Rush Creek Project, FERC Project No. 1389

AQ 6 – Fish Population and Barriers
Draft Technical Study Report

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List of Acronyms

CDFW	California Department of Fish and Wildlife
CPUE	catch per unit effort
FERC	Federal Energy Regulatory Commission
FL	fork length
ft^2	square foot/feet
GPS	global positioning system
lbs/acre	pounds per acre
lbs/mile	pounds per mile
m	meter

mm	millimeter
Project	Rush Creek Project
RC	Rush Creek
RM	River Mile
SCE	Southern California Edison Company
TSP	Technical Study Plan
TSR	Technical Study Report
UAV	unmanned aerial vehicle

1 INTRODUCTION

This Technical Study Report (TSR) describes survey methods and results developed by Southern California Edison Company (SCE) associated with implementation of the AQ 6 – Fish Population and Barriers Technical Study Plan (AQ 6 – TSP) for the Rush Creek Project (Project). The AQ 6 – TSP was included in SCE's Revised Study Plan[1] and was approved by the Federal Energy Regulatory Commission (FERC) on October 26, 2022, as part of its Study Plan Determination for the Project. Specifically, this report describes the methods and results of AQ 6 –TSP, implemented in 2023.

2 STUDY OBJECTIVES

The AQ 6 – TSP included four study objectives addressing fish population and fish barriers/migration as described below.

2.1 FISH POPULATION

- Document fish species composition, distribution, and relative abundance in Project-affected stream segments and Project reservoirs.
- Characterize fish growth, condition factor, and population age structure in Project-affected stream segments and Project reservoirs.

2.2 FISH BARRIERS/MIGRATION

- Document the location, nature, and characteristics of fish barriers in Project-affected stream segments.
- Identify Project facilities and operations (e.g., dam, reservoir operations, instream flow releases) that may affect fish migration.

3 STUDY IMPLEMENTATION

Study elements described in the AQ 6 – TSP were completed in 2023. A summary of the study elements that have been completed and any deviations or proposed modifications to the AQ-6 – TSP are discussed in the following subsections.

3.1 STUDY ELEMENTS COMPLETED

In 2023, all study elements were completed at all sites except in South Rush Creek, which was dry at the time of the scheduled fish population surveys.

3.2 VARIANCES FROM THE AQ 6 – TSP

Fish were not sampled in South Rush Creek, which was dry at the time of the study. Conditions at the South Rush Creek site at the time of field surveys were documented with photographs.

[1] SCE filed a Proposed Study Plan on May 26, 2022 (SCE 2022a). Four comment letters were filed on the Proposed Study Plan, and six study plans were revised. SCE filed a Revised Study Plan on September 23, 2022 (SCE 2022b). FERC subsequently issued a Study Plan Determination on October 26, 2022, approving the AQ-6 TSP (FERC 2022).

3.3 OUTSTANDING STUDY ELEMENTS

There are no outstanding study elements.

4 STUDY AREA AND STUDY SITES

The study area for the assessment of fish population and migration includes Project-affected stream segments and Project reservoirs.

Stream and reservoir fish population sampling locations are identified in Table AQ 6-1 and Map AQ 6-1. Additional detailed descriptions of fish population sampling locations are provided in Appendix A.

Qualitative barrier surveys were conducted along the entire length of the Project-affected stream segments. Additional quantitative barrier surveys were conducted for barriers occurring at Project dams or other instream infrastructure.

5 STUDY APPROACH

5.1 STUDY SITES

The locations of study sites selected for developing fish species composition, distribution, and standing crop estimates (fish per mile [fish/mile] and/or pounds per acre [lbs/acre]) are presented in Table AQ 6-1 and Map AQ 6-1. Stream sampling sites in Rush Creek (RC) were named based on the River Mile (RM) were they were located with the exception of South Rush Creek, which is a side channel and was given a separate (South Rush Creek) designation. Stream sampling sites (for electrofishing and/or snorkeling) were generally 100 meters (m) long (with the exception of one site which was 78 m, and one site which was 108 m) so they would include multiple habitat types. Habitat types, lengths, and sampling methods for selected stream segments and Project reservoirs are provided in Table AQ 6-1.

The results of the AQ 5 – Geomorphology TSP mesohabitat mapping were used to identify representative reach sampling sites with mesohabitat types in similar proportion to the larger geomorphic river segments. Where possible, sampling sites were chosen that overlapped with the instream flow study sites (see the AQ 1 – Instream Flow TSP). The specific locations of sampling sites were determined in the field to represent habitat conditions in the surrounding reach considering the presence of barriers (i.e., waterfalls) and access. The site below Rush Meadows Dam was the same site used for previous compliance monitoring (Read and Sada 2012; Sada and Rosamond 2010).

Appendix A includes photos of the specific stream sampling sites, along with site dimensions and sampling methods. Detail on reservoir gillnet sampling locations is provided in Appendix B.

5.2 FISH SAMPLING

5.2.1 Stream Sites

Stream sampling sites were surveyed to identify the spatial distribution and abundance of fish species. Sampling was conducted from September 25 to September 29, 2023, during the late-summer/early-fall base flow period using a combination of electrofishing (shallow water) and snorkeling (deep water) at each representative sampling site (Table AQ 6-1).[2] Multi-pass electrofishing (e.g., Reynolds 1996; Van Deventer and Platts 1989) was used to sample and estimate fish populations in shallow stream habitats (<1.5 m). The sampling sites were partitioned into mesohabitat types for sampling using block nets. Captured fish from each pass in each mesohabitat type were kept in separate live wells. Fish were enumerated, identified to species, and measured (fork length [FL] and weight). Scale samples were obtained from a subsample of fish measuring over 75 millimeters (mm) in length. Fish were returned to the sampling site when the survey was completed. Sampling protocols and field data forms were consistent with those described by Flosi et al. (1998). The lengths and widths of the habitat units sampled were recorded to calculate fish abundance by length and area (density) of stream sampled.

Snorkeling (Dolloff et al. 1996) was used to assess fish populations in deep-water habitats (≥ 1.5 m) at each representative stream sampling site (Table AQ 6-1). Three sites contained no snorkel units due to shallow pool depth (<1.5 m), and one site consisted entirely of snorkel units due to consistent depth over 1.5 m. Snorkelers surveyed in lanes within the stream and identified, counted, and estimated the length of each fish observed. Fish data were recorded by mesohabitat type. Snorkeling protocols and field data forms were consistent with those described by Flosi et al. (1998).

5.2.2 Reservoir Sites

Variable-mesh gillnets were set in Project reservoirs to characterize fish species composition, relative abundance, and size. Gem Lake and Agnew Lake were sampled from August 28 to August 29, 2023, and August 29 to August 30, 2023, respectively, using a rowed cataraft at each reservoir.[3] The sampling locations were distributed evenly along the length of each reservoir to sample both deep-water and littoral zone habitats. One net at each location was set perpendicular from the shore in the littoral zone, with small mesh near the shore, and the other net was set in deeper water vertically, with small mesh near the surface (Appendix B, Map B-1 and Map B-2). One vertical deep-water gillnet was also placed at three sampling locations in Gem Lake and two sampling locations in Agnew Lake (Appendix B, Table B-1). Gillnets were set in the afternoon of one day and retrieved and processed the morning of the following day. Upon retrieval of each gillnet, fish were enumerated, weighed, and measured (FL). Severely injured fish were euthanized, and dead fish were placed in deep water after their air bladders were punctured to sink the carcass and return the biomass back to the ecological system. Data from gillnet sampling

[2] No sampling was conducted at South Rush Creek River Mile [RM] 0.15 (South Rush Creek 0.15), as this site was dry at the time of scheduled survey activities.

[3] Gill net sampling was not conducted in Waugh Lake as the low-level outlet was open and the area did not represent reservoir habitat.

were used to summarize fish composition, size, relative abundance, and body condition in each Project reservoir.

5.3 FISH BARRIERS/MIGRATION

Biologists surveyed the Project-affected stream segments and Project reservoirs to identify and classify potential fish barriers. Initial qualitative fish barrier surveys were conducted in 2022 in conjunction with AQ 5 – Geomorphology TSP mesohabitat mapping to identify the location and nature (natural or Project-related) of potential barriers (e.g., natural falls, tributary junctions, road crossings, shallow riffles, and dams). The Project-affected reaches were surveyed visually on foot. Inaccessible locations such as steep cliffs and waterfalls (e.g., Horsetail Falls) outside the wilderness area were surveyed using video footage from unmanned aerial vehicle (UAV) overflights. Naturally occurring barriers were evaluated qualitatively by classifying each potential barrier identified in the field or from UAV footage into the falls, chute, and cascade types defined by Powers and Orsborn (1985) or as critical riffles (Thompson 1972). Reaches with repeated naturally occurring barriers throughout the reach were classified as barrier reaches. Naturally occurring barriers within an otherwise passable reach were identified individually and evaluated qualitatively. Project dams and other instream infrastructure (i.e., stream gages) representing barriers were evaluated using quantitative techniques including the general fish barrier assessment methodologies outlined by Powers and Orsborn (1985) and Thompson (1972), which were modified, where necessary, for the specific species (e.g., rainbow trout [*Oncorhynchus mykiss*] and brook trout [*Salvelinus fontinalis*]) and barriers within the study area; leaping and swimming capabilities of the fish based on the literature (Powers and Orsborn 1985; Hoar and Randall 1978); and a classification approach consistent with Flosi et al. (2010) for road crossings.

5.4 DATA REPORTING

A combination of English and metric units was used for data reporting as identified in the AQ-6 Fish Population and Barriers TSP and to facilitate comparison to previous reports.

5.4.1 Stream Sites

The following analyses were completed:

- Fish abundances from sampling events were used to summarize fish standing crop estimates in terms of linear and areal density (e.g., fish/mile and fish/square foot [ft^2] and biomass (pounds per mile [lbs/mile] and lbs/acre). Abundance and biomass were totaled for individual sampled mesohabitat units at each sampling site. For deep-water mesohabitat units that were snorkeled, the number of fish observed during snorkeling was used to estimate fish abundance. As fish were not weighed (only measured) at snorkel sites, their weight was calculated using a Project- and species-specific length-weight regression.[4] The midpoint length of each fish-size class bin was used to calculate average biomass. Snorkeling biomass estimates

[4] Length-weight regression formulas used the equation $(W = aL^b)^1$, where W=Weight (grams); a=constant; L=length(mm); and b=constant.

were used as a relative measure of biomass as they were likely not as accurate as those at electrofishing-only sites as the fish were categorized by size using visual estimates (underwater visual observations calibrated with a ruler).

- Density and biomass data from the legacy sampling site below Rush Meadows Dam was compared to previous results from 2010 (Read and Sada 2012).

- Fish standing crop estimates for all Project stream sampling sites were compared to similar datasets from nearby streams.

- A fish life-stage periodicity chart (by calendar month) was developed for each species for each sampling site based the work of Moyle (2002) and Read and Sada (2012).

- Length frequency histograms of sampled fish data were generated to examine distribution modality and, in conjunction with scale data, to determine the age structure of fish populations.

