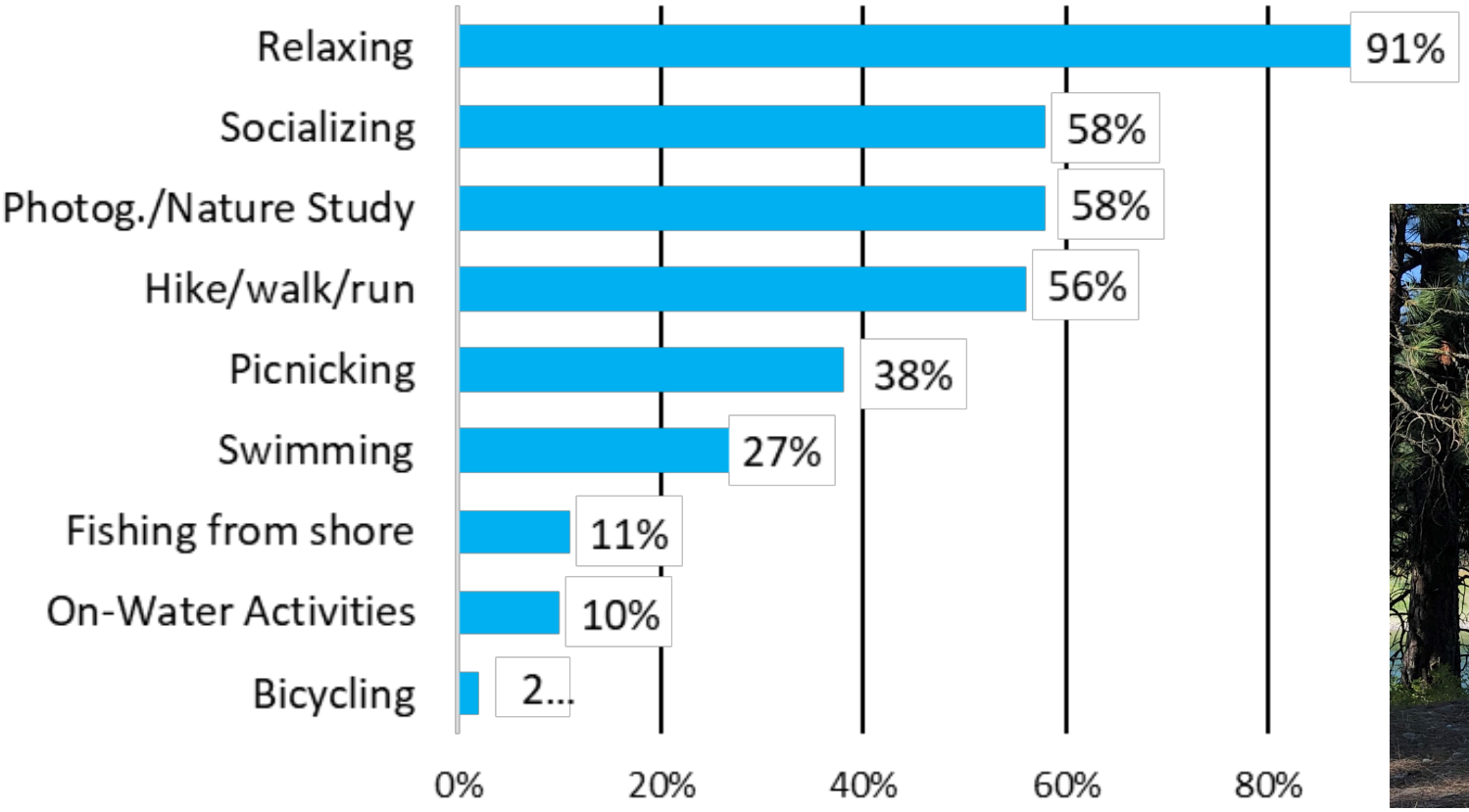
Perception of Crowding

Not at all Crowded (1)	71%
Not very Crowded (2)	25%
Somewhat Crowded (3)	4%
Very Crowded (4)	--
Extremely Crowded (5)	--

