Technical Report No. 23-10

Water Supply Creek Fish and Fish Habitat Assessment

by

Greg Albrecht and Katrina M. Kanouse

December 2023

Alaska Department of Fish and Game **Habitat Section**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in reports by the Divisions of Sport Fish and Commercial Fisheries, and the Habitat Section. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milligram	mg
milliliter	mL
millimeter	mm
nanometer	nm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
inch of mercury	inHg
kilowatt	kW
Kilopascal	kPa
Nephelometric Turbidity Unit	NTU
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
etalii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
idest (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
no data	ND
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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Cover: Water Supply Creek and resident Dolly Varden (inset).

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

We appreciate Inside Passage Electric Cooperative Operations Manager Brandon Shaw approaching the Alaska Department of Fish and Game Habitat Section to conduct these studies in preparation for hydroelectric project permitting, and for supplying funding for Habitat Section staff time, travel, and equipment. Habitat Biologist Evan Fritz assisted with developing the study plan with Inside Passage Electric Cooperative staff; Inside Passage Electric Cooperative staff in Hoonah assisted with logistics and transportation; and Evan Fritz along with Habitat Biologists Erika King, Flynn Casey, and Dylan Krull assisted with field work. Habitat Section Operations Manager Dr. Al Ott, Dylan Krull, and Hydrologist Carl Reese with the Alaska Department of Natural Resources Division of Mining, Land, and Water reviewed the report.

EXECUTIVE SUMMARY

Inside Passage Electric Cooperative contracted the Alaska Department of Fish and Game Habitat Section to assess fish use and fish habitat in Water Supply Creek, the proposed location for a 400 kW run-of-river hydroelectric project (1.4–14 ft^3/s design flow), which would supplement the City of Hoonah electrical demand that is currently supported by the Gartina Creek hydroelectric project and diesel generators. Water Supply Creek is a tributary of Gartina Creek, above the barrier to anadromous fish migration, and upstream of the Gartina Creek Hydroelectric project.

Habitat Section staff traveled to Hoonah seven times between March 31, 2022, and August 8, 2023, to gage stream discharge and document fish presence and fish habitat in the vicinity of the project. Using water level loggers sampling at 2-hour intervals and stream discharge measurements, we generated a rating curve to approximate daily discharge throughout the 16-month monitoring period at the upstream and downstream ends of the proposed project. We used a backpack electrofisher and minnow traps to sample fish throughout the bypass reach, and repeated trapping efforts conducted in 2010 (unpublished HDR Inc. data obtained from Erin Cunningham, Anchorage, Alaska). We also documented pools and surface tributaries, which would provide habitat and supplemental flow during hydroelectric operation.

Mean annual flow at the proposed intake and tailrace was estimated at 9.4 ft^3/s and 10.9 ft^3/s, with a range of 1.3–106.4 ft^3/s and 2.0–146.2 ft^3/s during the monitoring period. The maximum design flow of 14 ft^3/s was exceeded about 26% of the time at the intake site. The 4,600 ft long bypass reach mean gradient is 12% and contains several upstream fish migration barriers. The reach is bedrock-confined and provides habitat for resident Dolly Varden, primarily in the form of deep pools which provide refuge during high and low flow events; otherwise the canyon mainly provides a downstream fish migration corridor. In August 2023 we sampled the bypass reach for fish presence, capturing 23 Dolly Varden (55–160 mm FL) and documented resident Dolly Varden in lower-gradient habitat 1,700 ft upstream of the intake site. We documented 25 pools having 1–4.5 ft residual pool depth, and 17 surface tributaries in the bypass reach; the tributaries nearly cease to flow during extended cold and warm periods with little precipitation.

The proposed hydroelectric project includes providing up to 1 ft^3/s instream flow reservation for fish habitat and to ensure uninterrupted flow through the bypass reach and to the City of Hoonah water supply intake[a], in the event of a planned or emergency shutdown. Supplemental tributary flow, periodic exceedance of hydroelectric flow capacity, and the presence of many pools provide adequate habitat conditions for resident Dolly Varden to persist in Water Supply Creek, regardless of the amount of instream flow provided.

[a] Located adjacent to the proposed project tailrace.

INTRODUCTION

Water Supply Creek is a tributary to Gartina Creek[b] that provides habitat for resident Dolly Varden. The confluence of the two creeks is 830 ft upstream of Gartina Falls, a natural barrier to upstream anadromous fish migration and the site of the Gartina Creek hydroelectric facility. The City of Hoonah (City) operates a water intake behind a low-head dam for water supply 2,800 ft upstream of the confluence, which has been in place for decades. The intakes for the Gartina Creek hydro and City water supply do not have fish exclusion screens.

Inside Passage Electric Cooperative's (IPEC) proposed location of the tailrace for the Water Supply Creek run-of-river hydroelectric facility would be immediately upstream of the City water supply intake impoundment. The proposed intake would be 4,600 ft upstream at the head of a newly constructed 10 ft tall rock and concrete diversion weir. The proposed hydroelectric operation has a design flow of 1.4–14 ft^3/s and IPEC proposes a continuous instream flow release of up to 1 ft^3/s to maintain fish habitat and supply water to the City water supply intake in the event of a shutdown, which could result in a flow interruption when streamflow is less than 14 ft^3/s. The proposed bypass reach is a bedrock-confined channel characterized by cobble and boulder riffles, bedrock cascades, pools, and a 20 ft waterfall. We documented resident Dolly Varden in the bypass reach and within 1,700 ft upstream of the proposed intake site.

Since the proposed project has the potential to restrict resident fish passage, a Title 16 Fish Habitat Permit from the Alaska Department of Fish and Game (ADF&G) Habitat Section is required to construct the project per the Fish Passage Act at Alaska Statute 16.05.841.[c] Since barriers to upstream migration are naturally present in the drainage, a fishway is not required. This investigation centered on collecting data to evaluate the need for, and potential amount of, instream flow needed for fish habitat during hydroelectric operation.

PURPOSE

The purpose of this assessment was to document fish habitat and seasonal fish use in and around the proposed Water Supply Creek hydroelectric project bypass reach and to generate a continuous streamflow record using water level loggers and discharge measurements for evaluation of the proposed hydroelectric facilities' potential affects to fish habitat.

STUDY AREA

Water Supply Creek is a snowmelt and rain-fed drainage (Figure 1) that has a watershed area of 1.9 mi^2 upstream of the proposed hydro tailrace[d], and is bounded by steep ridgelines ascending to 3,180 ft elevation.[e] The approximately 4,600 ft bypass reach is confined by bedrock slopes and rises from 430 ft elevation at the proposed tailrace site (Figure 2) to 800 ft at the proposed intake site (Figure 3) for an average gradient of 12%; which results in a potential 370 ft of gross hydraulic head. Throughout the bypass reach, gradient ranges 3–30% with numerous cascades, chutes, and falls, characteristics of a high gradient contained channel type (Paustian 2010); the largest of which

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[b] ADF&G Stream No. 114-31-10090; cataloged for chum, coho, and pink salmon and Dolly Varden.

[c] Project authorized under Fish Habitat Permit No. FH23-I-0077, issued September 17, 2023.

[d] Drainage area upstream of the proposed intake location is 1.4 mi^2.

[e] Drainage area and elevation data obtained from geospatial analysis using Statewide IFSAR 10 ft contours. DGGS Staff, 2013, Elevation Datasets of Alaska: Alaska Division of Geological & Geophysical Surveys Digital Data Series 4, https://elevation.alaska.gov/.

is a 20 ft vertical waterfall that constitutes one of several upstream fish migration barriers (Figure 4). Additionally, there are several other falls and debris jams that are fish migration barriers at some or all stream flows. During our surveys, we observed at least 17 surface tributaries of variable size and seasonal flow that enter the bypass reach. The most valuable fish habitat in the project area are deep pools that provide refuge during high and low streamflow events.

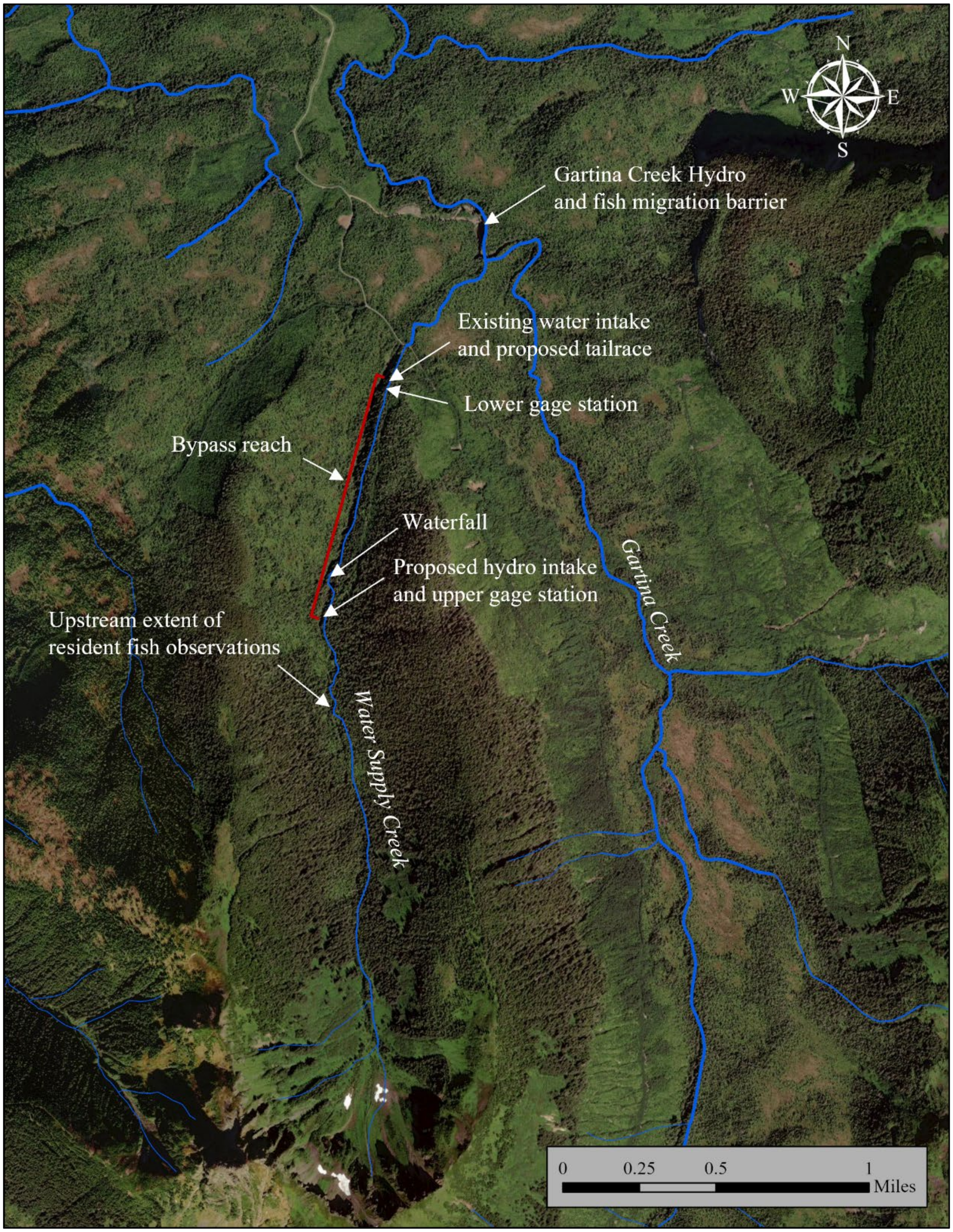

Figure 1.–Water Supply Creek area study map.