- Fish growth and age data were summarized using length frequency and scale analysis. The scale analysis used the narrower growth rings (circuli) during the cold-water season compared to other times of the year to identify the number of growth years (i.e., number of annuli). The reading of magnified scales was done by an experienced fish biologist.

- Fulton's condition factor (Ricker 1975) was calculated for sampled fish. Fulton's fish condition factor provides a relative index of the nutritional state (e.g., storage of muscle and lipids) of individual fish but varies by size and species. The average condition factor for each species at each sampling site was calculated using individual condition factors. Across all species captured, fish smaller than 50 mm FL were excluded from the condition factor analysis because these weights are more likely to be influenced by minor environmental factors (e.g., wind or water droplets) when weighed, which could result in erroneous condition factor calculations.

5.4.2 Reservoir Sites

Fish composition, size, and relative abundance were summarized for Gem Lake and Agnew Lake. Catch per unit effort (CPUE) was calculated and length frequency histograms were generated. Data from 2023 reservoir sampling was compared to historical reservoir sampling data from 2002 (CDFW 2021, Table AQ 6-9).

5.4.3 Fish Barriers/Migration

The locations of all barriers were mapped with a Trimble sub-meter global positioning system (GPS) unit. All anthropogenic barriers (Project dams and other instream infrastructure) were photographed in the field for visual reference. Descriptions of observed barriers were developed and are provided along with photos in Appendix C.

6 STUDY RESULTS

6.1 FISH SAMPLING

6.1.1 Fish Species Distribution

Although Rush Creek was historically fishless, it is currently occupied by trout species introduced from Europe (brown trout [*Salmo trutta*]), eastern North America (brook trout), and regions of California (golden [*O. aguabonita*] and rainbow trout) due to stocking activities (Moyle 2002). These trout-dominated waters are representative of mid- to high-elevation Eastern Sierra Nevada streams. Results from 2023 fish population sampling events were used to characterize the distribution of fish species in Rush Creek (Table AQ 6-2 and Appendix D, Table D-1).

Rainbow trout were the most widely distributed species and were found in all but the highest elevation stream sampling site above Waugh Lake. Rainbow Trout were collected in both Project reservoirs. At the legacy sampling site in Rush Creek below Rush Meadows Dam, rainbow trout appeared to be mostly rainbow trout X golden trout hybrids as identified in previous studies (Read and Sada 2012). Rainbow X golden trout hybrids were also observed in smaller numbers in Rush Creek below Agnew Dam, above Horsetail Falls. These hybrid fish are referred to as rainbow trout in this report and analysis.

Brook trout (were found from above Silver Lake to the highest elevation stream sampling site above Waugh Lake and in both Project reservoirs. Brown trout had the smallest distribution and were found from Rush Creek below Silver Lake (lowest-elevation site) to Rush Creek above Silver Lake, below Horsetail Falls.

Observed fish distribution and elevations of stream sampling sites are shown in Figure AQ 6-1. All sampling sites were above 7,000 feet above mean-sea-level, and three sampling sites were above 9,000 feet above mean-sea-level.

6.1.2 Life-Stage Periodicity

A fish life-stage periodicity (or life-history chronology) chart by month for species in the sampling sites was developed based on available literature (Moyle 2002; Read and Sada 2012), discussion with qualified fisheries biologists, and review of the 2023 fish population sampling information (Table AQ 6-3). Periodicities were adjusted based on Project elevation and associated environmental factors (e.g., water temperature), where appropriate.

6.1.3 Stream Sites

6.1.3.1 Fish Density and Biomass

In total, 184 rainbow trout, 342 brown trout, and 333 brook trout were captured or observed in the stream sampling sites (Table AQ 6-4). Fish densities (fish/mile, fish/ft^2) and biomass (lbs/mile, lbs/acre) by mesohabitat type and totals for each sampling site are shown in Table AQ 6-4. Site totals are illustrated in Figure AQ 6-2. Fish densities by species at sampling sites varied widely, ranging from 16 to 3,271 fish/mile.

The highest linear densities were found in Rush Creek below Silver Lake (2,876–3,271 fish/mile) and in Rush Creek above Highway 158 and below Agnew Dam (470–3,034 fish/mile). Intermediate densities were found in in Rush Creek above Waugh Lake (1,367 fish/mile) and in Rush Creek below Rush Meadows Dam (291–907 fish/mile). The lowest densities were found in Rush Creek as it flowed through Waugh Lakebed (16–435 fish/mile) and in Rush Creek above Silver Lake, below Highway 158 (54–81 fish/mile). Areal density (fish/ft^2) generally exhibited a similar pattern as linear density (Table AQ 6-5; Figure AQ 6-2). Linear and areal biomass was highest (218.81 lbs/mile and 93.91 lbs/acre) in Rush Creek below Agnew Dam. Rush Creek as it flowed through Waugh Lakebed had the lowest linear and areal biomass density for all species (0.12–12.25 lbs/mile and 0.02–1.58 lbs/acre, respectively).

Density and standing crop estimates from 2023 sampling conducted at the legacy sampling site below Rush Meadows Dam were compared to historical sampling data from 1999-2002 and 2010 (Read and Sada 2012, Sada 2001, Sada 2003; Table AQ 6-6). Brook trout density was higher in 2023 than in previous sampling years at 907 fish/mile. However, standing crop (biomass density) was not high at only 18.08 lbs/acre. Historical brook trout density and standing crop ranged from 128 fish/mile and 3.57 lbs/acre to 784 fish/mile and 30.33 lbs/acre. Rainbow trout density and biomass in 2023 (291 fish/mile, 8.39 lbs/acre) was mid-range compared to historical sampling, which ranged from 96 fish/mile and 3.57 lbs/acre to 320 fish/mile and 13.38 lbs/acre.

Data from the 2023 sampling effort in Rush Creek were also compared to available density and biomass information from other Eastern Sierra Nevada stream systems within a comparable elevation range (Figure AQ 6-3). Comparison data were sourced from SCE's Bishop Creek and Lee Vining Hydroelectric Projects (SCE 2021, 2022c), historical Rush Creek data (Read and Sada 2012), and publicly available reports from the Inland Desert Region of California Department of Fish and Wildlife's (CDFW) Heritage and Wild Trout Program (CDFW 2008, 2012). The dataset was limited to Eastern Sierra Nevada streams in Inyo, Mono, and Alpine counties at elevations between 5,000 and 10,000 feet.

Observed fish density (fish/mile) and biomass (lbs/acre) at low- and mid-elevation Rush Creek sampling sites was generally higher than in other streams at similar elevations. At high-elevation Rush Creek sampling sites, fish density was comparable to that from available datasets at similar elevations such as Lee Vining Creek below Saddlebag Lake.

6.1.3.2 Length Frequency and Age Structure

Length frequency histograms for each species across the sampling sites are provided in Figure AQ 6-4 and in Appendix E. A length versus weight regression for each species is also provided in Figure AQ 6-5.

In general, there were differences in growth and length-at-age based on sampling site elevation and species. Small (<90 mm FL) rainbow trout and brown trout were captured during sampling across all sites but made up a larger proportion of the catch at lower elevation sites. Small rainbow trout (<90 mm) made up a lower proportion of total catch at high-elevation sites, consistent with the findings of Sada and Rosamond (2010). Small

rainbow trout included both 0+ and 1+ juvenile fish, with high-elevation sites associated with lower first and second year size ranges. A relatively large proportion of moderately sized brook trout (90–200 mm FL) were observed at higher elevation sites. Brown trout primarily consisted of small to moderately sized individuals (<175 mm FL), with a small proportion of large individuals. Rainbow trout and brook trout exhibited a more even distribution of fish sizes across all sites (Figure AQ 6-5). Minimum sizes for 0+ fish varied by species. Autumn-spawning trout (brown and brook) for 2023 were not available for capture at the time of sampling, and all 0+ fish of these species were almost a full year old at the time of capture. Young-of-the-year rainbow trout spawned in 2023 were available for capture, although they were uncommon at high-elevation sites where recruitment is relatively low (Read and Sada 2012).

Ages of fish were estimated from scale samples (Figure AQ 6-6 and Appendix D, Table D-2). Scale analysis was used to verify age class determinations in length frequency histograms. A discussion of fish length and age derived from scale analysis is provided below by species.

Rainbow Trout

Rainbow trout at lower and mid-elevation sampling sites below Agnew Dam consisted of age 0+ fish with an average FL of 82 mm and age 1+ fish with an average FL of 123 mm. At higher elevation sites, age 0+ fish had an average FL of 74 mm and age 1+ fish had an average FL of 116 mm. Age 2+ rainbow trout at lower and mid-elevation sites ranged from 157 to 238 mm FL and had an average FL of 150 mm at higher elevation sites. The oldest rainbow trout (age 3+) observed had an average FL of 200 mm at higher elevation sites and ranged from 201 to 266 mm FL below Agnew Dam.

Brook Trout

Brook trout at lower and mid-elevation sampling sites below Agnew Dam consisted of age 0+ fish with an average of 98 mm FL and age 1+ fish from 112 to 138 mm FL. At higher elevation sites, age 0+ fish had an average FL of 104 mm and age 1+ fish ranged from 122 to 128 mm FL. Age 2+ fish had an average FL of 172 mm at lower elevation sites. and ranged from 157 to 205 mm FL at higher elevation sites.

Brown Trout

Scale-aged brown trout were all sampled at lower sampling sites and included age 0+ and 1+ fish up to an average FL of approximately 112 mm. Age 2+ fish averaged 162 mm FL.

6.1.3.3 Age and Growth Rates

Lengths of scale-sampled fish were plotted with estimated ages to develop the growth rate summaries shown in Figure AQ 6-6.

At lower elevation sampling sites, rainbow trout demonstrated faster rates of growth, while growth rates at higher elevation sites were slower. Conversely, brook trout generally exhibited faster rates of growth in higher elevation sites, while growth rates appeared to

be slower at RM 18.55. Brook trout were less common at RM 18.55, and the apparent slower growth may be an artifact of there being fewer samples or due to increased competition for food and space with other trout species. Growth rates of brown trout were higher below Silver Lake than above Silver Lake.

6.1.3.4 Condition Factor

The average condition factors of rainbow trout in Rush Creek ranged from 0.84 in Waugh Lakebed to 1.13 below Silver Lake (Table AQ 6-7). Brown trout condition factors ranged from 1.05 above Silver Lake to 1.08 below Silver Lake, and brook trout condition factors ranged from 0.97 in Rush Creek below Rush Meadows Dam to 1.13 in Waugh Lakebed.

Condition factors for trout can range from <0.6 to >2.0 (Carlander 1969), where starving fish often have a condition factor <0.7 (Reimers 1963; Carlander 1969), and exceptionally healthy fish have high condition factors (e.g., >1.5). Variation in average body condition between sampling sites was roughly correlated with elevation.