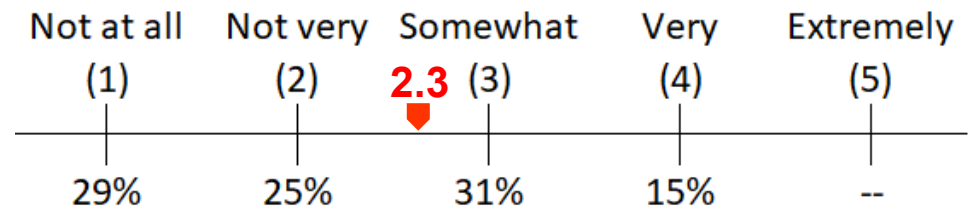
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Activity Participation at Recreation Site



Familiar with No-Wake Zone Regulations

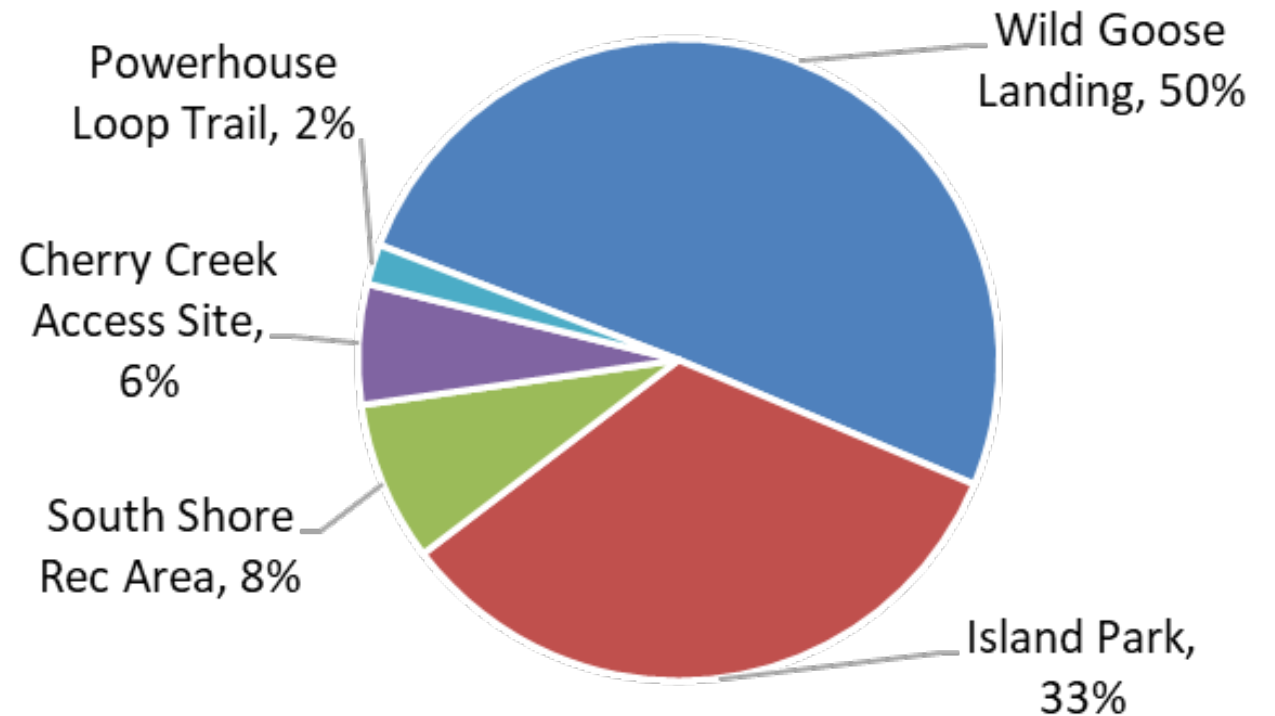




2021 Visitor Group Distribution