Figure 2.–Existing City water supply intake and location of the proposed hydroelectric facility tailrace, 8/9/2023.

Figure 3.–Aerial image of the proposed hydroelectric facility intake site, taken 100 ft above ground level, 12/5/2022.

Figure 4.–Water Supply Creek 20 ft barrier falls, 8/9/2023.

METHODS

Stream Gaging

Onset® Hobo UL20 water level loggers were installed in PVC cases; one secured to a boulder with concrete anchor bolts in a pool 180 ft upstream of the proposed hydro tailrace location (lower gage station; Figure 5) and one with a rebar stake pounded into the substrate in a riffle at the proposed intake location (upper gage station; Figure 6). Both dataloggers were set to sample at 2 h intervals and corrected for atmospheric pressure by readings taken simultaneously from a third datalogger hung from a tree at the lower station. The datalogger at the lower station was adjacent to an existing staff gage in a plunge pool and stage was recorded at the upper station by measuring the depth of water above the rebar stake with a tape measure to the nearest 0.10 inch.

Figure 5.–Staff gage and data logger at the lower station, 8/22/2023.

Figure 6.–Data logger at the upper station, 4/19/2023.

Stream discharge was measured with a SonTek Flowtracker® acoustic doppler velocimeter at the lower station on nine occasions and at the upper station six times to gage base flow and estimate supplemental flow entering the reach throughout the seasons (Figure 7) following standard procedures from Rantz (1982) and Sontek (2007). Channel ice and snow was removed for discharge measurements if possible. Data collection was impacted when heavy snow and ice covered the channel or impounded the dataloggers on two occasions for 2–4 days. The atmospheric datalogger produced erroneous readings over three periods of cold weather for a total of 22 days; we corrected the data based on readings from the opposite station, or an estimate based on weather conditions during events when both stations were affected, to produce a full 16-month data set for evaluation.

Stage-discharge datapoints were graphed and the logarithmic curve equation generated by the datapoints was used to build rating curves for the range of observed flows and the range above the maximum observed flow to the maximum recorded stage level at both stations. Discharge for the highest recorded stage level at the upper gage station was estimated by surveying channel cross-sectional area and applying the U.S. Geological Survey slope-conveyance method, which uses Manning's equation (Dalrymple and Benson 1968):

$$Q = \left(\frac{1.486}{n}\right) AR^{2/3}S^{1/2}$$

Where n equals the channel roughness coefficient, A equals the cross-sectional area, R equals the hydraulic radius, and S equals channel slope. This method is inappropriate for the lower station, which was in a pool, so we scaled our estimate of peak flow at the downstream station based on relative drainage area: the peak upstream value was multiplied by a factor of 1.357 (the ratio of drainage area at the downstream station and the upstream station; 1.9 mi^2/1.4 mi^2). Daily discharge values were calculated using the mean water level for each 24-hour day and these values were used to calculate mean monthly flow and mean annual flow. In months where sampling occurred in both 2022 and 2023, the average of the data from both years was used for the mean monthly value.

Figure 7.–Habitat Section biologists recording discharge measurement at the upstream station, 6/23/2023.

FISH AND FISH HABITAT

Fish were sampled throughout the bypass reach in all habitat types by using a Smith-Root LR-24 backpack electrofisher on three occasions 2022–2023, and on August 8, 2023, using 1/4 inch mesh minnow traps baited with disinfected[f] salmon roe set for 24 hours. While surveying the bypass reach, we documented surface tributaries and estimated streamflow input in summer and winter; also, we documented the location of pools, and visually estimated pool area and measured residual depth to the nearest inch. Photos were taken from ground level and the air using a drone in summer and winter to characterize and document stream features. We also surveyed fish use and fish habitat about 1,700 ft upstream of the proposed water intake; resident fish habitat appears to exist further upstream based on topography, however the extent of fish use is unknown.

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[f] Following methods in Magnus et al. (2006).

RESULTS

STREAM GAGING

Fifteen streamflow measurements were collected to calculate discharge at the upper and lower gage stations between March 31, 2022, and August 8, 2023, which ranged 1.5–32.6 ft^3/s (Table 1). Peak discharge values, which occurred at both stations on October 1, 2022, for the upper and lower sites were estimated at 106 ft^3/s and 144 ft^3/s.

The upstream value was estimated using a recorded stage level of 2.42 ft and Manning's equation values of 0.19 for n, a surveyed channel cross sectional area (A) of 36.93 ft^2, a surveyed hydraulic radius of 1.63 ft, and a channel slope (S) of 0.07. Peak discharge at the lower site was obtained by multiplying the upstream peak discharge value by a factor of 1.357, the ratio of drainage area at the lower and upper stations. Due to the assumptions and estimations in Manning's equation,[g] estimated streamflow statistics above the observed peak discharge values should be treated with caution.[h]

The estimated mean annual streamflow at the upper site was 9.4 ft^3/s, and mean monthly streamflow ranged 2.9–21.1 ft^3/s (Table 2). Mean annual streamflow at the lower site was estimated at 10.9 ft^3/s, and mean monthly flows ranged 4.1–27.6 ft^3/s (Table 3). Estimates of daily exceedances and streamflow frequencies are presented in Figures 8–11, an annual water level and discharge graph is presented in Appendix B, and mean daily water level data is in Appendix C.

Table 1.–Discharge data.

	Upstream site			Downstream site			
Date	Time	Water level (ft)	Discharge (ft^3/s)	Time	Staff gage (ft)	Water level (ft)	Discharge (ft^3/s)
3/31/2022	12:30	0.809	4.1	14:36	1.17	1.16	6.8
9/15/2022	14:09	0.810	5.2	12:27	1.12	1.08	5.5
12/5/2022	11:36	0.729	4.0	13:36	1.00	0.96	4.1
3/13/2023	13:29	0.604	1.5	10:40	0.84	0.77	2.0
4/19/2023	ND	ND	ND	9:00	1.08	0.99	5.1
5/18/2023	ND	ND	ND	10:35	1.57	1.48	25.6
5/18/2023	12:15	1.267	27.0	15:20	1.61	1.51	32.6
8/7/2023	ND	ND	ND	16:00	0.85	0.78	2.5
8/8/2023	12:50	0.631	2.7	14:19	0.88	0.80	2.9

[g] Such as the assumptions of uniform flow and channel roughness.

[h] The estimates are the result of a rating curve produced from two points, one of which is an estimate from the slope-conveyance method multiplied by the ratio of drainage area between the two sites. Scaling the downstream peak discharge value based on drainage area assumes uniform rainfall, water transport, and seasonal temperature characteristics, among others.

Table 2.–Mean annual and monthly flow statistics for the upper gage station.

Time period	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean discharge (ft^3/s)	**9.4**	5.5	3.1	3.3	**4.5**	**21.1**	**18.2**	**6.4**	6.0	11.8	19.7	10.2	2.9

Note: Bold values indicate means derived from more than one year of observations.

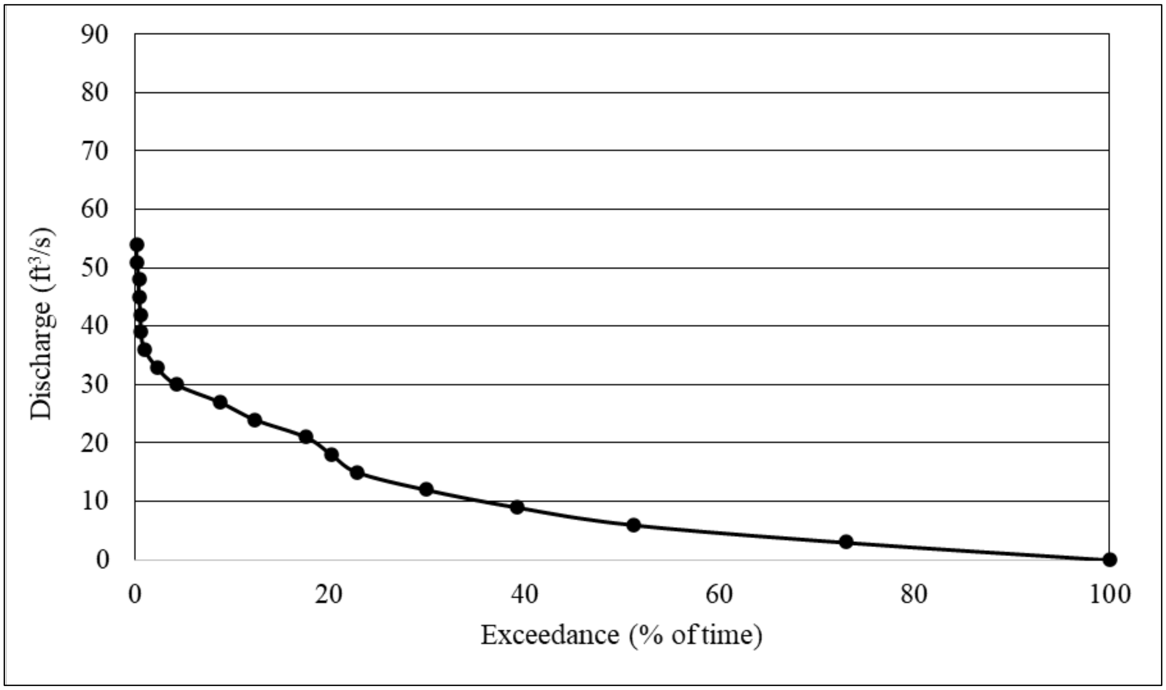

Figure 8.–Flow duration curve for the upper gage station.

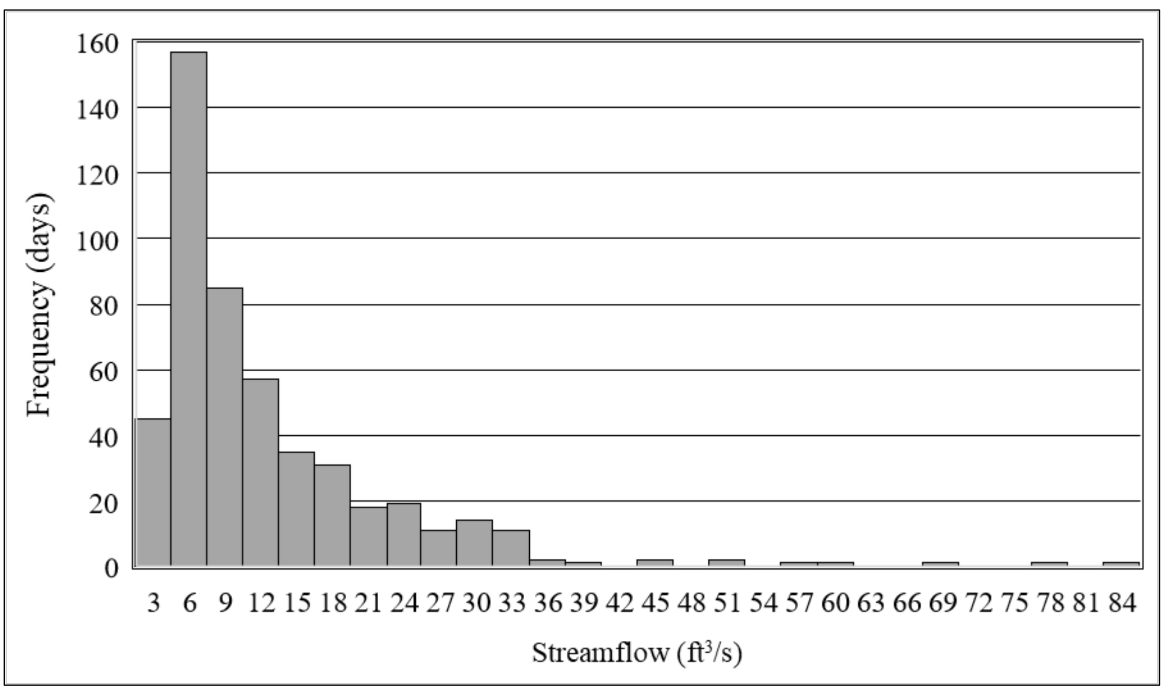

Figure 9.–Flow-frequency histogram for the upper gage station.