6.1.4 **Reservoir Sites**

6.1.4.1 Species Captured and Catch per Unit Effort

Rainbow trout and brook trout were captured during reservoir gillnetting in Gem Lake and Agnew Lake (Table AQ 6-2). More rainbow trout than brook trout were caught in Gem Lake, and more brook trout than rainbow trout were caught in Agnew Lake (Table AQ 6-8). Only medium-sized fish between 213 and 375 mm FL were captured in the nets even though variable size mesh was used. Most fish were captured by horizontal gillnets in less than 10 feet of water.

CPUE was lower in 2023 than in 2002 in both Gem and Agnew Lakes (0.18 and 0.25 fish per net hour in Gem, compared to 0.63 and 2.31 fish per net hour in Agnew). This difference may be largely due to additional deployment of gill nets vertically away from the shore and in deep water in 2023. CPUE was very low in vertical gillnets and in the deeper segments of horizontal gillnets (>10 feet). Only single horizontal gillnets were deployed in 2002.

Additional detail on 2023 reservoir sampling, including net deployment locations, is provided in Appendix B.

6.1.4.2 Length Frequency of Captured Fish

Length frequency histograms were created for species captured during Gem Lake and Agnew Lake gillnet sampling (Figure AQ 6-7). Fish between 230 and 260 mm FL were the most frequently caught across all reservoir sampling sites.

6.1.4.3 Condition Factor

The average condition factor of rainbow trout in Gem Lake was 1.09, and the average condition factor of brook trout was 0.99. In Agnew Lake, the average condition factor of rainbow trout was 1.01, and the average condition factor of brook trout was 1.06 (Table AQ 6-7). Based on data from Carlander (1969) and Reimers (1963), the condition factor for trout species in Project reservoirs is within the expected range of good condition.

6.2 FISH BARRIERS AND MIGRATION

Eight anthropogenic barriers, two natural barrier reaches, and eight individual natural barriers were surveyed along Rush Creek from the upstream influence of Grant Lake to approximately 0.5 mile upstream of Waugh Lake (Appendix C, Map AQ C-1). Natural barriers such as waterfalls, chutes, and cascades were abundant in Rush Creek upstream of the Rush Creek Powerhouse. Anthropogenic barriers were assessed quantitatively and categorized based on relative passage restriction for trout (Table AQ 6-10). Complete barriers, those categorized as *not passable*, consisted of infrastructure unsuitable for the passage of any trout. Complete barriers consisted of Gem Dam and Rush Meadows Dam and the notches cut into Agnew Dam in 2017. Natural barriers occurred below all three anthropogenic complete barriers, limiting the area impacted. Although the design of the notches in Agnew Dam could allow for passage at some flows, the presence of a large cascade immediately downstream further restricts potential passage.

Two gage weirs (one below Agnew Lake and one below Silver Lake) were assessed and determined to be potentially passable for adult trout at some flows but presented jump and velocity barriers to juvenile trout at all flows and depth barriers to adult trout at low flows. Critical riffles at the upstream end of Agnew Lake and Waugh Lake present depth barriers only under seasonal low-flow conditions. Therefore, they are likely to primarily effect fall spawning species such as brook trout. The critical riffle at the upstream end of Silver Lake (in the sediment delta) is affected by lake surface elevation and inflow. This critical riffle did not present a depth barrier in 2023 but could reach critically shallow depths when the lake surface elevation approaches 7,220.5 feet and inflow is low.

Two road crossings (Highway 158 and the powerhouse access road) occur in the surveyed area of Rush Creek. These road crossings were assessed at a range of flows and do not represent barriers to fish passage (Appendix C).

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TABLES

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Table AQ 6-1. 2023 Fish Population Sampling Site Locations

Study Sites[1] [2]	Downstream Starting Location (UTM)[3]		Unit Number	Unit Type[4]	Elevation (ft)	Unit Length (m)	Unit Width (m)	Survey Date	Survey Method[5]	Study Reach Description
	Easting	Northing								
Rush Creek										
RC23.9	305491	4180023	1	MCP	9549	20	6.0	9/26/2023	E	Rush Creek above Waugh Lake
	305475	4180010	2	STP	9553	20	6.5		E	
	305380	4179949	3	LGR	9577	27	6.5		E	
	305356	4179988	4	HGR	9589	26	6.0		E	
RC23.4 (Waugh Lakebed)	306188	4180357	1	LGR	9430	100	19.7	9/26/2023	E	Waugh Lakebed
RC21.65	308422	4180588	1	HGR	9308	35	9.0	9/25/2023	E	Rush Creek below Rush Meadows Dam
	308389	4180602	2	MCP	9313	20	6.3		E	
	308370	4180609	3	HGR	9314	22	7.3		E	
	308362	4180627	4	STP	9315	17	5.8	9/27/2023	E	
RC18.55	312345	4181378	1	PLP	8359	18	14.0	9/27/2023	S	Rush Creek below Agnew Dam, above Horsetail Falls
	312299	4181204	2	LGR	8461	31	3.5		E	
	312281	4181178	3	Run	8463	47	4.5		E	
	312237	4181125	4	PLP	8466	17	5.3		S	
RC17.55	313116	4181948	1	HGR	7241	18	3.2	9/29/2023	E	Rush Creek below Horsetail Falls and above Silver Lake, above Highway 158
	313111	4181931	2	Run/MCP	7246	25	3.5		E	
	313090	4181921	3	LGR	7250	28	3.5		E	
	313063	4181933	4	STP	7252	12	3.0		E	
	313052	4181938	5	HGR	7256	25	4.0		E	
RC17.05	313007	4182607	1	MCP	7242	51	5.2	9/29/2023	S	Rush Creek above Silver Lake below Highway 158
	312934	4182532	2	Run	7242	55	5.2		S	
	312923	4182427	3	CRP	7242	115	5.2		S	
	312945	4182402	4	CRP/Run	7242	74	5.2		S	
	312880	4182391	5	LSP/CRP	7242	61	5.2		S	
RC13.9[6]	314038	4186020	1	MCP	7202	26	7.0	9/28/2023	S	Rush Creek below Silver Lake
	314012	4185998	2	LGR	7202	35	9.0		E	
	313961	4185929	3	HGR	7204	18	8.0		E	
	313962	4185910	4	MCP	7204	60	13.0		S	
	313849	4185887	5	STR	7205	42	14.0		E	
SRC0.15	not sampled in 2023		-	-	-	-	-	-	-	South Rush Creek above Highway 158
Rservoirs										
Gem Lake	311249	4180598	-	Reservoir	9050	-	-	9/28-9/29/2023	G	Gem Lake
Agnew Lake	311926	4180946	-	Reservoir	8515	-	-	9/29-9/30/2023	G	Agnew Lake

[1]Site ID includes a river abbreviation and river mile location. RC = Rush Creek, RM = river mile.
[2] See Map AQ 6-1.
[3] Universal Transverse Mercator Zone 11 South, North American Datum 1983
[4] Mesohabitat unit type: MCP= Mid-channel Pool; LGR= Low Gradient Riffle; HGR= High Gradient Riffle; STR= Step Run; CRP= Corner Pool; LSP= Lateral Scour Pool; STP= Step Pool; PLP= Plunge Pool
[5] S = Snorkel, E = Electrofishing, G = Gillnet
[6] This site was re-located from RM 15.2, as originally identified in the AQ - 6 RSP, to RM 13.9 in the field due to safety and accessiblity restrictions (large woody debris present in the stream channel).

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Table AQ 6-2. Summary of Fish Species Observed During the 2023 Fish Population Sampling

Study Site	Date	Fish Species[1]		
		RBT	BNT	BRK
Stream Segments				
RC23.9	9/26/2023			•
RC23.4 (Waugh Lakebed)	9/26/2023	•		•
RC21.65	9/25/2023, 9/27/2023	•		•
RC18.55	9/27/2023	•		•
RC17.55	9/29/2023	•	•	•
RC17.05	9/29/2023	•	•	•
RC13.9	9/28/2023	•	•	
SRC0.15	NA [2]	-	-	-
Reservoirs				
Gem Lake	8/28-8/29/2023	•		•
Agnew Lake	8/29-8/30/2023	•		•

[1] RBT = Rainbow Trout, BNT = Brown Trout, BRK = Brook Trout

[2] Not sampled in 2023.

Table AQ 6-3. Species and Life Stage Periodicities

Species	Month											
Life Stage	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Rainbow Trout												
Spawning												
Incubation												
Fry												
Juvenile												
Adult												
Brown Trout												
Spawning												
Incubation												
Fry												
Juvenile												
Adult												
Brook Trout												
Spawning												
Incubation												
Fry												
Juvenile												
Adult												

Table AQ 6-4. Summary of Fish Sampled at Stream Sampling Sites

Study Site	Date	Sample Type[1]	Species[2]		
			RBT	BNT	BRK
RC23.9	9/26/2023	E	0	-	77
RC23.4 (Waugh Lakebed)	9/26/2023	E	1	-	25
RC21.65	9/25/2023, 9/27/2023	E	17	-	38
RC18.55	9/27/2023	E	23	-	110
		S	9	-	40
RC17.55	9/29/2023	E	39	75	41
RC17.05	9/29/2023	S	12	18	2
RC13.9	9/28/2023	E	0	172	0
		S	83	77	0
SRC0.15	NA[3]	-	-	-	-

[1] E = Electrofishing, S = Snorkeling

[2] RBT = Rainbow Trout, BNT = Brown Trout, BRK = Brook Trout

[3] Not sampled in 2023.