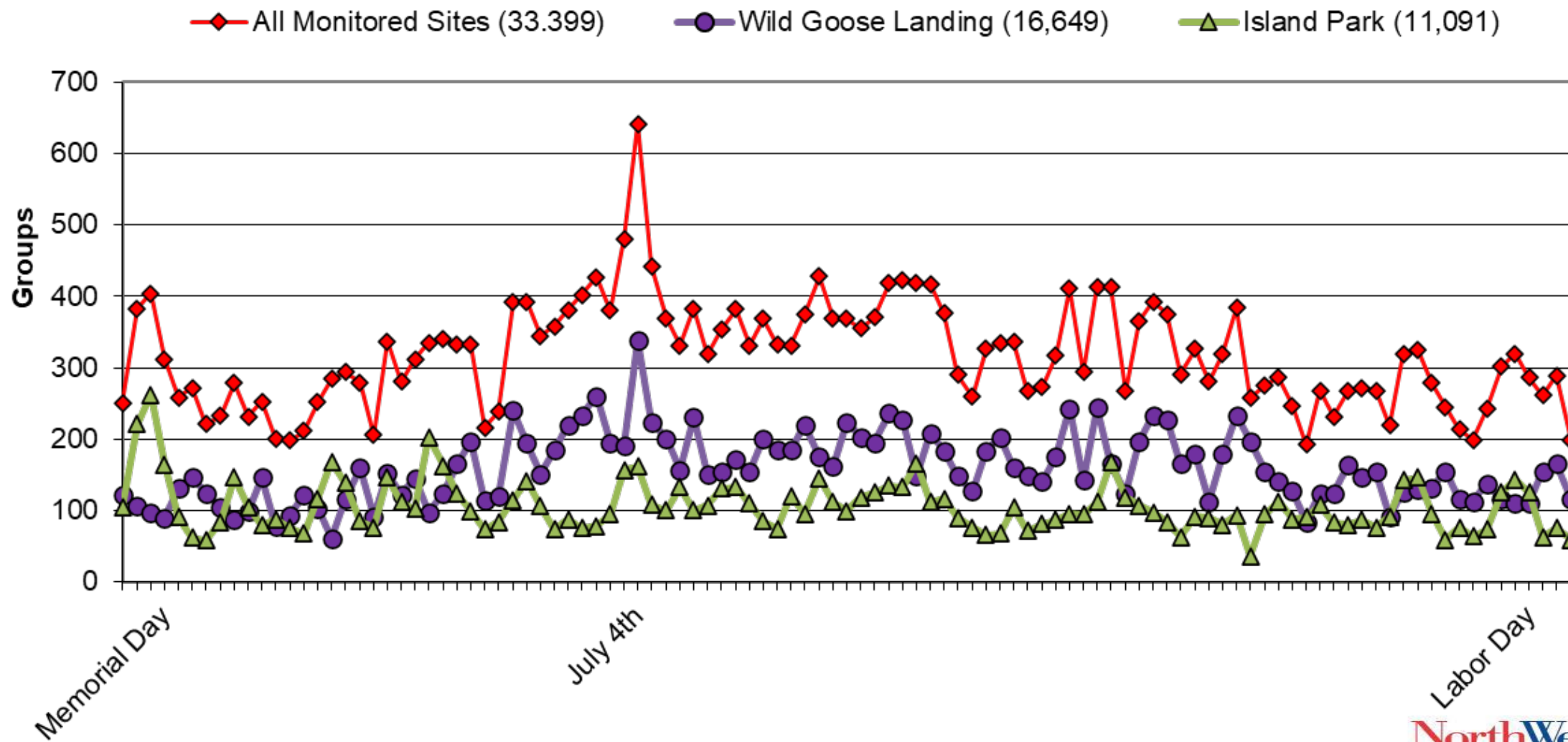
Visitor Groups Per Site

Wild Goose Landing	16,649
Island Park	11,091
South Shore Rec Area	2,819
Cherry Creek Access Site	2,105
Powerhouse Loop Trail	735
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Total	33,399