Table 3.–Mean annual and monthly flow statistics for the lower gage station.

Month	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean discharge (ft^3/s)	**10.9**	8.6	4.4	4.5	**8.2**	**19.5**	**13.5**	**5.4**	**6.5**	14.7	27.6	13.4	4.1

Note: Bold values indicate means derived from more than one year of observations.

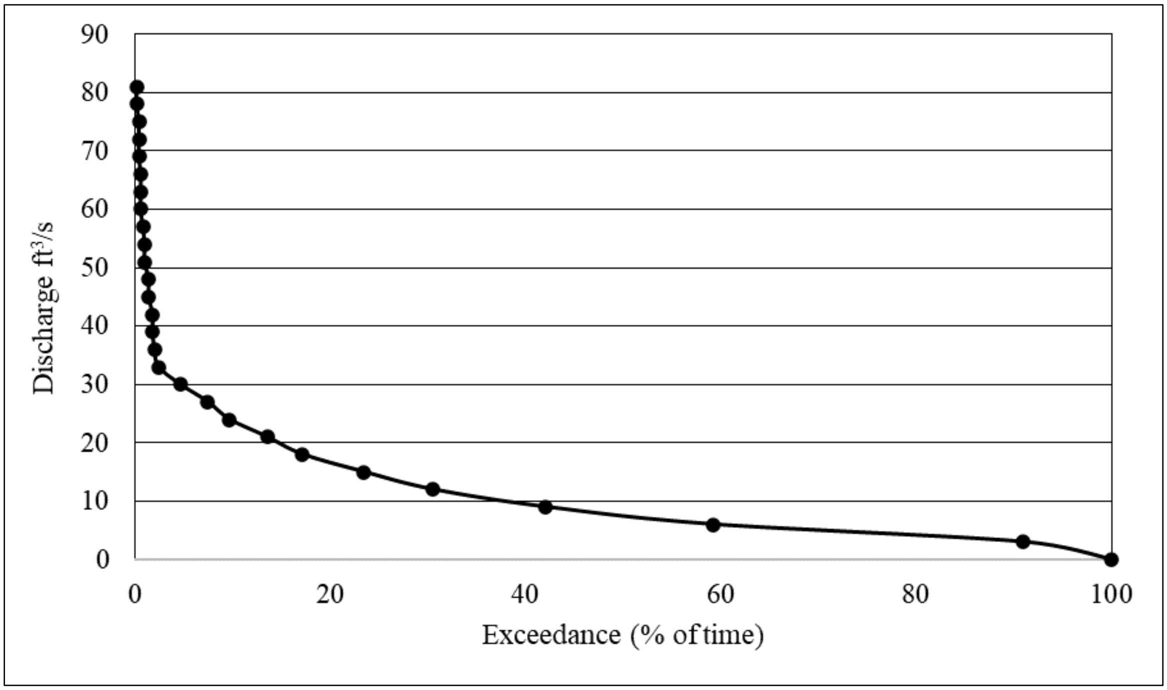

Figure 10.–Flow duration curve for the lower gage station.

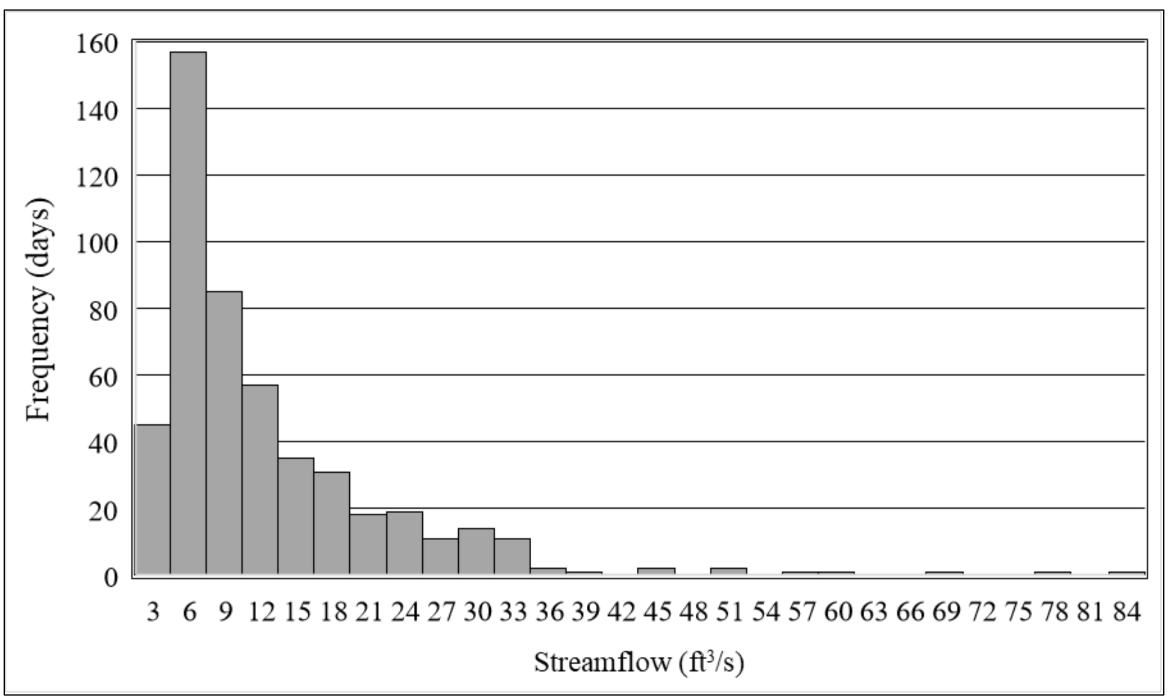

Figure 11.–Flow-frequency histogram for the lower gage station.

Low flow periods, which can limit hydroelectric generation potential, typically occur in mid-summer and mid-winter during warm, dry and extended cold conditions in Southeast Alaska. The 16-month streamflow record period was marked by wet conditions mid-July through November 2022, with a relatively heavy snowpack remaining in the spring and average precipitation in 2023 (ACIS 2023). The lowest mean monthly discharge rates were observed in February, March, and December and peak flows were in May, June, and October. The estimated daily mean discharge at the intake site exceeded 1.4 ft^3/s 100% of the time and 14 ft^3/s 26% of the time.

Supplemental flow entering the bypass reach was variable throughout the seasons and dependent on rainfall, snowmelt, and soil saturation. We visually estimated supplemental flow entering the bypass reach at each tributary mouth and by measuring Water Supply Creek discharge at the upper and lower stations during all seasons; supplemental flow made up 2–39% of total estimated discharges, with lower rates of contribution occurring during dry periods and freezing temperatures (Table 4).

FISH AND FISH HABITAT

Surveys of the bypass reach resulted in identification of 25 pools with residual depths ranging 1–4.5 ft and capture of resident Dolly Varden (Table 4). The lower 2,250 ft of the bypass reach was sampled with a backpack electrofisher on April 19, 2023, prior to breakup of ice and snow; though, only one fish was captured. On August 8, 2023, we captured 7 fish in 16 baited minnow traps placed in the bypass reach, a replication of trapping performed in August 2010 by HDR Inc., in which 11 fish were captured (unpublished HDR Inc. data obtained from Erin Cunningham, HDR Inc., Anchorage, Alaska). On this occasion we also used a backpack electrofisher to extensively sample the bypass reach and within 1,100 ft downstream and 2,000 ft upstream of the project, capturing an additional 23 Dolly Varden. The bypass reach is confined by bedrock canyon walls and has an average gradient of 12%. Dolly Varden spawning substrate is scattered in patches, typically at the tail of pools; however, it is likely subject to scour and redistribution during high flows due to channel confinement.

Overall, the bypass reach appears to provide seasonal habitat that is primarily occupied in the summer as fish move downstream from the source population that extends at least 1,700 ft upstream of the proposed intake site (Appendix A). Dolly Varden are relatively inactive in winter months due to cold temperatures limiting movement and likely reside in pools (Armstrong and Morrow 1980). Due to scour potential in the bypass reach, it is most likely spawning that contributes to the population upstream of the City water intake structure, upstream of the proposed hydro intake location where the stream valley is less confined and gradient is lower (about 3–6%; Figure 12). Therefore, the primary value of the bypass reach is for summer migration and feeding, with the possibility of a few fish overwintering in pools (Figure 13).

Table 4.–Fish habitat survey results.

Waypoint	Pool area (ft^2)	Residual pool depth (ft)	Observed discharge range (gpm)	Fish captured in minnow traps (8/8/2023)	Fish captured with electrofisher (8/8/2023)
MT1				0	5
MT2				0	2
P1	311	3.25			
P2	175	2.5			
MT3				0	9
P3	125	2.75			
MT4				0	1
P4	180	3			
P5	150	2.25			
MT5, TR1			10-65	2	1
TR2			0-50		
P6, TR3	300	3	0-135		
TR4			15-25		
MT6, P7	307.5	3.75		1	3
TR5			10-65		
TR6			0-35		
TR7, P8	100	3	0-30		
TR8, MT7, P9	24	1	20-135	3	1
P10, TR9	73	2.25	0-90		
P11	123	3			
TR10			0-5		
TR11, P11,MT8	25	1.5	0-30	1	
P12	25	1			
P13	25	1			
P14	225	2.5			
TR11, P15	100	2	30-40		
P16	300	2.5			
TR12			0-20		
P17	100	2			
P18, TR13	220	1.25	0-80		
P19, TR14, MT9	300	4.5	20-50	0	
P20	36	2			
P21	48	1			
P22	48	1			
P23, TR15	80	1.25	2-20		
P24, TR16	120	1.5	0-40		
P25, TR17	144	1.5	0-100		
MT10				2	
MT11				1	1

Note: MT = minnow trap; P = pool, and TR = tributary.

Note: Minnow traps that did not capture fish are not shown. Waypoint MT1, MT2, MT10, and MT11 were located outside the bypass reach.

Figure 12.–Low gradient habitat upstream of intake site, 8/23/2023.

Figure 13.–Bypass reach pool habitat, 8/7/2023.

DISCUSSION

The proposed hydroelectric facility has a design flow of 1.4–14 ft^3/s, meaning base flow through the bypass reach would be diverted about 74% of the time based on our observations and streamflow estimates during the 16-month monitoring period. However, periodic high flow events would flood the bypass reach and supplemental flow from tributaries would usually be flowing to maintain sufficient dissolved oxygen in the stream. The bypass reach contains about 25 pools with residual depths of 1–4.5 ft, which provide valuable habitat during periods with little supplemental flow. Given the observed low fish density, low solar gain due to aspect and canyon shade, and the absence of a large lake upstream which could increase water temperature in summer and freeze over in winter, dissolved oxygen is expected to remain sufficient for Dolly Varden in the bypass reach during low flow events. Furthermore, IPEC's proposal includes an instream flow reservation of up to 1 ft^3/s to support fish habitat and ensure uninterrupted flow to the City water supply intake, in the event of a shutdown.

The combination of a continuous flow release from the proposed hydroelectric project, periodic natural high flows, supplemental tributary flow accumulating to about 0.05 ft^3/s –2.2 ft^3/s, pool habitat, and naturally cool water conditions will provide sufficient water quantity and quality for resident Dolly Varden. Therefore, diversion of water for the proposed hydroelectric project is not expected to have a negative impact on the resident fish population in Water Supply Creek.