Table AQ 6-5. Species Density and Biomass at Sampling Sites

Study Site	Habitat Type	Number of Fish Captured			Population Estimate			Species[1] Density						Species Biomass					
								fish/mile	fish/ft²	fish/mile	fish/ft²	fish/mile	fish/ft²	lbs/acre	lbs/mi	lbs/acre	lbs/mi	lbs/acre	lbs/mi
		RBT	BNT	BRK	RBT	BNT	BRK	RBT		BNT		BRK		RBT		BNT		BRK	
RC23.9	MCP	0	-	26	0	-	28	0	0.00000	-	-	2253	0.02168	0.00	0.00	-	-	59.52	142.02
	STP	0	-	24	0	-	24	0	0.00000	-	-	1931	0.01715	0.00	0.00	-	-	40.50	104.68
	LGR	0	-	15	0	-	15	0	0.00000	-	-	894	0.00794	0.00	0.00	-	-	23.02	59.50
	HGR	0	-	12	0	-	12	0	0.00000	-	-	743	0.00715	0.00	0.00	-	-	17.07	40.73
	Site Total	**0**	**-**	**77**	**0**	**-**	**79**	**0**	**0.00000**	**-**	**-**	**1367**	**0.01262**	**0.00**	**0.00**	**-**	**-**	**32.86**	**81.72**
RC23.4 (Waugh Lakebed)	LGR	1	-	25	1	-	27	16	0.00005	-	-	435	0.00127	0.02	0.12	-	-	1.58	12.39
	Site Total	**1**	**-**	**25**	**1**	**-**	**27**	**16**	**0.00005**	**-**	**-**	**435**	**0.00127**	**0.02**	**0.12**	**-**	**-**	**1.56**	**12.25**
RC21.65	HGR	8	-	23	8	-	33	226	0.00156	-	-	932	0.00645	5.54	18.39	-	-	17.12	56.80
	MCP	7	-	9	7	-	14	563	0.00516	-	-	1127	0.01032	15.79	39.56	-	-	21.91	54.89
	STP	2	-	6	2	-	6	189	0.00188	-	-	568	0.00565	12.70	29.28	-	-	17.86	41.20
	Site Total	**17**	**-**	**38**	**17**	**-**	**53**	**291**	**0.00226**	**-**	**-**	**907**	**0.00703**	**8.39**	**24.87**	**-**	**-**	**18.08**	**53.57**
RC18.55	PLP*	9	-	40	9	-	40	414	0.00244	-	-	1839	0.01086	39.98	155.40	-	-	67.73	263.25
	LGR	16	-	70	16	-	85	831	0.01370	-	-	4413	0.07278	50.76	70.65	-	-	85.20	118.59
	Run	7	-	40	8	-	88	274	0.00351	-	-	3013	0.03865	7.57	13.55	-	-	140.72	251.82
	Site Total	**32**	**-**	**150**	**33**	**-**	**213**	**470**	**0.00463**	**-**	**-**	**3034**	**0.02989**	**31.39**	**73.15**	**-**	**-**	**93.91**	**218.81**
RC17.55	HGR	20	40	17	21	43	17	786	0.01238	1609	0.02535	636	0.01002	36.24	52.82	9.38	13.67	30.15	43.94
	Run/MCP	10	16	15	11	17	15	708	0.01168	1094	0.01805	966	0.01593	79.41	110.53	21.67	30.16	87.93	122.39
	LGR	3	11	5	3	11	5	172	0.00284	632	0.01043	287	0.00474	8.63	12.01	9.07	12.62	20.99	29.22
	STP	6	8	4	6	8	4	805	0.01548	1073	0.02065	536	0.01032	67.14	80.10	158.59	189.20	42.40	50.59
	Site Total	**39**	**75**	**41**	**41**	**79**	**41**	**611**	**0.01005**	**1177**	**0.01936**	**611**	**0.01005**	**42.00**	**58.63**	**26.30**	**36.72**	**42.28**	**59.02**
RC17.05	MCP*	0	0	0	0	0	0	0	0.00000	0	0.00000	0	0.00000	0.00	0.00	0.00	0.00	0.00	0.00
	Run*	0	3	0		3	0	0	0.00000	88	0.00097	0	0.00000	0.00	0.00	37.35	76.96	0.00	0.00
	CRP*	12	13	0	12	13	0	168	0.00187	182	0.00203	0	0.00000	25.73	53.02	30.93	63.73	0.00	0.00
	CRP/Run*	0	0	0	0	0	0	0	0.00000	0	0.00000	0	0.00000	0.00	0.00	0.00	0.00	0.00	0.00
	LSP/CRP*		2	2		2	2	0	0.00000	53	0.00059	53	0.00059	0.00	0.00	0.45	0.94	0.03	0.07
	Site Total	**12**	**18**	**2**	**12**	**18**	**2**	**54**	**0.00060**	**81**	**0.00090**	**81**	**0.00090**	**8.28**	**17.07**	**15.81**	**32.57**	**0.01**	**0.01**
RC13.9	MCP*	83	77	0	83	77	0	1553	0.00802	1441	0.00744	0	0.00000	8.75	38.92	4.87	21.68	0.00	0.00
	LGR	37	73	0	140	128	0	6437	0.04129	5886	0.03775	0	0.00000	24.43	87.45	18.57	66.48	0.00	0.00
	HGR	16	39	0	17	50	0	1520	0.01097	4470	0.03226	0	0.00000	3.39	10.79	19.87	63.23	0.00	0.00
	STR	37	60	0	37	60	0	1418	0.00585	2299	0.00948	0	0.00000	0.88	4.90	12.88	71.70	0.00	0.00
	Site Total	**173**	**249**	**0**	**277**	**315**	**0**	**2876**	**0.01409**	**3271**	**0.01602**	**0**	**0.00000**	**8.52**	**43.92**	**10.44**	**53.81**	**0.00**	**0.00**
SRC0.15	-	not sampled in 2023						-						-					

[1] RBT = Rainbow Trout, BNT = Brown Trout, BRK = Brook Trout

* These sites were sampled by snorkeling. All other sites were sampled by electrofishing.

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Table AQ 6-6. Historical Comparison of Species Density and Biomass in Rush Creek (Site RC21.65) Below Rush Meadows Dam

Year	Season	Species[1]	Population Estimate	Species Density		Species Biomass	
				fish/mile	fish/ft²	lbs/acre	lbs/mile
1999	Summer	BRK	8	128	0.001	3.57	9.74
		RBT	6	96	0.001	3.57	9.70
	Fall	BRK	41	656	0.009	29.44	48.16
		RBT	8	128	0.002	9.81	14.42
2000	Summer	BRK	17	272	0.002	7.14	32.16
		RBT	6	96	0.001	3.57	9.86
	Fall	BRK	44	704	0.009	34.79	75.34
		RBT	19	304	0.005	23.20	39.28
2001	Summer	BRK	49	784	0.008	30.33	67.50
		RBT	24	384	0.005	28.55	57.02
	Fall	BRK	34	544	0.007	29.44	48.32
		RBT	18	280	0.005	34.79	45.79
2002	Spring	BRK	37	584	0.006	12.49	32.07
		RBT	20	320	0.003	13.38	33.99
2010	Spring	BRK	35	563	0.005	14.90	38.74
		RBT	19	306	0.003	14.63	31.08
	Summer	BRK	21	334	0.003	13.56	27.94
		RBT	9	145	0.001	4.91	13.12
2023	Summer	BRK	53	907	0.007	18.08	53.57
		RBT	17	291	0.002	8.39	24.87

[1] BRK = Brook Trout; RBT = Rainbow Trout.

Table AQ 6-7. Condition Factors by Species Collected by Electrofishing and Gillnetting

Site ID	RBT[2]		BNT		BRK	
	Average Condition Factor	n	Average Condition Factor	n	Average Condition Factor	n
Stream Segments						
RC23.9	-	0 [3]	-	-	1.07	75
RC23.4 (Waugh Lakebed)	0.84	1	-	-	1.13	14
RC21.65	1.09	17	-	-	0.97	38
RC18.55	1.06	21	-	-	1.02	87
RC17.55	1.02	35	1.05214	67	0.97	41
RC17.05[4]	--	NA	--	NA	-	NA
RC13.9	1.13	58	1.07664	168	-	0
SRC0.15[5]	-		-		-	
Reservoirs						
Gem Lake	1.10	18	-	no fish observed	0.99	6
Agnew Lake	1.01	4	-	no fish observed	1.06	15

[1] Captured fish under 50mm in fork length were excluded from condition factor analysis.

[2] RBT = Rainbow Trout, BNT = Brook Trout, BRK = Brook Trout

[3] No rainbow trout were captured at this site.

[4] Snorkel only site. No individual weights were collected to calculate condition factors.

[5] Not sampled in 2023.

Table AQ 6-8. Reservoir Gillnetting Catch and Catch Per Unit Effort (CPUE)

Date	Total Nets Deployed	Total Deployment Hours	Average Hours per Net	Reservoir Totals		RBT[1]		BRK	
				Total Fish	Fish per net hour	Total Fish	Fish per net hour	Total Fish	Fish per net hour
Agnew Lake									
8/29-8/30/2023	4	76.7	19.2	19	0.25	4	0.05	15	0.20
Gem Lake									
8/28-8/29/2023	6	132.7	22.1	24	0.18	18	0.14	6	0.05

[1]RBT = Rainbow Trout; BRK = Brook Trout

Table AQ 6-9. Historical Comparison of Reservoir Gillnetting Catch and Catch Per Unit Effort (CPUE)

Year	Total Nets Deployed	Total Deployment Hours	Reservoir Totals		RBT[1]		BRK	
			Total Fish	Fish per net hour	Total Fish	Fish per net hour	Total Fish	Fish per net hour
Agnew Lake								
2023	4	76.7	19	0.25	4	0.05	15	0.20
2002	1	13.4	31	2.31	6	0.45	25	1.87
Gem Lake								
2023	6	132.7	24	0.18	18	0.14	6	0.05
2002	1	8	5	0.63	2	0.25	3	0.38

[1]RBT = Rainbow Trout; BRK = Brook Trout

Table AQ 6-10. Quantitative Measurements of Anthropogenic Passage Barriers

Barrier Name	RM	Barrier Type(s)	Leap Height (inches)	Minimum Depth (inches)	Plunge Pool Depth (inches)	Fish Passage Category
LADWP Gage Weir (Below Silver Lake)	13.67	Leap, Velocity	12	4	12	Potentially Passable
Upper Silver Lake Sediment Delta	16.5	Depth	NA	<6[a]	NA	Critical Riffle (Temporary)
Agnew Gage Wier	18.49	Leap, Depth, Velocity	30	2	36	Potentially Passable[b]
Agnew Dam (Notches)	18.6	Leap, Depth	36	1	12	Not Passable[b]
Upper Agnew Sediment Delta	19.1	Depth	NA	1	NA	Critical Riffle (Temporary)
Gem Dam	19.47	Dam[c]	NA	NA	NA	Not Passable
Rush Meadows Dam	22.25	Dam[c]	NA	NA	NA	Not Passable
Waugh Lakebed	23.5	Depth	NA	2	NA	Critical Riffle (Temporary)

[a] Minimum depths are dependent on lake surface elevation and were not observed in 2023.

[b] Fish access to these infrastructure barriers is restricted by natural barriers downstream.

[c] Primary water release points in Agnew and Waugh Dams are valves that are impassable to fish.