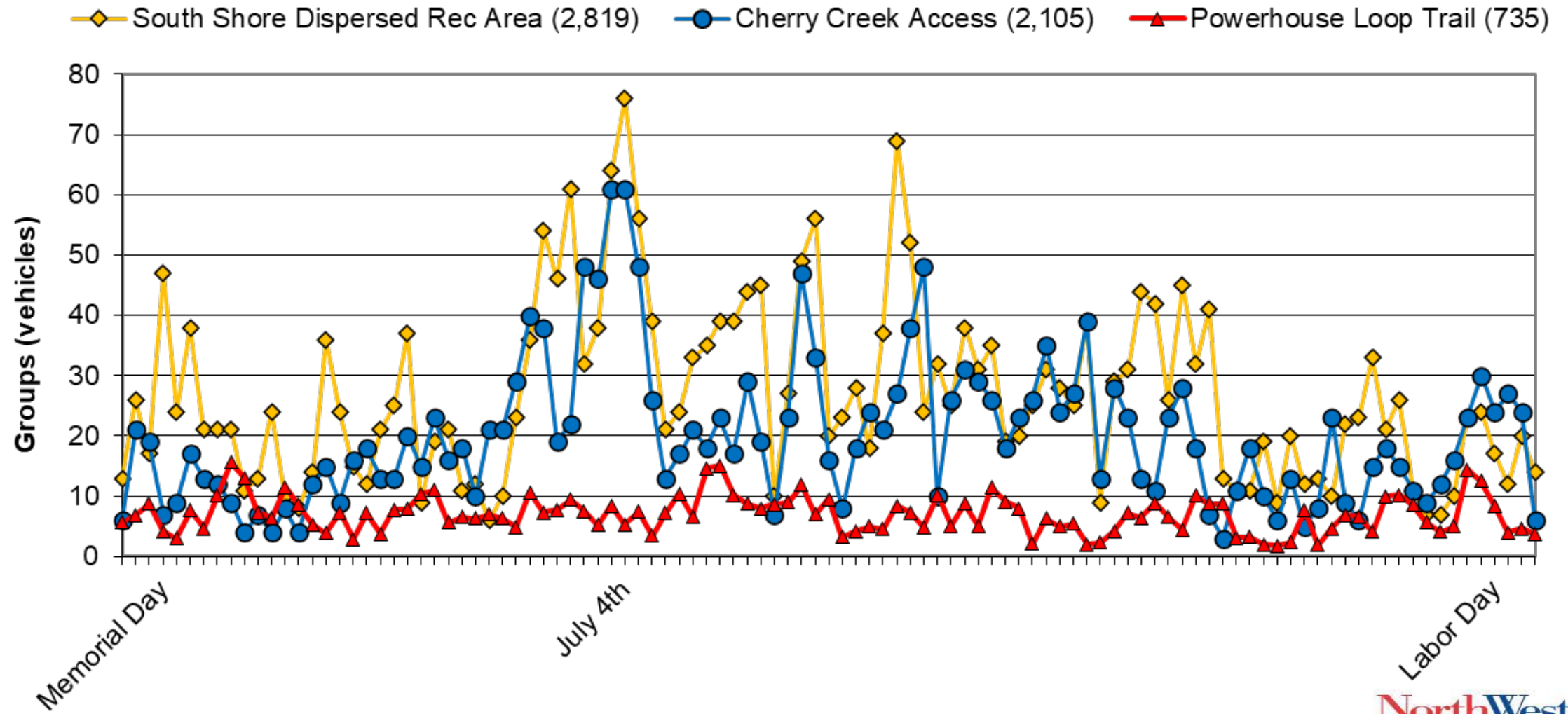


Visitor Survey Results – Visitor Volume





Visitor Survey Results – Visitor Volume





Conclusions

Visitor group characteristics are largely unchanged.

Visitors are generally repeat visitors from the local area that utilize recreation sites for both passive and active recreation pursuits.

Crowding and satisfaction ratings are positive.

Recreation sites hosted an average of more than 300 group visits overall per day, with the most use occurring at Wild Goose Landing Park and Island Park.

Recreation patterns were influenced to some extent by environmental conditions (wildfire smoke and unusually hot temperatures) and social factors surrounding the COVID-19 pandemic.



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Thompson Falls Hydroelectric Project No. 1869

Initial Study Plan Meeting – Cultural Resources Study

May 5, 2022



Cultural Resources Inventory and National Register Evaluation

- Update inventory and evaluation of Historic Architectural and Engineering Properties.
- Develop high probability model for Precontact and Historic Archaeological Properties, and conduct field inventory to identify and evaluate properties in high site probability areas.