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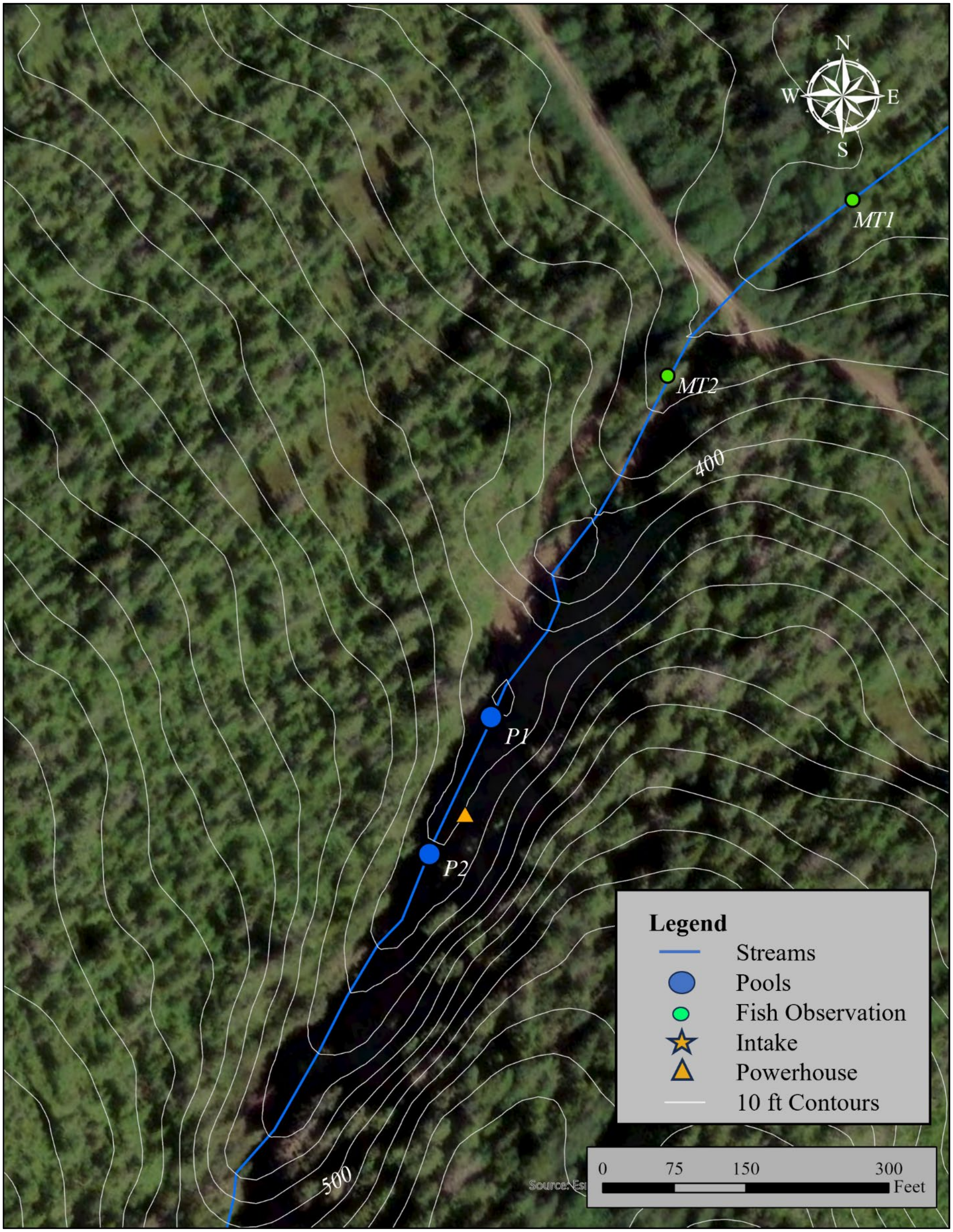
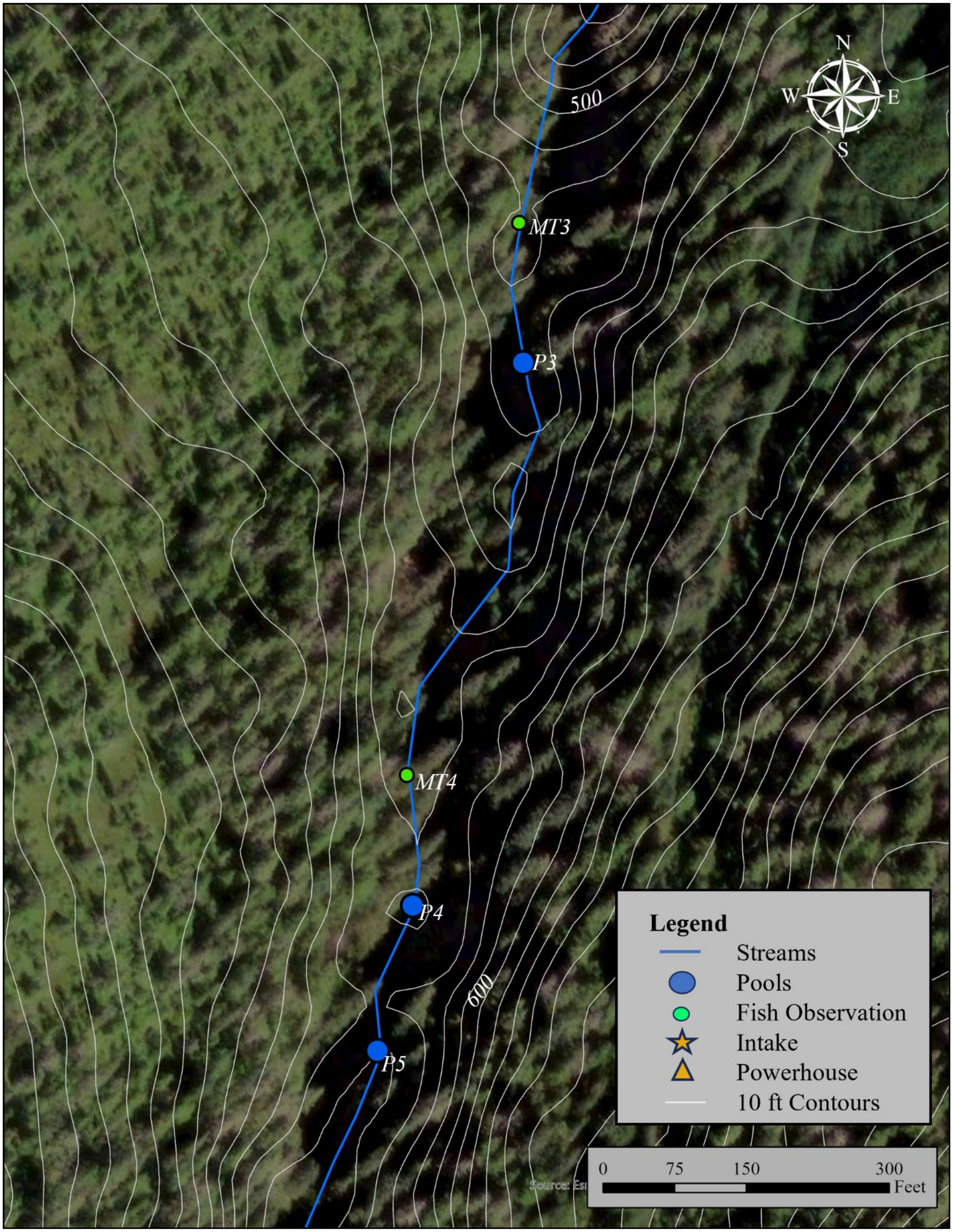
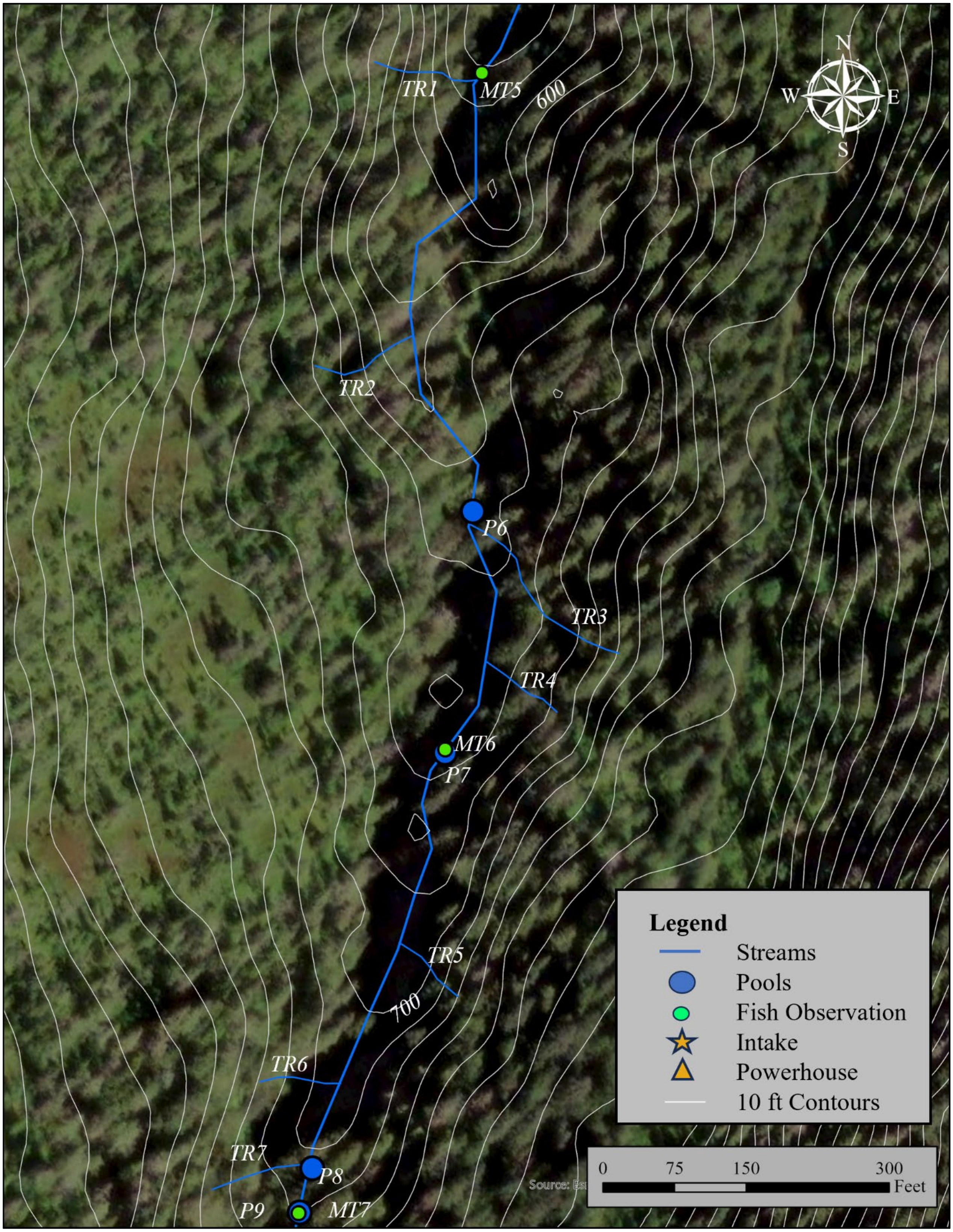
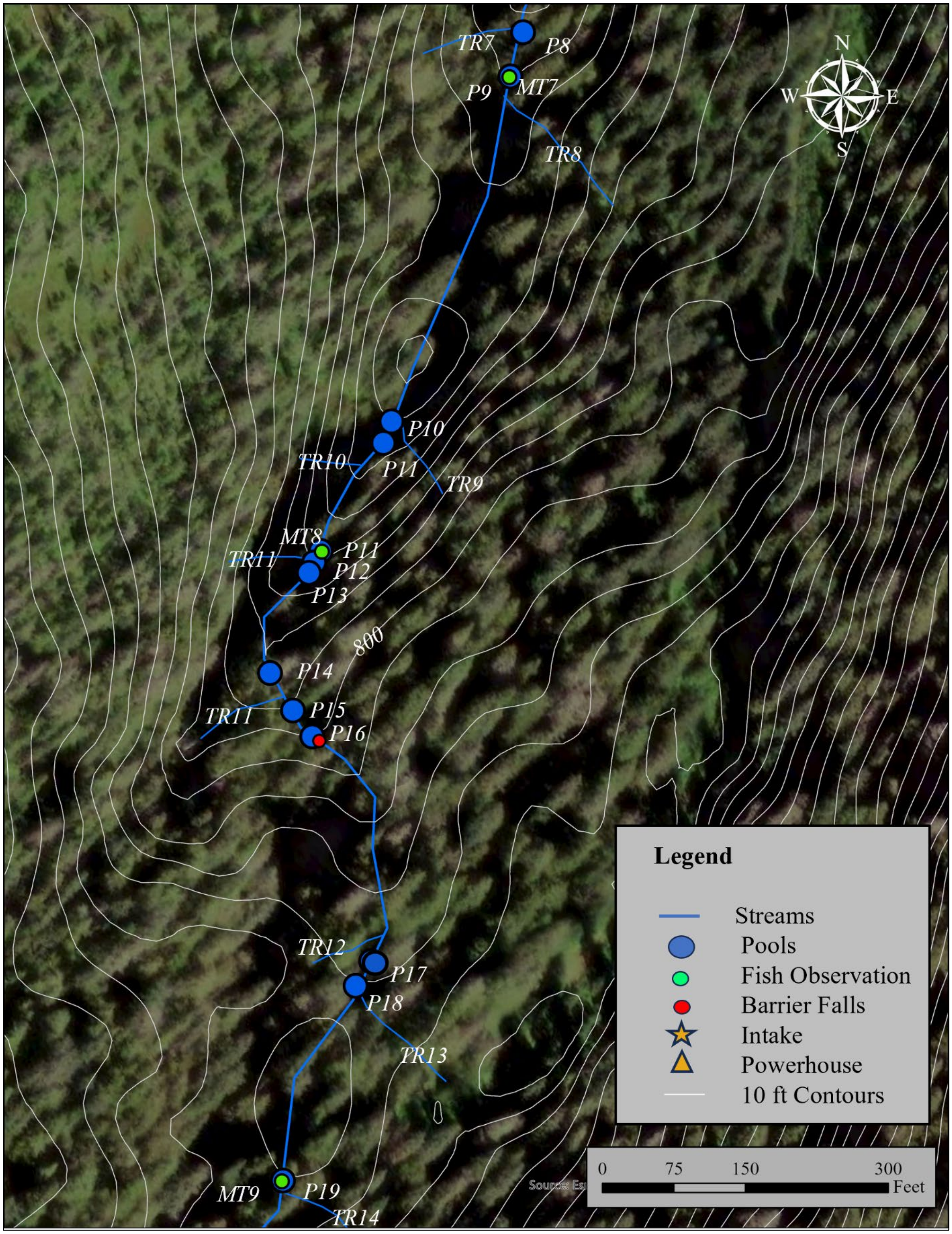
APPENDIX A: FISH HABITAT REACH MAPS