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FIGURES

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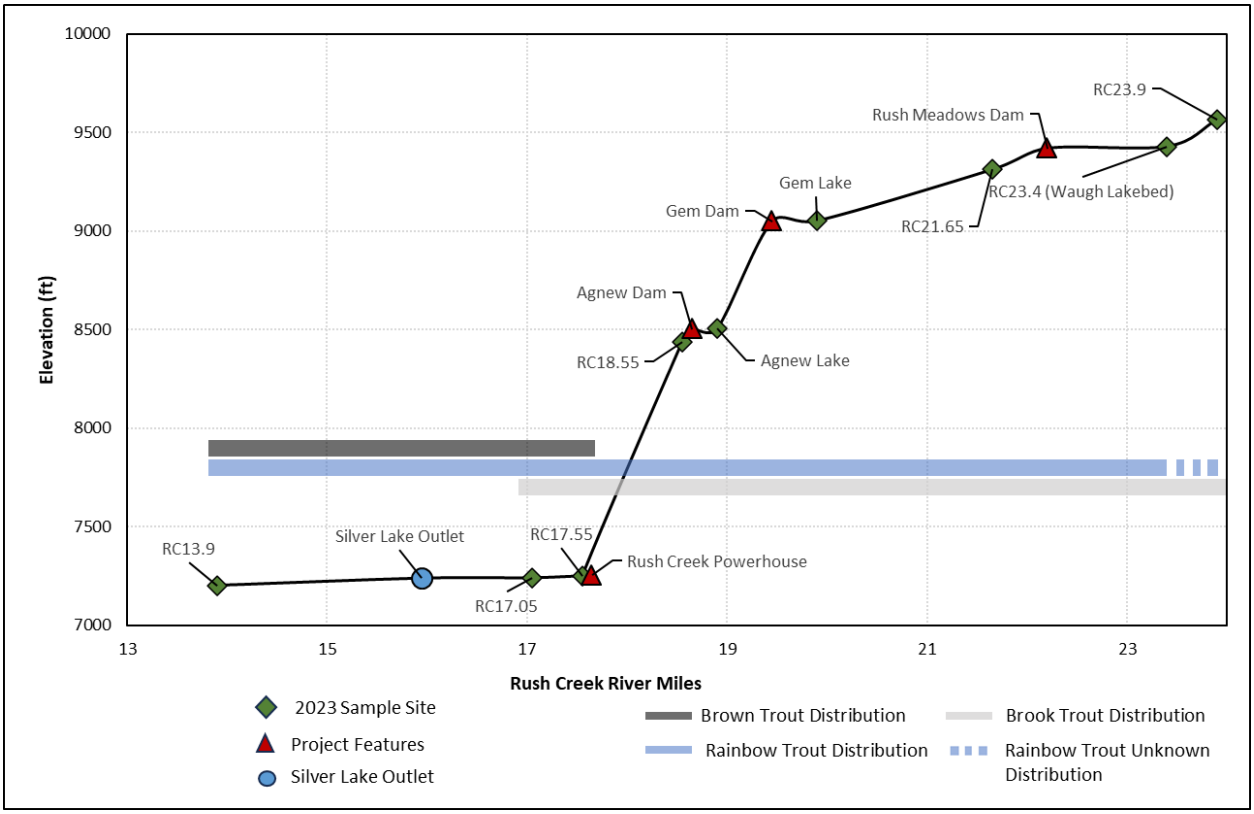
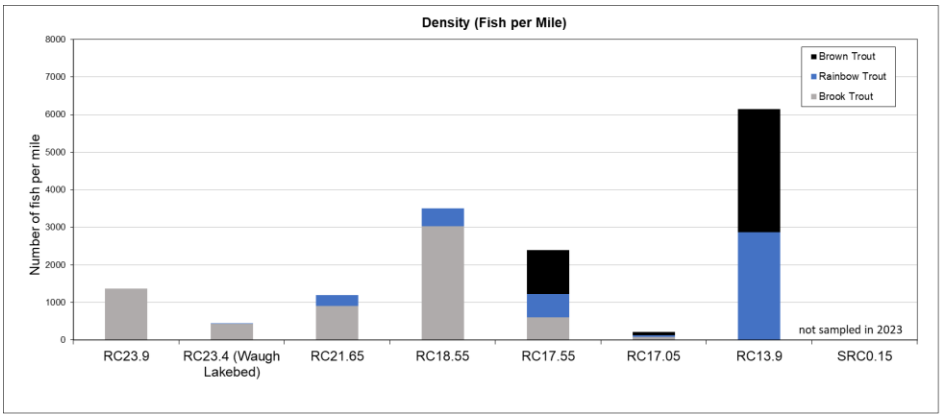
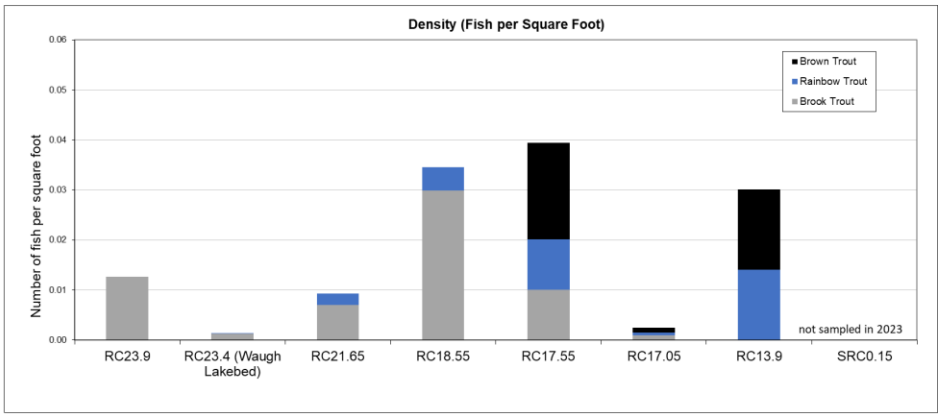
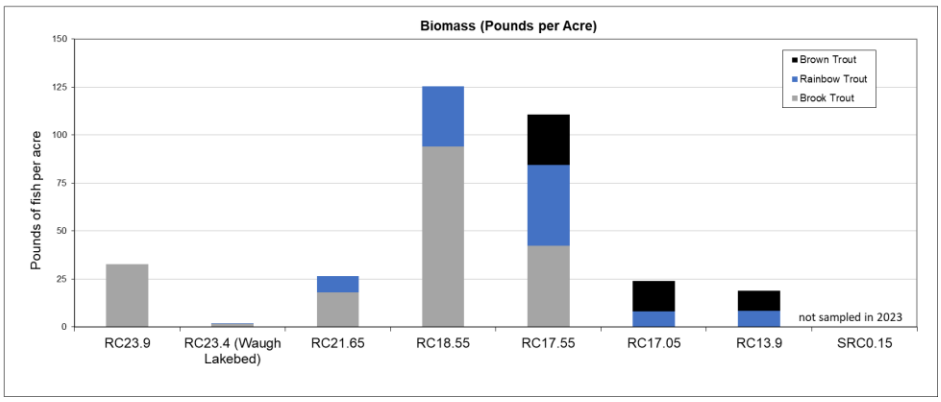


Figure AQ 6-1. Elevations of Sampling Sites on Rush Creek and Fish Species Distribution







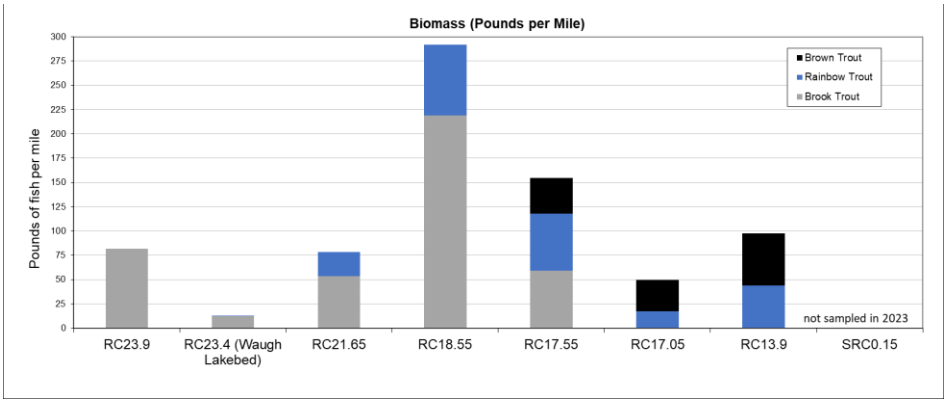


Figure AQ 6-2. Density and Biomass of Fish at Sampling Sites

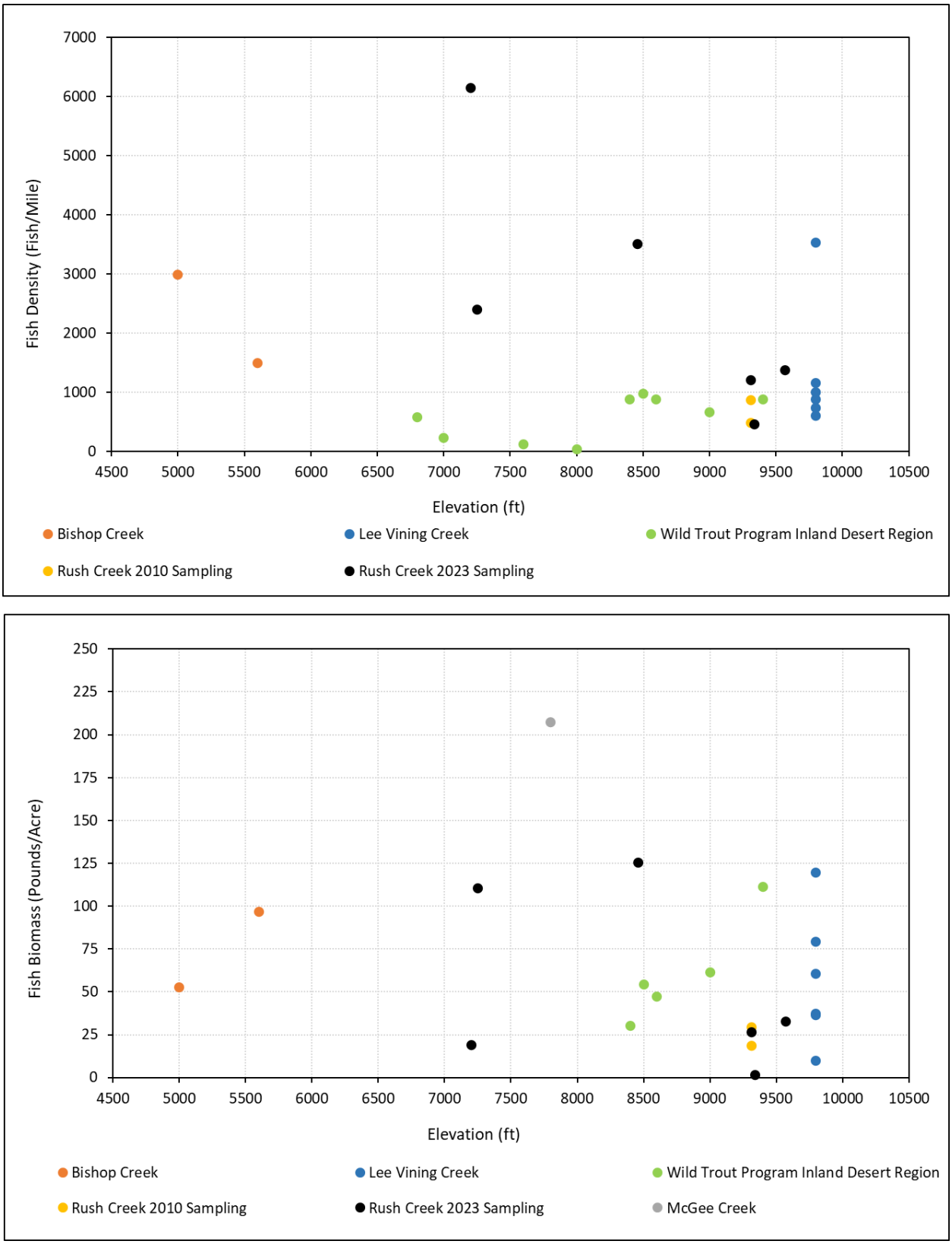


Figure AQ 6-3. Elevation vs. Fish per Mile (Top) and Elevation vs. Pounds per Acre (Bottom)