- Collect and analyze baseline resource data to gauge any current and anticipated Project effects on cultural properties.
- Develop Historic Properties Management Plan under new License.



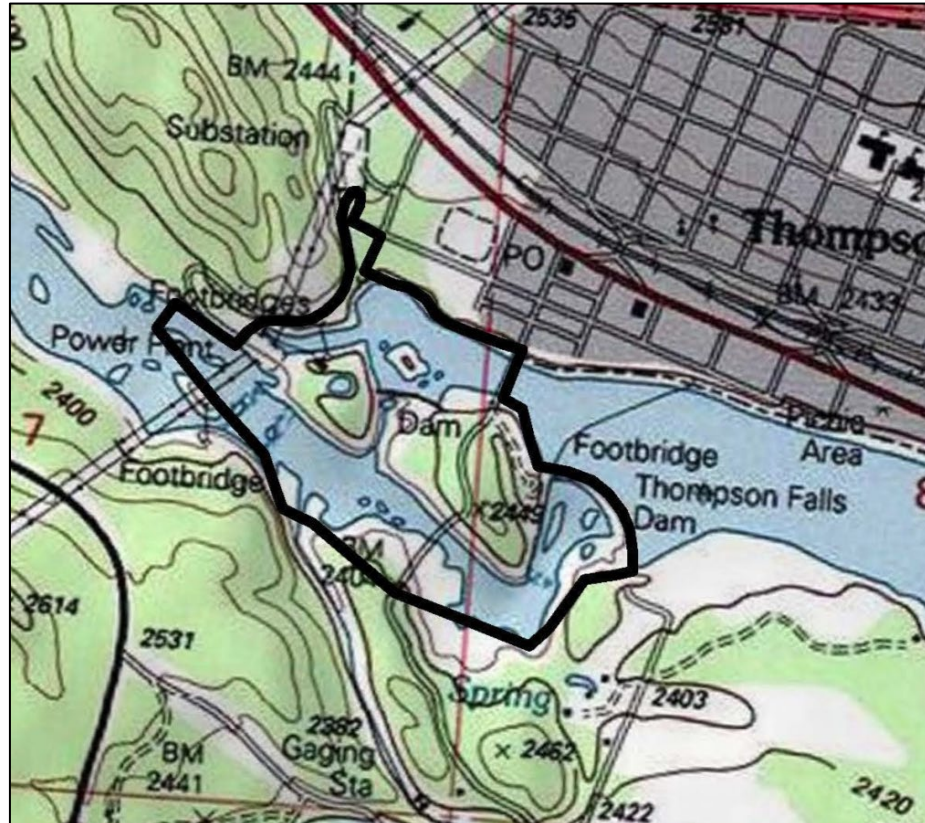
- Update inventory and evaluation of historic architectural and engineering elements of Thompson Falls Hydroelectric Dam Historic District.
- Expand record of known precontact and historic archaeological properties through systematic inventory of high site probability areas.





For Historic Architectural and Engineering Properties

- Re-Inventory Thompson Falls Hydroelectric Dam Historic District and update 1986 National Register of Historic Places listing.





For Previously-Unknown Precontact and Historic Archaeological Properties

- Developed and evaluated high probability model to predict where previously-unknown precontact and historic archaeological properties mostly likely exist within project.
- In summer 2022 - Inventory high site probability areas to determine locations, types, importance, and condition of those properties. (Report to be completed by May 2023)





For Historic Architectural and Engineering Properties

- Thompson Falls Hydroelectric Dam Historic District boundary modification and additional documentation is finalized and scheduled for approval at May meeting of Montana State Historic Preservation Review Board.
- District continues to be considered of local and state significance.
- Boundary modification encompasses all identified contributing buildings, structures, and sites, and excludes recent additions at facility perimeter.
- Document provides enhanced facility history and resource descriptions.



For Previously-Unknown Precontact and Historic Archaeological Properties

- Draft high site probability model circulated for review November 2021. Responses to received comments incorporated into final model January 2022 and forwarded to FERC as Interim Study Report.
- High site probability areas involve 839 acres of dry and near shore land.
- Majority of high probability areas on private property; to be inventoried only with owner permission.

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