Appendix A.1–Reach scale habitat maps.

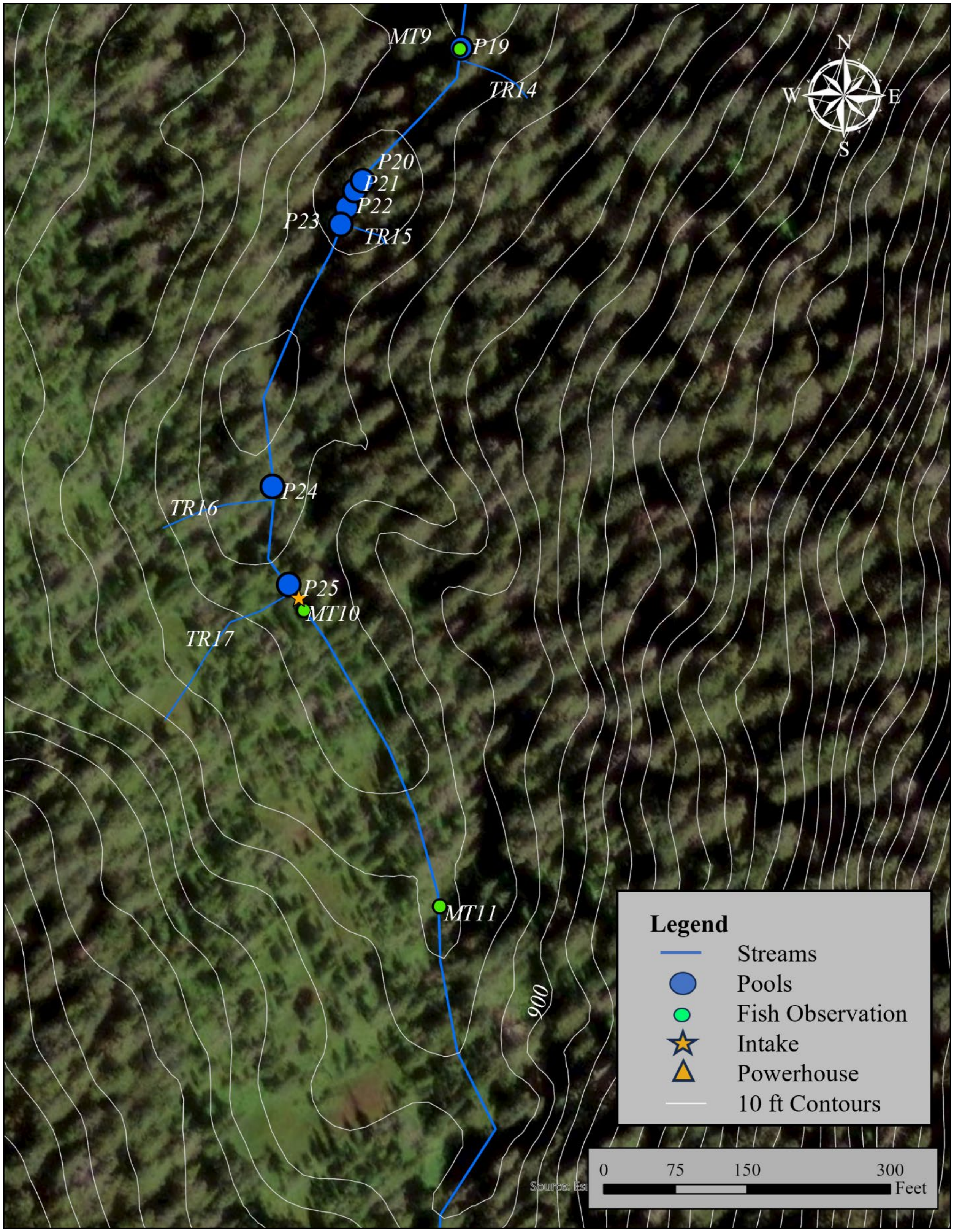



N
W
E
S
500
MT3
P3
MT4
P4
600
P5
Legend
Streams
Pools
Fish Observation
Intake
Powerhouse
10 ft Contours
0
75
150
300
Feet


N
S
W
E
TR1
MT5
600
TR2
P6
TR3
TR4
MT6
P7
TR5
700
TR6
TR7
P8
P9
MT7
Legend
Streams
Pools
Fish Observation
Intake
Powerhouse
10 ft Contours
0
75
150
300
Feet

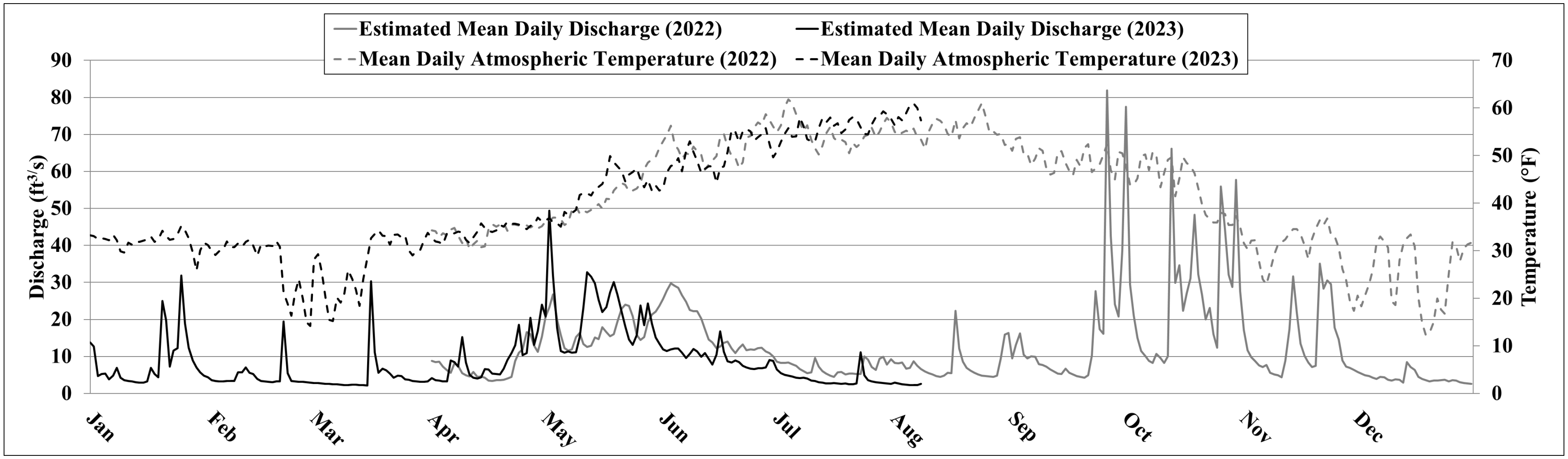

TR7
P8
P9
MT7
TR8
N
W
E
S
P10
P11
TR10
TR9
MT8
TR11
P11
P12
P13
800
P14
TR11
P15
P16
Legend
Streams
Pools
Fish Observation
Barrier Falls
Intake
Powerhouse
10 ft Contours
TR12
P17
P18
TR13
0
75
150
300
Feet
MT9
P19
TR14

Appendix A.1.–Page 5 of 5.