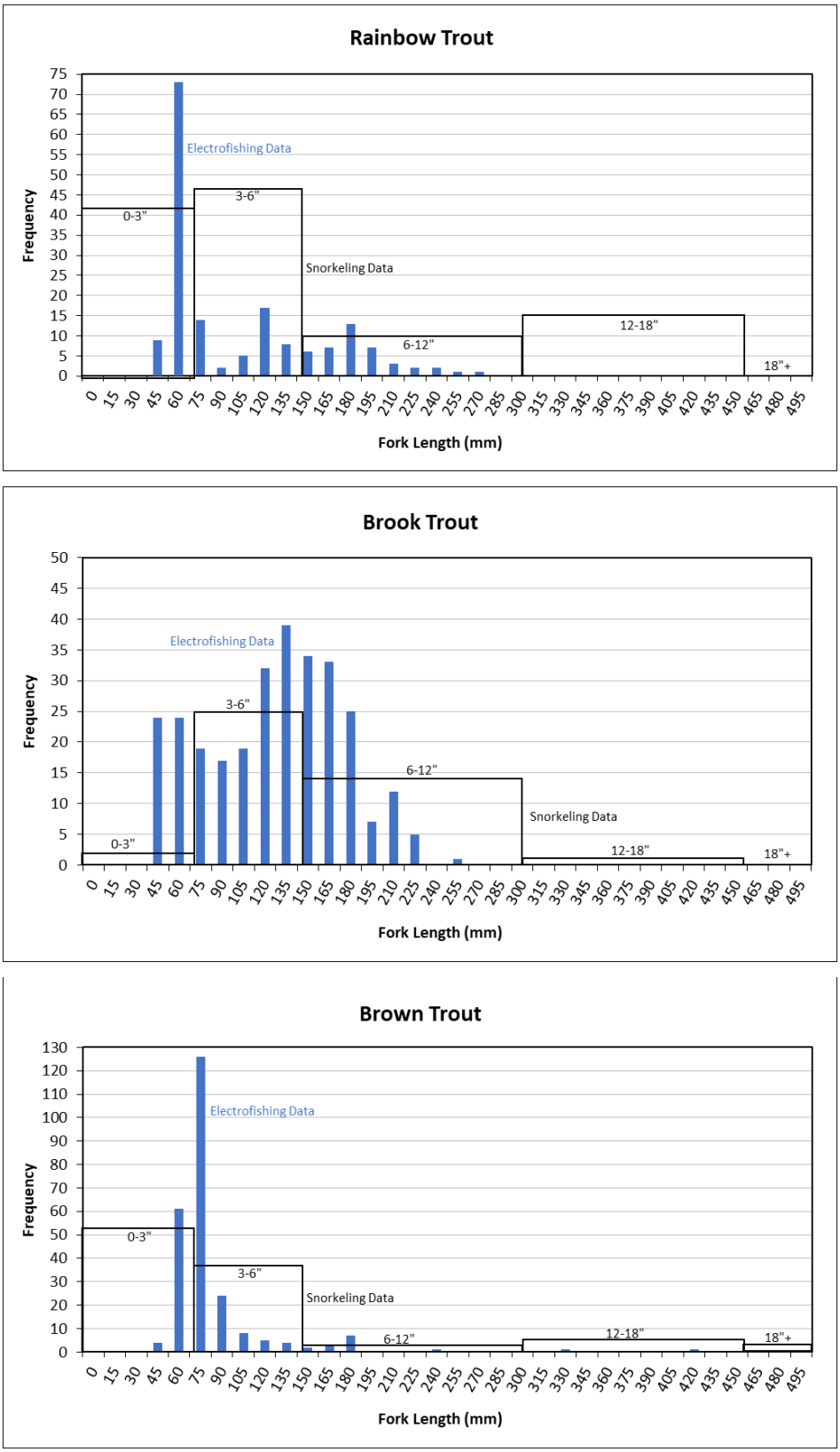


Figure AQ 6-4. Length Frequency Histograms for Each Species Captured During Electrofishing and Snorkeling at All Sampling Sites

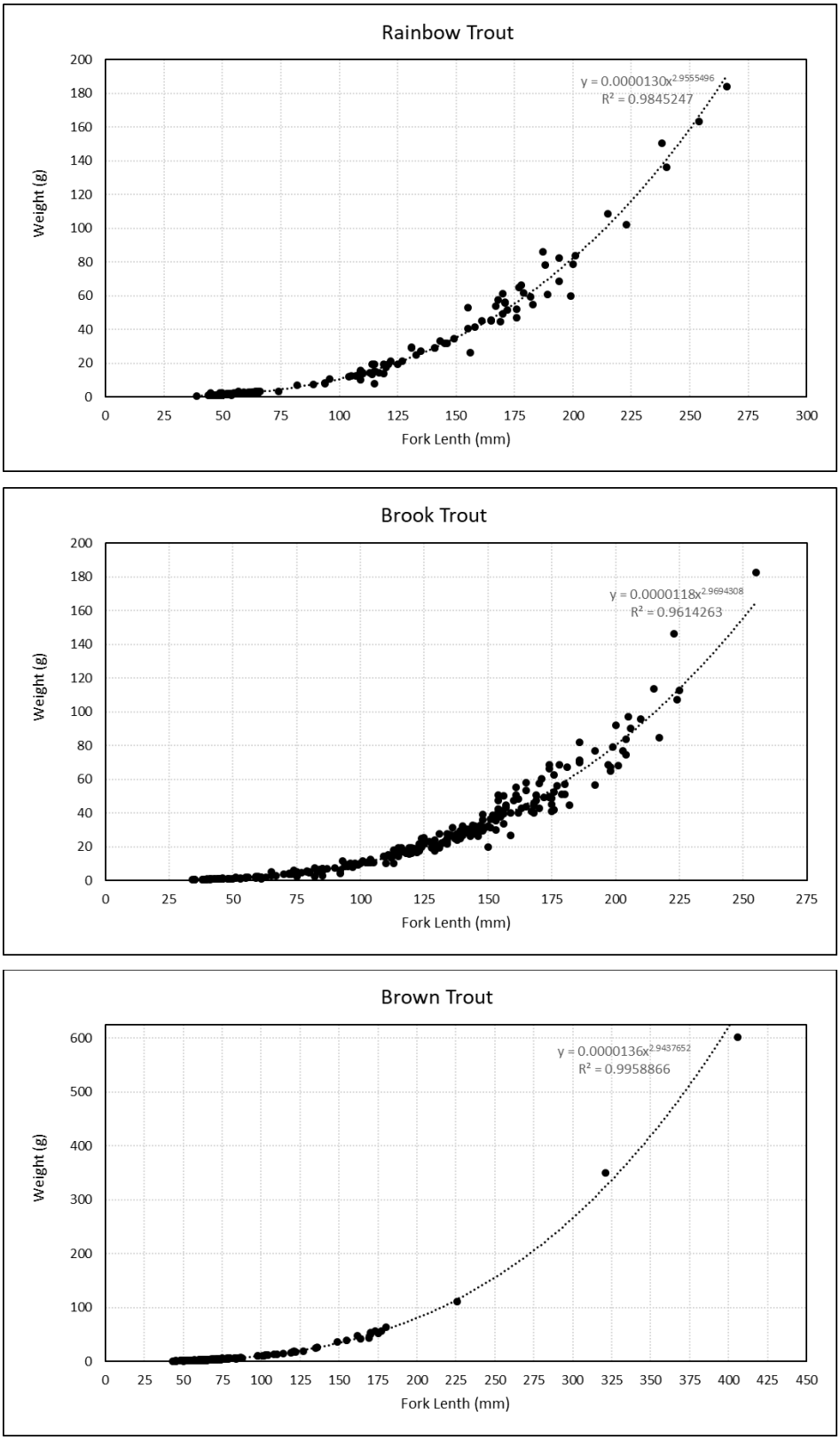


Figure AQ 6-5. Length and Weight Relationship for Each Species at All Sampling Sites

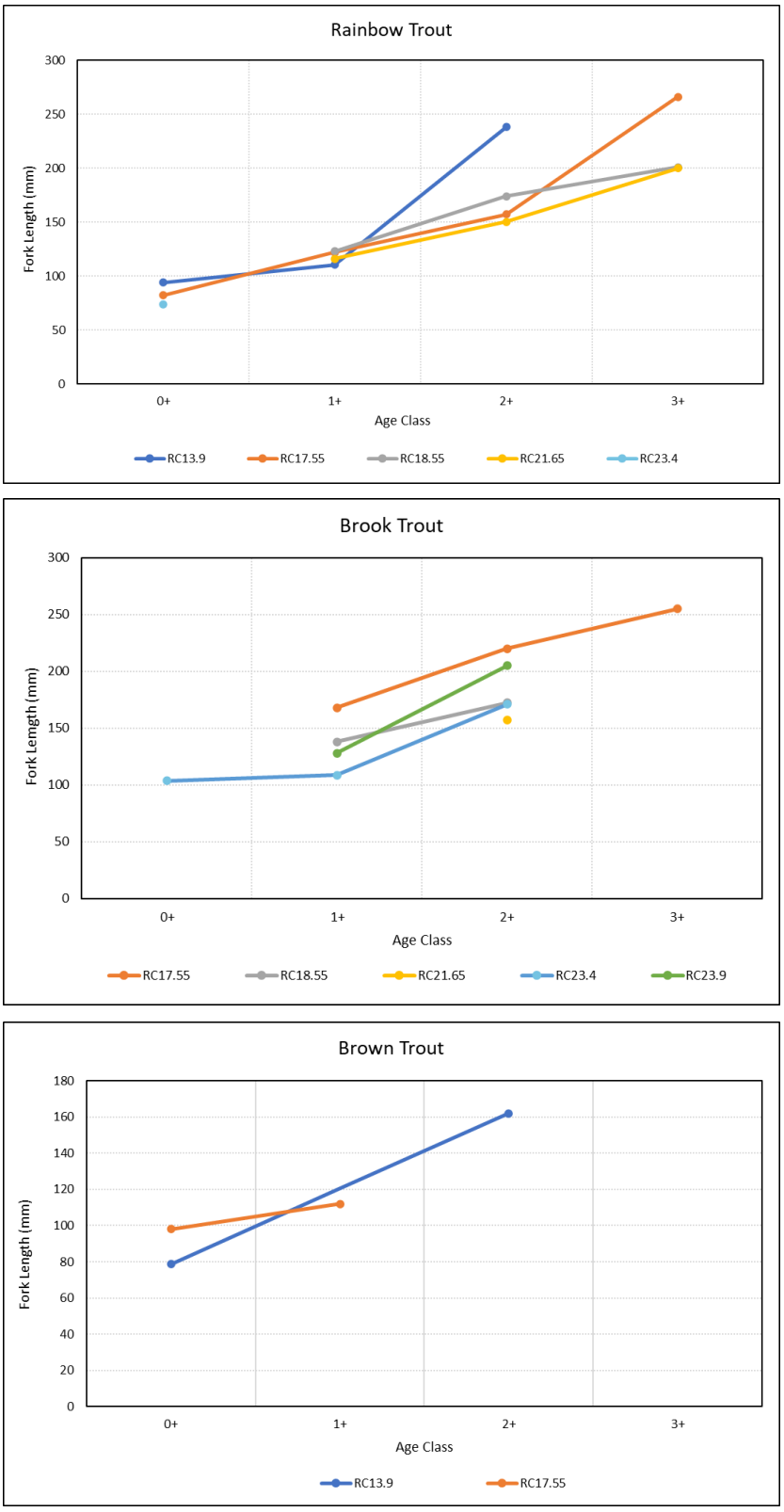
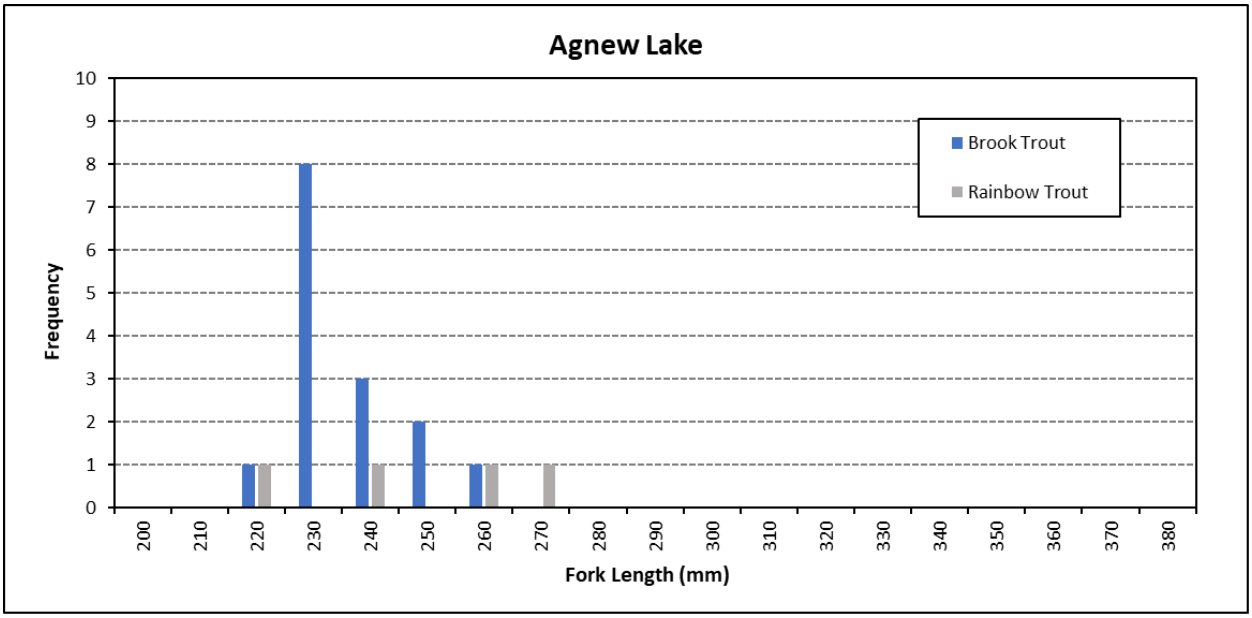