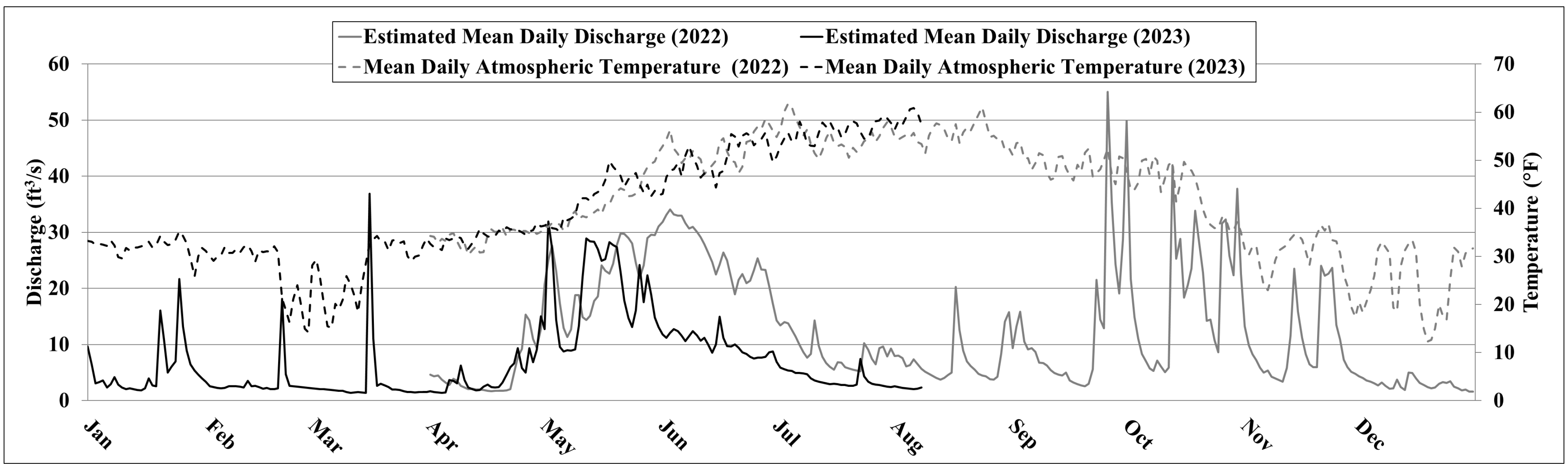


APPENDIX B: ANNUAL DISCHARGE AND TEMPERATURE SUMMARY

Appendix B.1.–Lower gage station estimated mean daily discharge and atmospheric temperature.



Appendix B.2.–Upper gage station estimated mean daily discharge and atmospheric temperature.



APPENDIX C: MEAN DAILY WATER LEVEL DATA

Appendix C.–Mean daily water level data.

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
4/1/2022	1.17	8.8	0.81	4.6	34.3
4/2/2022	1.16	8.5	0.79	4.4	34.1
4/3/2022	1.16	8.5	0.80	4.5	32.8
4/4/2022	1.11	7.2	0.76	3.7	33.7
4/5/2022	1.07	6.2	0.72	3.2	33.2
4/6/2022	1.04	5.5	0.69	2.8	34.5
4/7/2022	1.14	8.2	0.76	3.9	34.8
4/8/2022	1.12	7.5	0.74	3.5	33.1
4/9/2022	1.04	5.5	0.67	2.6	31.6
4/10/2022	1.01	5.0	0.64	2.3	32.7
4/11/2022	0.99	4.6	0.61	2.1	30.3
4/12/2022	1.04	5.8	0.62	2.1	31.3
4/13/2022	0.98	4.5	0.60	2.0	32.1
4/14/2022	0.98	4.6	0.60	2.0	30.8
4/15/2022	0.96	4.3	0.59	1.9	30.9
4/16/2022	0.91	3.5	0.57	1.8	34.4
4/17/2022	0.90	3.3	0.57	1.7	35.6
4/18/2022	0.92	3.6	0.57	1.7	35.0
4/19/2022	0.92	3.6	0.57	1.7	35.5
4/20/2022	0.93	3.7	0.57	1.8	35.8
4/21/2022	0.95	4.0	0.59	1.9	34.2
4/22/2022	0.98	4.5	0.61	2.1	35.5
4/23/2022	1.17	8.8	0.81	5.0	35.5
4/24/2022	1.23	11.0	0.93	7.7	35.3
4/25/2022	1.26	11.9	0.97	9.2	35.3
4/26/2022	1.35	16.5	1.10	15.3	35.3
4/27/2022	1.34	16.0	1.08	14.3	34.9
4/28/2022	1.28	12.9	1.02	11.0	35.3
4/29/2022	1.24	11.3	0.98	9.5	34.7
4/30/2022	1.33	15.3	1.06	12.8	35.1

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
5/1/2022	1.41	20.8	1.18	20.7	36.2
5/2/2022	1.45	23.2	1.23	25.0	36.2
5/3/2022	1.49	26.8	1.27	27.7	36.9
5/4/2022	1.40	19.9	1.20	23.1	37.0
5/5/2022	1.34	15.8	1.13	17.3	36.6
5/6/2022	1.27	12.2	1.06	13.0	35.4
5/7/2022	1.25	11.6	1.03	11.3	35.9
5/8/2022	1.26	12.0	1.05	12.7	38.5
5/9/2022	1.32	15.3	1.15	18.8	39.4
5/10/2022	1.35	16.3	1.15	18.8	37.8
5/11/2022	1.29	13.4	1.09	14.9	38.4
5/12/2022	1.27	12.6	1.08	14.3	38.1
5/13/2022	1.28	12.9	1.10	15.1	38.6
5/14/2022	1.32	15.1	1.14	17.7	39.1
5/15/2022	1.32	14.7	1.15	18.6	39.8
5/16/2022	1.37	17.9	1.21	24.1	38.8
5/17/2022	1.35	16.5	1.20	23.1	40.9
5/18/2022	1.33	15.5	1.20	22.6	40.8
5/19/2022	1.34	16.0	1.22	24.4	42.6
5/20/2022	1.39	19.4	1.28	27.7	43.5
5/21/2022	1.44	22.9	1.34	29.8	44.2
5/22/2022	1.46	24.1	1.35	29.7	43.8
5/23/2022	1.45	23.7	1.33	29.0	42.5
5/24/2022	1.42	20.9	1.29	28.0	42.6
5/25/2022	1.34	15.8	1.22	24.6	43.1
5/26/2022	1.31	14.4	1.19	21.8	44.1
5/27/2022	1.33	15.2	1.23	24.2	47.1
5/28/2022	1.39	19.2	1.30	29.0	48.5
5/29/2022	1.42	21.3	1.34	29.6	49.2
5/30/2022	1.43	22.1	1.34	29.5	49.7
5/31/2022	1.45	23.7	1.38	31.1	51.6

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
6/1/2022	1.48	25.6	1.41	31.9	53.0
6/2/2022	1.50	27.8	1.44	33.2	54.3
6/3/2022	1.53	29.7	1.46	34.1	56.3
6/4/2022	1.52	29.1	1.44	33.2	52.4
6/5/2022	1.51	28.6	1.44	33.0	51.3
6/6/2022	1.49	26.5	1.43	32.9	49.4
6/7/2022	1.47	24.8	1.40	31.6	50.5
6/8/2022	1.44	22.5	1.37	30.7	50.1
6/9/2022	1.44	22.3	1.38	31.0	51.9
6/10/2022	1.44	22.2	1.36	30.1	50.9
6/11/2022	1.41	20.2	1.33	29.1	50.2
6/12/2022	1.36	17.3	1.28	27.9	47.1
6/13/2022	1.31	14.6	1.23	26.4	48.1
6/14/2022	1.30	13.7	1.22	24.7	48.9
6/15/2022	1.26	12.2	1.19	22.5	49.9
6/16/2022	1.27	12.6	1.21	24.2	53.8
6/17/2022	1.30	13.7	1.24	26.4	54.6
6/18/2022	1.30	14.0	1.22	25.0	51.8
6/19/2022	1.26	12.1	1.19	21.8	49.9
6/20/2022	1.23	10.9	1.15	19.0	49.6
6/21/2022	1.26	12.3	1.18	21.6	47.4
6/22/2022	1.29	13.2	1.20	22.6	48.6
6/23/2022	1.25	11.7	1.18	20.9	53.8
6/24/2022	1.26	11.9	1.18	21.4	54.1
6/25/2022	1.25	11.8	1.20	23.2	55.9
6/26/2022	1.27	12.2	1.22	25.4	57.0
6/27/2022	1.27	12.3	1.20	23.4	56.4
6/28/2022	1.24	11.4	1.20	23.3	58.7
6/29/2022	1.23	10.9	1.17	20.4	57.5
6/30/2022	1.21	10.0	1.13	17.2	56.1

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
7/1/2022	1.16	8.6	1.08	14.3	54.9
7/2/2022	1.15	8.2	1.07	13.4	56.4
7/3/2022	1.15	8.3	1.08	14.0	60.2
7/4/2022	1.16	8.4	1.08	13.8	61.8
7/5/2022	1.14	7.9	1.05	12.6	61.0
7/6/2022	1.13	7.5	1.03	11.4	58.7
7/7/2022	1.09	6.6	0.99	9.8	56.9
7/8/2022	1.06	6.0	0.96	8.6	55.2
7/9/2022	1.04	5.5	0.93	7.7	56.4
7/10/2022	1.05	5.8	0.95	8.3	53.3
7/11/2022	1.19	9.6	1.08	14.3	51.5
7/12/2022	1.12	7.3	0.99	9.8	50.3
7/13/2022	1.06	6.1	0.94	7.8	52.1
7/14/2022	1.03	5.3	0.90	6.7	54.6
7/15/2022	1.00	4.8	0.87	6.1	56.0
7/16/2022	0.98	4.5	0.85	5.5	53.7
7/17/2022	1.05	5.7	0.90	6.8	53.0
7/18/2022	1.05	5.8	0.90	6.8	53.3
7/19/2022	1.02	5.2	0.87	6.0	52.8
7/20/2022	1.03	5.4	0.86	5.7	50.5
7/21/2022	1.03	5.4	0.85	5.5	52.6
7/22/2022	1.02	5.2	0.85	5.4	51.8
7/23/2022	1.03	5.3	0.84	5.2	52.6
7/24/2022	1.20	10.1	1.00	10.3	54.0
7/25/2022	1.18	9.2	0.97	9.1	54.4
7/26/2022	1.11	7.2	0.92	7.4	55.8
7/27/2022	1.08	6.4	0.89	6.4	53.9
7/28/2022	1.18	9.4	0.97	9.4	55.0
7/29/2022	1.20	10.0	0.99	9.7	56.7
7/30/2022	1.14	7.8	0.94	7.9	57.9
7/31/2022	1.18	9.2	0.98	9.3	57.0

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
8/1/2022	1.15	8.3	0.94	8.0	55.0
8/2/2022	1.15	8.1	0.94	8.0	54.3
8/3/2022	1.16	8.4	0.93	7.6	54.9
8/4/2022	1.09	6.7	0.88	6.1	55.3
8/5/2022	1.10	7.0	0.88	6.4	54.8
8/6/2022	1.17	8.7	0.92	7.3	55.7
8/7/2022	1.12	7.4	0.89	6.6	53.8
8/8/2022	1.09	6.6	0.86	5.7	53.3
8/9/2022	1.06	6.0	0.84	5.2	51.4
8/10/2022	1.04	5.5	0.82	4.8	55.1
8/11/2022	1.02	5.1	0.80	4.4	56.7
8/12/2022	1.00	4.7	0.78	4.1	57.7
8/13/2022	0.98	4.5	0.76	3.8	57.3
8/14/2022	1.00	4.8	0.78	4.1	56.5
8/15/2022	1.04	5.5	0.80	4.6	54.5
8/16/2022	1.03	5.4	0.82	5.0	54.0
8/17/2022	1.45	22.3	1.18	20.3	57.5
8/18/2022	1.26	12.1	1.05	12.6	53.6
8/19/2022	1.16	8.6	0.97	8.9	55.8
8/20/2022	1.10	7.0	0.91	7.0	56.8
8/21/2022	1.07	6.1	0.88	6.2	56.1
8/22/2022	1.04	5.6	0.85	5.5	57.9
8/23/2022	1.02	5.1	0.82	4.8	59.5
8/24/2022	1.00	4.9	0.80	4.5	61.0
8/25/2022	1.00	4.8	0.79	4.3	58.0
8/26/2022	0.99	4.6	0.76	3.8	54.8
8/27/2022	0.98	4.5	0.76	3.8	55.1
8/28/2022	1.00	4.8	0.78	4.3	54.4
8/29/2022	1.18	9.3	0.94	8.3	54.6
8/30/2022	1.30	15.9	1.04	14.1	52.2
8/31/2022	1.33	16.3	1.10	15.7	52.5

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
9/1/2022	1.19	9.4	0.98	9.3	51.0
9/2/2022	1.28	13.2	1.06	13.2	53.5
9/3/2022	1.34	16.2	1.11	15.9	53.8
9/4/2022	1.22	10.5	1.01	10.5	50.3
9/5/2022	1.19	9.5	0.97	9.1	50.4
9/6/2022	1.21	10.1	0.98	9.3	48.0
9/7/2022	1.20	10.0	0.96	8.7	49.4
9/8/2022	1.14	7.9	0.90	6.7	51.5
9/9/2022	1.13	7.7	0.90	6.7	51.0
9/10/2022	1.12	7.3	0.88	6.2	47.4
9/11/2022	1.08	6.5	0.85	5.5	46.0
9/12/2022	1.06	6.0	0.83	4.9	46.3
9/13/2022	1.03	5.4	0.81	4.6	50.7
9/14/2022	1.02	5.2	0.80	4.5	50.9
9/15/2022	1.09	6.7	0.82	5.0	48.4
9/16/2022	1.04	5.6	0.75	3.6	46.8
9/17/2022	1.02	5.1	0.72	3.2	45.8
9/18/2022	0.99	4.7	0.70	2.9	49.1
9/19/2022	0.98	4.5	0.68	2.7	47.7
9/20/2022	0.96	4.2	0.67	2.6	51.6
9/21/2022	1.00	4.9	0.69	3.0	52.4
9/22/2022	1.20	10.2	0.85	5.6	46.5
9/23/2022	1.54	27.7	1.18	21.5	47.3
9/24/2022	1.36	17.4	1.08	14.4	48.2
9/25/2022	1.34	16.1	1.05	12.9	50.1
9/26/2022	2.33	81.9	1.78	55.0	52.4
9/27/2022	1.82	42.7	1.48	35.3	47.0
9/28/2022	1.46	24.1	1.21	24.3	45.0
9/29/2022	1.42	20.7	1.15	19.1	50.8
9/30/2022	1.73	38.5	1.33	28.7	50.5

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
10/1/2022	2.29	77.5	1.69	49.9	47.8
10/2/2022	1.55	29.5	1.18	21.7	43.8
10/3/2022	1.42	21.0	1.09	14.9	43.9
10/4/2022	1.32	15.1	1.02	11.0	45.2
10/5/2022	1.25	11.5	0.95	8.3	49.9
10/6/2022	1.21	10.1	0.91	7.0	50.2
10/7/2022	1.17	8.8	0.86	5.8	46.9
10/8/2022	1.15	8.2	0.84	5.3	50.8
10/9/2022	1.23	10.7	0.91	7.1	49.9
10/10/2022	1.20	9.6	0.87	6.1	43.4
10/11/2022	1.15	8.2	0.83	5.1	46.3
10/12/2022	1.18	10.1	0.86	5.9	49.1
10/13/2022	2.20	66.2	1.61	42.0	49.6
10/14/2022	1.55	29.8	1.24	25.3	41.4
10/15/2022	1.66	34.6	1.30	28.8	45.1
10/16/2022	1.43	22.3	1.14	18.4	49.7
10/17/2022	1.51	27.1	1.17	20.6	48.4
10/18/2022	1.60	31.1	1.23	23.5	47.8
10/19/2022	1.95	48.3	1.46	33.9	46.3
10/20/2022	1.60	32.2	1.27	27.9	43.2
10/21/2022	1.50	26.8	1.19	22.8	39.8
10/22/2022	1.40	20.0	1.08	14.3	37.6
10/23/2022	1.45	23.1	1.08	14.4	36.6
10/24/2022	1.34	16.0	1.01	10.7	35.9
10/25/2022	1.27	12.4	0.96	8.6	35.9
10/26/2022	2.00	56.0	1.42	31.5	38.0
10/27/2022	1.89	44.4	1.42	32.3	37.8
10/28/2022	1.61	32.1	1.25	25.8	35.4
10/29/2022	1.56	28.7	1.21	22.3	35.4
10/30/2022	2.11	57.7	1.54	37.8	37.3
10/31/2022	1.52	27.6	1.20	22.6	35.1

- continued -

Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
11/1/2022	1.36	17.1	1.07	13.3	31.6
11/2/2022	1.25	11.7	0.99	9.9	30.3
11/3/2022	1.20	9.8	0.95	8.2	32.1
11/4/2022	1.17	8.8	0.92	7.2	32.2
11/5/2022	1.13	7.6	0.87	5.9	27.8
11/6/2022	1.11	7.1	0.83	5.0	24.0
11/7/2022	1.13	7.7	0.84	5.4	22.9
11/8/2022	1.04	5.5	0.79	4.3	25.7
11/9/2022	1.02	5.1	0.77	4.0	29.2
11/10/2022	1.00	4.9	0.76	3.7	31.3
11/11/2022	0.98	4.4	0.73	3.4	31.8
11/12/2022	1.10	8.8	0.83	5.8	32.4
11/13/2022	1.36	17.4	1.02	11.5	33.7
11/14/2022	1.62	31.7	1.22	23.5	34.5
11/15/2022	1.43	21.7	1.11	15.8	34.6
11/16/2022	1.29	13.5	1.02	11.2	33.5
11/17/2022	1.21	10.2	0.95	8.2	31.1
11/18/2022	1.16	8.3	0.89	6.5	28.2
11/19/2022	1.11	7.2	0.87	6.0	32.4
11/20/2022	1.13	7.5	0.87	6.0	34.6
11/21/2022	1.69	35.1	1.25	24.0	36.5
11/22/2022	1.52	28.4	1.19	22.2	35.4
11/23/2022	1.60	30.5	1.22	22.7	36.8
11/24/2022	1.56	29.5	1.22	23.7	33.4
11/25/2022	1.37	17.8	1.07	13.5	33.1
11/26/2022	1.31	14.6	1.01	10.9	30.7
11/27/2022	1.17	8.9	0.92	7.3	26.2
11/28/2022	1.12	7.3	0.87	6.0	23.9
11/29/2022	1.10	6.9	0.84	5.2	19.5
11/30/2022	1.08	6.4	0.82	4.8	17.3

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
12/1/2022	1.06	5.9	0.80	4.4	20.6
12/2/2022	1.03	5.4	0.77	4.0	18.3
12/3/2022	1.01	5.0	0.75	3.6	20.6
12/4/2022	0.99	4.6	0.73	3.4	23.0
12/5/2022	0.96	4.2	0.71	3.1	26.0
12/6/2022	0.94	3.9	0.68	2.7	31.6
12/7/2022	0.98	4.4	0.72	3.2	33.0
12/8/2022	0.97	4.4	0.67	2.6	31.9
12/9/2022	0.93	3.7	0.62	2.1	30.6
12/10/2022	0.90	3.4	0.62	2.2	19.3
12/11/2022	0.93	3.8	0.76	3.8	18.6
12/12/2022	0.93	3.7	0.65	2.4	28.0
12/13/2022	0.86	3.0	0.59	1.9	31.3
12/14/2022	1.11	8.5	0.80	5.0	32.6
12/15/2022	1.11	7.2	0.82	4.9	33.4
12/16/2022	1.08	6.3	0.77	4.0	30.9
12/17/2022	0.98	4.5	0.72	3.2	20.2
12/18/2022	0.94	3.9	0.68	2.8	14.9
12/19/2022	0.91	3.6	0.65	2.4	12.3
12/20/2022	0.89	3.3	0.62	2.2	12.7
12/21/2022	0.90	3.4	0.64	2.3	14.9
12/22/2022	0.91	3.5	0.71	3.0	20.0
12/23/2022	0.92	3.6	0.73	3.3	17.7
12/24/2022	0.93	3.7	0.71	3.1	16.8
12/25/2022	0.89	3.3	0.73	3.4	25.2
12/26/2022	0.91	3.6	0.65	2.5	31.8
12/27/2022	0.91	3.5	0.63	2.2	31.0
12/28/2022	0.86	3.0	0.59	1.9	27.8
12/29/2022	0.85	2.8	0.60	1.9	30.6
12/30/2022	0.84	2.7	0.55	1.6	31.4
12/31/2022	0.83	2.6	0.55	1.6	31.7

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
1/1/2023	1.23	13.7	0.93	9.6	33.2
1/2/2023	1.25	12.6	0.87	6.4	33.0
1/3/2023	0.99	4.7	0.71	3.1	32.4
1/4/2023	1.01	5.2	0.72	3.3	32.6
1/5/2023	1.03	5.4	0.75	3.6	32.5
1/6/2023	0.93	3.8	0.64	2.3	32.2
1/7/2023	0.97	4.8	0.69	2.9	33.3
1/8/2023	1.09	7.0	0.78	4.2	32.2
1/9/2023	0.96	4.2	0.69	2.8	29.8
1/10/2023	0.92	3.6	0.65	2.4	29.6
1/11/2023	0.89	3.3	0.61	2.0	31.7
1/12/2023	0.89	3.2	0.62	2.2	31.2
1/13/2023	0.87	3.1	0.61	2.0	31.9
1/14/2023	0.86	2.9	0.59	1.9	31.9
1/15/2023	0.86	2.9	0.59	1.8	32.1
1/16/2023	0.89	3.3	0.62	2.2	32.4
1/17/2023	1.08	6.9	0.76	3.9	33.0
1/18/2023	1.02	5.3	0.67	2.7	31.9
1/19/2023	0.96	4.4	0.65	2.5	32.4
1/20/2023	1.49	25.0	1.10	16.1	34.2
1/21/2023	1.40	19.8	0.98	10.9	33.1
1/22/2023	1.11	7.3	0.83	5.0	32.3
1/23/2023	1.22	11.5	0.86	6.0	32.5
1/24/2023	1.25	12.2	0.90	7.0	33.5
1/25/2023	1.60	31.8	1.19	21.7	35.2
1/26/2023	1.39	18.9	1.06	13.2	34.2
1/27/2023	1.26	12.3	0.97	8.9	32.7
1/28/2023	1.18	8.9	0.89	6.4	29.6
1/29/2023	1.11	7.0	0.85	5.4	25.9
1/30/2023	1.05	5.7	0.81	4.7	30.1
1/31/2023	1.00	4.8	0.77	4.0	31.7

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
2/1/2023	0.97	4.3	0.73	3.4	31.2
2/2/2023	0.92	3.6	0.66	2.5	30.0
2/3/2023	0.90	3.4	0.65	2.4	29.1
2/4/2023	0.89	3.3	0.64	2.3	29.9
2/5/2023	0.88	3.2	0.63	2.2	30.2
2/6/2023	0.90	3.4	0.64	2.3	31.9
2/7/2023	0.90	3.4	0.66	2.6	30.7
2/8/2023	0.90	3.4	0.66	2.5	30.8
2/9/2023	1.02	5.7	0.67	2.6	31.5
2/10/2023	1.03	5.7	0.66	2.5	30.8
2/11/2023	1.10	7.0	0.64	2.4	31.9
2/12/2023	1.04	5.6	0.74	3.5	32.3
2/13/2023	1.02	5.2	0.66	2.6	31.1
2/14/2023	0.94	3.9	0.67	2.6	28.9
2/15/2023	0.90	3.4	0.65	2.4	31.3
2/16/2023	0.89	3.3	0.62	2.2	30.9
2/17/2023	0.87	3.1	0.63	2.2	31.1
2/18/2023	0.87	3.0	0.61	2.1	31.0
2/19/2023	0.88	3.2	0.61	2.1	32.1
2/20/2023	0.89	3.2	0.62	2.2	30.9
2/21/2023	1.36	19.5	1.12	18.2	21.2
2/22/2023	1.03	5.5	0.81	4.7	18.8
2/23/2023	0.90	3.4	0.68	2.7	16.3
2/24/2023	0.89	3.3	0.67	2.6	21.1
2/25/2023	0.88	3.2	0.66	2.5	24.0
2/26/2023	0.87	3.1	0.65	2.4	19.9
2/27/2023	0.87	3.0	0.64	2.4	14.9
2/28/2023	0.86	2.9	0.64	2.3	14.2