Figure AQ 6-6. Age and Growth Rates of Each Species for All Sampling Sites Combined Based on Scale Analysis



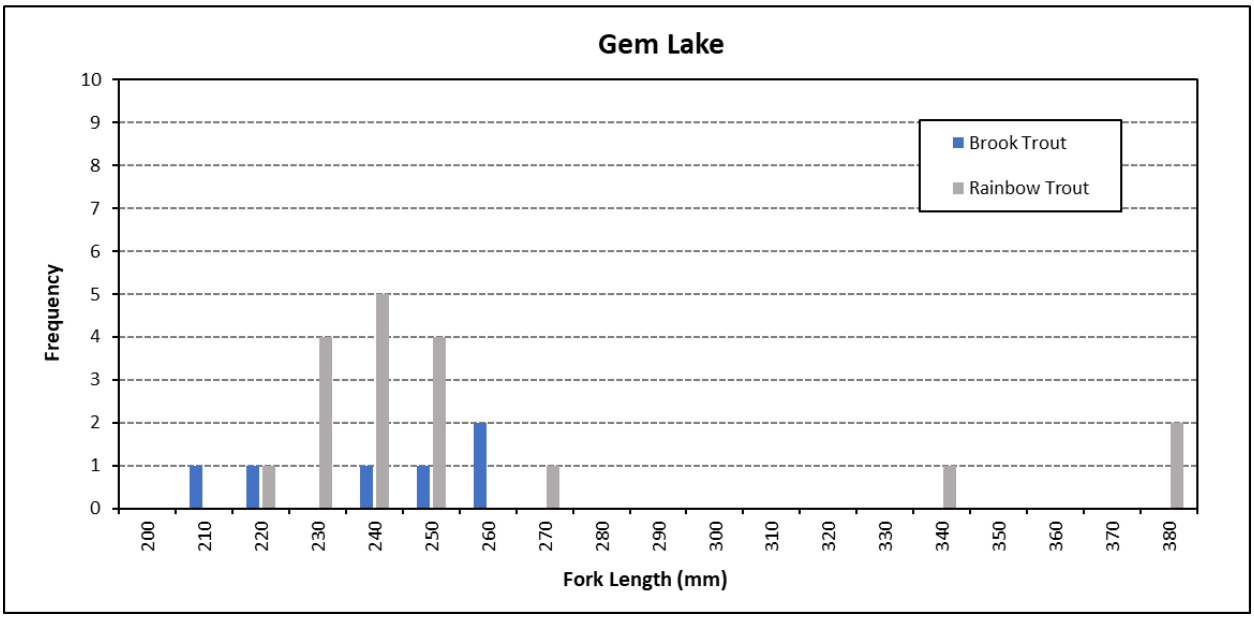


Figure AQ 6-7. Length Frequency Histogram of Fish Captured in Gem Lake and Agnew Lake during Gillnet Sampling

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MAPS

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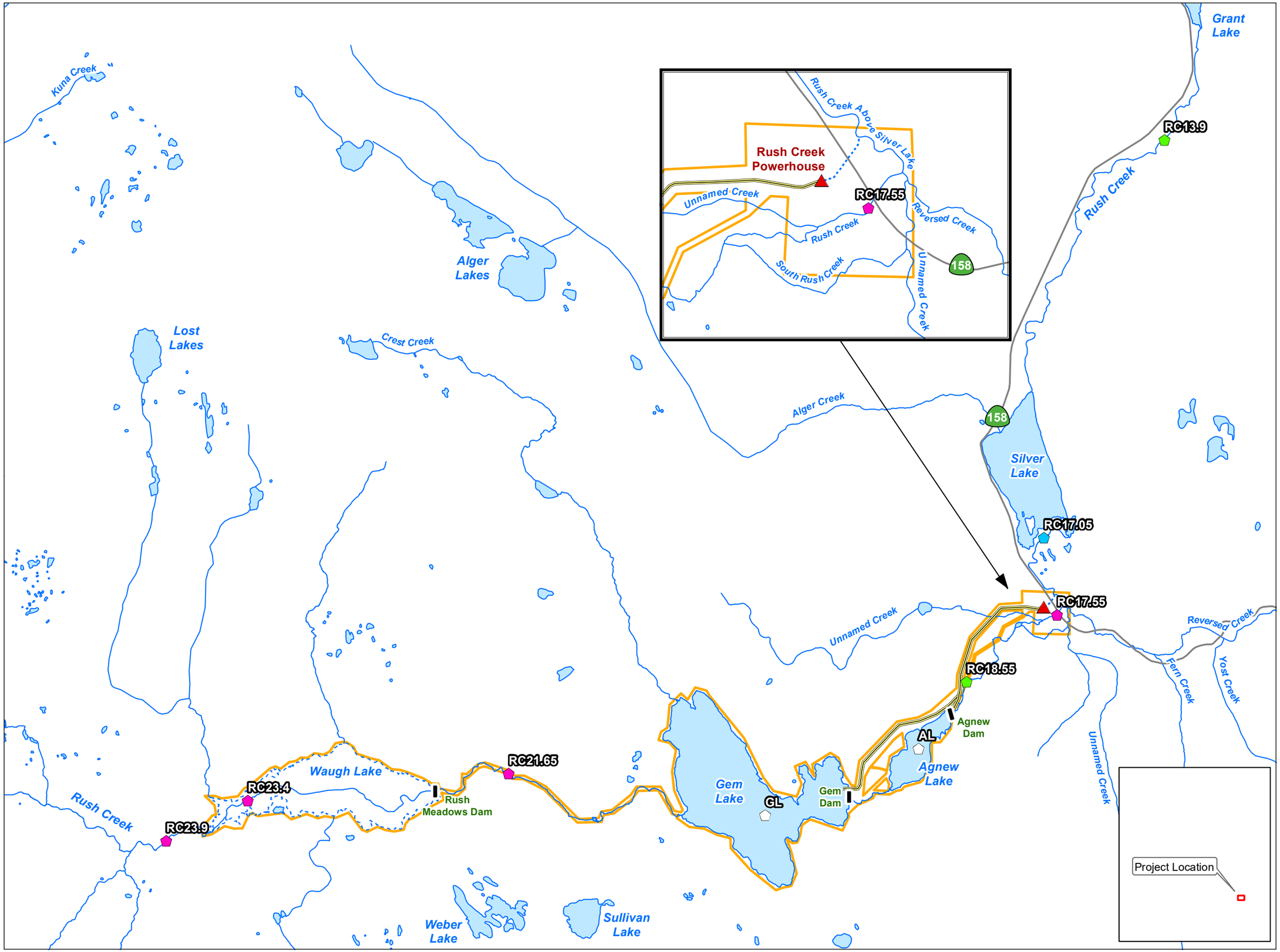

SCE Facilities
- Dam
- Powerhouse
- Flowline / Penstock
- Tailrace

Other Features
- Highway
- River/Stream
- Lake/Reservoir
- Dry Lake/Reservoir
- FERC Boundary

Sampling Locations
- Gill Net
- Electrofishing
- Electrofishing/Snorkeling
- Snorkeling

Rush Creek Project (FERC 1389)

Map AQ 6-1

Sampling Locations

0 0.25 0.5 Miles

Projection: UTM Zone 11
Datum: NAD 83

Date: 12/1/2023

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APPENDIX A
Fish Population Sampling Site Descriptions

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RUSH CREEK DOWNSTREAM OF SILVER LAKE

RC15.2

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	MCP	S	85.3	23.0	1,961.9	2.5	4.3	14.4%	9.1%
4	MCP	S	196.9	42.7	8,407.6	2.4	3.9	33.2%	38.9%
Total			*282.2*	--	*10,369.5*	--	--	*47.6%*	*48.0%*
Average			*141.1*	*32.9*	*5,184.8*	*2.5*	*4.1*	--	--
2	LGR	E	114.8	29.5	3,386.6	1.0	1.4	19.3%	15.7%
Total			*114.8*	--	*3,386.6*	--	--	*19.3%*	*15.7%*
3	HGR	E	59.1	26.2	1,548.4	1.7	2.8	9.9%	7.1%
Total			*59.1*	--	*1,548.4*	--	--	*9.9%*	*7.1%*
5	STR	E	137.7	45.9	6,320.4	0.7	2.0	23.2%	29.2%
Total			*137.7*	--	*6,320.4*	--	--	*23.2%*	*29.2%*
Grand Total			**593.8**	**--**	**21,624.9**	**--**	**--**	**100.0%**	**100.0%**