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
3/1/2023	0.85	2.9	0.63	2.2	28.1
3/2/2023	0.84	2.8	0.62	2.1	29.3
3/3/2023	0.84	2.7	0.61	2.1	25.6
3/4/2023	0.83	2.6	0.61	2.0	20.2
3/5/2023	0.82	2.6	0.60	2.0	15.5
3/6/2023	0.81	2.5	0.59	1.9	15.2
3/7/2023	0.81	2.4	0.58	1.8	20.1
3/8/2023	0.80	2.4	0.58	1.8	19.1
3/9/2023	0.79	2.3	0.57	1.7	21.0
3/10/2023	0.78	2.2	0.53	1.6	25.9
3/11/2023	0.79	2.3	0.51	1.4	24.1
3/12/2023	0.80	2.4	0.53	1.5	21.8
3/13/2023	0.78	2.2	0.54	1.5	18.4
3/14/2023	0.78	2.2	0.52	1.4	24.0
3/15/2023	0.77	2.2	0.51	1.4	28.5
3/16/2023	1.44	30.3	1.34	36.9	32.6
3/17/2023	1.21	11.1	0.95	11.1	33.5
3/18/2023	1.04	5.6	0.67	2.7	34.3
3/19/2023	1.09	6.7	0.70	3.0	33.1
3/20/2023	1.07	6.2	0.68	2.7	33.1
3/21/2023	1.03	5.4	0.65	2.5	31.3
3/22/2023	0.96	4.2	0.60	2.0	33.3
3/23/2023	1.00	4.9	0.60	2.0	33.4
3/24/2023	0.99	4.7	0.59	1.9	32.8
3/25/2023	0.94	3.9	0.56	1.7	33.2
3/26/2023	0.93	3.7	0.54	1.6	30.1
3/27/2023	0.90	3.4	0.54	1.6	29.0
3/28/2023	0.89	3.2	0.53	1.5	30.0
3/29/2023	0.88	3.2	0.54	1.5	30.2
3/30/2023	0.88	3.2	0.54	1.5	32.2
3/31/2023	0.89	3.2	0.54	1.5	33.7

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
4/1/2023	0.96	4.1	0.57	1.7	32.7
4/2/2023	0.92	3.6	0.54	1.5	31.9
4/3/2023	0.91	3.4	0.52	1.4	31.8
4/4/2023	0.89	3.2	0.52	1.4	31.3
4/5/2023	0.89	3.3	0.53	1.5	33.7
4/6/2023	1.15	8.9	0.73	3.7	33.4
4/7/2023	1.16	8.5	0.74	3.5	33.7
4/8/2023	1.11	7.2	0.71	3.1	34.0
4/9/2023	1.32	15.3	0.88	6.2	33.9
4/10/2023	1.14	8.3	0.75	3.7	32.3
4/11/2023	1.01	5.0	0.64	2.3	31.6
4/12/2023	0.97	4.3	0.61	2.0	32.8
4/13/2023	0.95	4.0	0.59	1.9	34.0
4/14/2023	0.97	4.4	0.59	1.9	35.7
4/15/2023	1.08	6.6	0.65	2.5	34.8
4/16/2023	1.08	6.5	0.69	2.8	34.2
4/17/2023	1.03	5.3	0.65	2.4	34.0
4/18/2023	1.03	5.3	0.64	2.3	34.3
4/19/2023	1.02	5.2	0.65	2.4	35.4
4/20/2023	1.09	6.7	0.72	3.2	35.0
4/21/2023	1.17	9.0	0.81	4.7	36.1
4/22/2023	1.23	10.9	0.87	6.0	35.7
4/23/2023	1.28	13.0	0.90	6.7	35.7
4/24/2023	1.38	18.5	0.98	9.3	35.5
4/25/2023	1.21	10.3	0.86	5.8	35.0
4/26/2023	1.22	10.9	0.83	5.0	34.5
4/27/2023	1.40	20.5	0.97	9.4	35.2
4/28/2023	1.28	13.2	0.90	6.9	35.5
4/29/2023	1.35	16.9	0.96	9.1	36.9
4/30/2023	1.46	24.0	1.10	15.1	36.2

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
5/1/2023	1.42	20.8	1.05	12.7	36.4
5/2/2023	1.91	49.4	1.41	31.9	36.9
5/3/2023	1.61	31.8	1.29	27.2	35.9
5/4/2023	1.37	17.7	1.08	14.3	35.7
5/5/2023	1.24	11.5	0.98	9.5	35.1
5/6/2023	1.23	11.0	0.96	8.8	38.1
5/7/2023	1.24	11.3	0.97	9.0	37.6
5/8/2023	1.24	11.1	0.97	8.9	37.9
5/9/2023	1.24	11.1	0.97	9.1	38.6
5/10/2023	1.32	15.3	1.06	13.3	41.7
5/11/2023	1.45	23.2	1.19	22.1	42.1
5/12/2023	1.62	32.8	1.32	28.9	42.1
5/13/2023	1.59	31.6	1.30	28.4	41.6
5/14/2023	1.54	29.8	1.27	28.3	43.0
5/15/2023	1.47	25.3	1.24	27.0	43.4
5/16/2023	1.43	22.1	1.22	24.9	44.0
5/17/2023	1.45	23.4	1.23	25.2	45.9
5/18/2023	1.50	27.4	1.28	28.2	49.9
5/19/2023	1.54	30.1	1.29	27.7	48.6
5/20/2023	1.49	26.7	1.25	27.4	47.8
5/21/2023	1.43	22.2	1.20	22.9	46.8
5/22/2023	1.38	18.2	1.14	17.8	44.5
5/23/2023	1.32	14.6	1.09	14.8	46.0
5/24/2023	1.28	13.1	1.06	13.1	46.5
5/25/2023	1.33	15.8	1.11	16.1	47.3
5/26/2023	1.45	23.8	1.21	24.2	45.0
5/27/2023	1.38	18.4	1.13	17.5	43.3
5/28/2023	1.46	24.4	1.19	22.4	44.9
5/29/2023	1.39	18.8	1.15	19.0	42.5
5/30/2023	1.33	15.1	1.09	14.8	43.6
5/31/2023	1.29	13.4	1.06	13.1	42.7

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
6/1/2023	1.26	12.0	1.04	11.8	43.1
6/2/2023	1.25	11.5	1.03	11.2	46.5
6/3/2023	1.26	11.9	1.04	12.1	47.9
6/4/2023	1.26	12.2	1.06	12.8	48.1
6/5/2023	1.26	12.2	1.05	12.4	49.4
6/6/2023	1.24	11.0	1.03	11.6	46.7
6/7/2023	1.20	9.6	1.01	10.6	50.9
6/8/2023	1.23	10.7	1.03	11.5	53.0
6/9/2023	1.26	12.1	1.05	12.4	50.7
6/10/2023	1.24	11.3	1.03	11.7	48.9
6/11/2023	1.20	9.9	1.01	10.7	46.4
6/12/2023	1.23	10.9	1.02	11.2	47.2
6/13/2023	1.19	9.4	1.00	10.0	47.7
6/14/2023	1.14	7.8	0.96	8.6	47.8
6/15/2023	1.18	10.5	0.98	10.0	44.3
6/16/2023	1.35	16.8	1.09	14.9	47.4
6/17/2023	1.24	11.3	1.02	11.2	47.8
6/18/2023	1.17	8.6	0.99	9.7	50.7
6/19/2023	1.16	8.3	0.99	9.6	55.5
6/20/2023	1.17	8.9	1.00	10.0	54.9
6/21/2023	1.16	8.5	0.98	9.4	52.8
6/22/2023	1.12	7.4	0.96	8.6	55.1
6/23/2023	1.11	7.0	0.95	8.3	55.6
6/24/2023	1.10	6.8	0.94	7.8	55.1
6/25/2023	1.09	6.6	0.93	7.5	53.1
6/26/2023	1.10	6.8	0.93	7.6	53.9
6/27/2023	1.10	6.8	0.93	7.7	54.4
6/28/2023	1.11	7.1	0.94	7.8	55.8
6/29/2023	1.17	9.0	0.96	8.6	52.5
6/30/2023	1.17	8.8	0.96	8.8	49.6

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
7/1/2023	1.08	6.4	0.91	6.9	50.8
7/2/2023	1.04	5.5	0.87	5.9	52.9
7/3/2023	1.01	5.0	0.86	5.6	54.6
7/4/2023	1.00	4.8	0.85	5.4	55.7
7/5/2023	0.99	4.6	0.84	5.3	53.9
7/6/2023	0.97	4.3	0.83	5.0	54.1
7/7/2023	0.95	4.1	0.83	4.9	58.0
7/8/2023	0.96	4.2	0.82	4.9	56.2
7/9/2023	0.95	4.0	0.81	4.7	53.4
7/10/2023	0.91	3.5	0.77	3.9	53.0
7/11/2023	0.89	3.3	0.75	3.6	53.0
7/12/2023	0.87	3.1	0.73	3.4	55.7
7/13/2023	0.86	3.0	0.72	3.2	57.9
7/14/2023	0.84	2.8	0.71	3.0	57.0
7/15/2023	0.84	2.7	0.70	3.0	58.0
7/16/2023	0.84	2.8	0.70	3.0	56.3
7/17/2023	0.84	2.7	0.70	2.9	56.8
7/18/2023	0.82	2.6	0.68	2.8	54.8
7/19/2023	0.83	2.7	0.69	2.8	55.5
7/20/2023	0.82	2.5	0.68	2.7	57.5
7/21/2023	0.82	2.5	0.68	2.7	58.1
7/22/2023	0.84	2.7	0.69	2.8	57.7
7/23/2023	1.21	11.1	0.91	7.4	55.9
7/24/2023	1.00	4.9	0.79	4.3	54.5
7/25/2023	0.92	3.6	0.73	3.4	54.5
7/26/2023	0.88	3.2	0.70	3.0	56.6
7/27/2023	0.87	3.1	0.69	2.9	58.1
7/28/2023	0.86	2.9	0.69	2.8	58.2
7/29/2023	0.84	2.8	0.67	2.6	59.3
7/30/2023	0.83	2.7	0.66	2.5	58.7
7/31/2023	0.83	2.6	0.65	2.4	57.8

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Date	Lower Station Mean Daily Stage (ft)	Lower Station Mean Daily Discharge Estimate (ft^3/s)	Upper Station Mean Daily Stage (ft)	Upper Station Mean Daily Discharge Estimate (ft^3/s)	Atmospheric Temperature at Lower Station (°F)
8/1/2023	0.86	2.9	0.66	2.6	56.4
8/2/2023	0.84	2.7	0.65	2.4	58.1
8/3/2023	0.82	2.5	0.63	2.3	57.4
8/4/2023	0.80	2.4	0.63	2.2	58.9
8/5/2023	0.79	2.3	0.62	2.1	60.6
8/6/2023	0.79	2.3	0.61	2.1	60.9
8/7/2023	0.79	2.3	0.62	2.1	60.0
8/8/2023	0.82	2.5	0.64	2.3	57.4