Notes: E = Electrofishing
HGR = High-Gradient Riffle
LGR = Low-Gradient Riffle
MCP = Mid-Channel Poo
S = Snorkeling
STR = Step Run

Photos of Representative Habitat Units

MCP

LGR

HGR

STR

RUSH CREEK UPSTREAM OF SILVER LAKE

RC17.05

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	MCP	S	168.0	17.0	2,856.0	5.0	7.0	14.3%	14.3%
Total			*168.0*	--	*2,856.0*	--	--	*14.3%*	*14.3%*
2	Run	S	181.0	17.0	3,077.0	5.0	7.0	15.5%	15.5%
Total			*181.0*	--	*3,077.0*	--	--	*15.5%*	*15.5%*
3	CRP	S	377.0	17.0	6,409.0	5.0	7.0	32.2%	32.2%
Total			*377.0*	--	*6,409.0*	--	--	*32.2%*	*32.2%*
4	CRP/Run	S	244.0	17.0	4,148.0	5.0	7.0	20.8%	20.8%
Total			*244.0*	--	*4,148.0*	--	--	*20.8%*	*20.8%*
5	LSP/CRP	S	201.0	17.0	3,417.0	5.0	7.0	17.2%	17.2%
Total			*201.0*	--	*3,417.0*	--	--	*17.2%*	*17.2%*
Grand Total			**1,171.0**	**--**	**19,907.0**	**--**	**--**	**100.0%**	**100.0%**

Notes CRP = Corner Pool
LSP = Lateral Scour Pool
MCP = Mid-channel Pool
S = Snorkeling

Photos of Representative Habitat Units

CRP/Run

Run

RUSH CREEK ABOVE SILVER LAKE NEAR POWERHOUSE AND US HWY 158

RC17.55

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	HGR	E	59.1	10.5	620.6	0.4	1.1	16.7%	15.2%
5	HGR	E	82.0	13.1	1,074.2	0.8	1.7	23.2%	26.3%
Total			*141.1*	--	*1,694.8*	--	--	*39.9%*	*41.5%*
Average			*70.6*	*11.8*	*847.4*	*0.6*	*1.4*	--	--
3	LGR	E	91.9	11.5	1,056.9	0.8	1.8	25.9%	25.9%
Total			*91.9*	--	*1,056.9*	--	--	*25.9%*	*25.9%*
2	Run/MCP	E	82.0	11.5	943.0	1.0	3.5	23.1%	23.1%
Total			*82.0*	--	*943.0*	--	--	*23.1%*	*23.1%*
4	STP	E	39.4	9.8	386.1	1.0	1.7	11.1%	9.5%
Total			*39.4*	--	*386.1*	--	--	*11.1%*	*9.5%*
Grand Total			**354.4**	**--**	**4,080.8**	**--**	**--**	**100%**	**100%**

Notes: E = Electrofishing
HGR = High-Gradient Riffle
LGR = Low-Gradient Riffle
Run/MCP = Run and Mid-channel Pool
STP = Step Pool

Photos of Representative Habitat Units

HGR

LGR

STP

Run/MCP

RUSH CREEK BELOW AGNEW DAM

RC18.55

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	PLP	S	59.1	45.9	2,712.7	5.5	7.6	15.9%	38.0%
4	PLP	S	55.8	17.4	970.9	4.0	6.2	15.1%	13.6%
Total			*114.9*	--	*3,683.6*	--	--	*31.0%*	*51.6%*
Average			*57.5*	*31.7*	*1,841.8*	*4.75*	*10.7*	--	--
2	LGR	E	101.7	11.5	1,169.6	0.5	0.8	27.4%	16.4%
Total			*101.7*	--	*1,169.6*	--	--	*27.4%*	*16.4%*
3	Run	E	154.2	14.8	2,282.2	0.5	1.0	41.6%	32.0%
Total			*154.2*	--	*2,282.2*	--	--	*41.6%*	*32.0%*
Grand Total			**370.8**	**--**	**7,135.4**	**--**	**--**	**100.0%**	**100.0%**

Notes: E = Electrofishing
LGR = Low-Gradient Riffle
PLP = Plunge Pool
S = Snorkeling

Photos of Representative Habitat Units

Plunge Pool

Run

RUSH CREEK BELOW RUSH MEADOWS DAM

RC21.65

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	HGR	E	114.8	29.5	3,386.6	0.8	1.7	37.2%	44.9%
3	HGR	E	72.2	24.0	1,732.8	1.6	2.6	23.4%	23.0%
Total			*187.0*	--	*5,119.4*	--	--	*60.6%*	*67.9%*
Average			*93.5*	*26.8*	*2,559.7*	*1.2*	*2.2*	--	--
2	MCP	E	65.6	20.7	1,357.9	2.6	3.5	21.3%	18.0%
Total			*65.6*	--	*1,357.9*	--	--	*21.3%*	*18.0%*
4	STP	E	55.8	19.0	1,060.2	2.3	2.9	18.1%	14.1%
Total			*55.8*	--	*1,060.2*	--	--	*18.1%*	*14.1%*
Grand Total			**308.4**	**--**	**7,537.5**	**--**	**--**	**100.0%**	**100.0%**

Notes: E = Electrofishing
HGR = High-Gradient Riffle
MCP = Mid-channel Pool
STP = Step Pool

Photos of Representative Habitat Units

HGR

MCP

STP

RUSH CREEK WAUGH LAKEBED

RC23.0

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	LGR	E	328.1	64.6	21,195.3	0.3	2.0	100%	100 %
Grand Total			**328.1**	**--**	**21,195.3**	**--**	**--**	**100.0%**	**100.0%**

Notes: E = Electrofishing
LGR = Low-Gradient Riffle

Photos of Representative Habitat Units:

LGR

RUSH CREEK ABOVE WAUGH LAKE

RC23.9

2023 Sampled Mesohabitat Units

Unit Number	Unit Type	Sampling Method	Length (ft)	Width (ft)	Unit Area (ft^2)	Mean Depth (ft)	Max Depth (ft)	% of Total Survey Length	% of Total Survey Area
1	MCP	E	65.6	19.7	1,292.3	1.5	4.5	21.5%	20.6%
Total			*65.6*	--	*1,292.3*	--	--	*21.5%*	*20.6%*
2	STP	E	65.6	21.3	1,397.3	1.2	2.0	21.5%	22.3%
Total			*65.6*	--	*1,397.3*	--	--	*21.5%*	*22.3%*
3	LGR	E	88.6	21.3	1,887.2	0.4	2.0	29.0%	30.2%
Total			*88.6*	--	*1,887.2*	--	--	*29.0%*	*30.2%*
4	HGR	E	85.3	19.7	1,680.4	0.5	2.0	28.0%	26.9%
Total			*85.3*	--	*1,680.4*	--	--	*28.0%*	*26.9%*
Grand Total			**305.1**	**--**	**6,257.2**	**--**	**--**	**100.0%**	**100.0%**

Notes: E = Electrofishing
HGR = High-Gradient Riffle
LGR = Low-Gradient Riffle
MCP = Mid-channel Pool
STP = Step Pool

Photos of Representative Habitat Units

MCP

STP

LGR

HGR

SOUTH RUSH CREEK

South Rush Creek was dry in September 2023 and not sampled.

Photos of Representative Habitat Units

Dry Riverbed

Dry Riverbed

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APPENDIX B
Reservoir Gillnet Sampling Details

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Table B-1. Fish Population Reservoir Study Site Locations and Gillnet Deployment Details.

Study Site	Net Deployment Location (UTM)[1]		Deployment		Retrieval		Net Type	Net Depth (ft)	Total Deployment Time (hrs)
	Easting	Northing	Date	Time	Date	Time			
Agnew Lake									
AL-1H[2]	311926	4180960	8/29/2023	2:40 PM	8/30/2023	9:55 AM	Horizontal	0-16	19.25
AL-1V	311904	4180916	8/29/2023	3:10 PM	8/30/2023	9:40 AM	Vertical	0-80	18.50
AL-2H	311779	4180768	8/29/2023	3:30 PM	8/30/2023	11:20 AM	Horizontal	0-20	19.83
AL-2V	311914	4180745	8/29/2023	4:00 PM	8/30/2023	11:05 AM	Vertical	0-65	19.08
Gem Lake									
GL-1H	311249	4180598	8/28/2023	11:20 AM	8/29/2023	10:03 AM	Horizontal	0-40	22.72
GL-1V	311126	4180548	8/28/2023	11:59 AM	8/29/2023	9:48 AM	Vertical	0-125	21.82
GL-2H	310652	4180377	8/28/2023	12:40 PM	8/29/2023	11:10 AM	Horizontal	0-12	22.50
GL-2V	310566	4180344	8/28/2023	1:23 PM	8/29/2023	10:59 AM	Vertical	0-185	21.60
GL-3H	309976	4180339	8/28/2023	1:45 PM	8/29/2023	12:05 PM	Horizontal	0-35	22.33
GL-3V	309960	4180412	8/28/2023	2:10 PM	8/29/2023	11:55 AM	Vertical	0-110	21.75

[1] Universal Transverse Mercator Zone 11 South, North American Datum 1983
[2] See Appendix B, Map B-1 and B-2.

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SCE Facilities

- Dam
- Flowline / Penstock
- Stream Gage
- Reservoir Gage
- Tramway
- FERC Boundary

Other Features

- River/Stream
- Lake

Gill Net Locations

- Horizontal Nets
- Vertical Nets

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Rush Creek Project (FERC 1389)

Map B-1

Fish Population Study Gill Net Locations
Gem Lake

0 125 250 500 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 11/28/2023

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SCE Facilities

- Dam
- Flowline / Penstock
- Stream Gage
- Reservoir Gage
- Tramway
- FERC Boundary

Other Features

- River/Stream
- Lake

Gill Net Locations

- Horizontal Nets
- Vertical Nets

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Rush Creek Project (FERC 1389)

Map B-2

Fish Population Study Gill Net Locations
Agnew Lake

0 125 250 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 11/28/2023

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Table B-2. Summary of Fish Species Captured During Reservoir Gillnetting.

Date	Study Site	Total Soaking Time (hrs.)	Number of Fish[1] Captured	
			RBT	BRK
Agnew Lake				
8/30/2023	AL-1H	19.25	2	10
	AL-1V	18.50	-	-
	AL-2H	19.83	2	5
	AL-2V	19.08	-	-
	Total	**76.66**	**4**	**15**
Gem Lake				
8/29/2023	GL-1H	22.72	7	-
	GL-1V	21.82	-	-
	GL-2H	22.50	4	1
	GL-2V	21.60	-	-
	GL-3H	22.33	6	4
	GL-3V	21.75	1	1
	Total	**132.72**	**18**	**6**

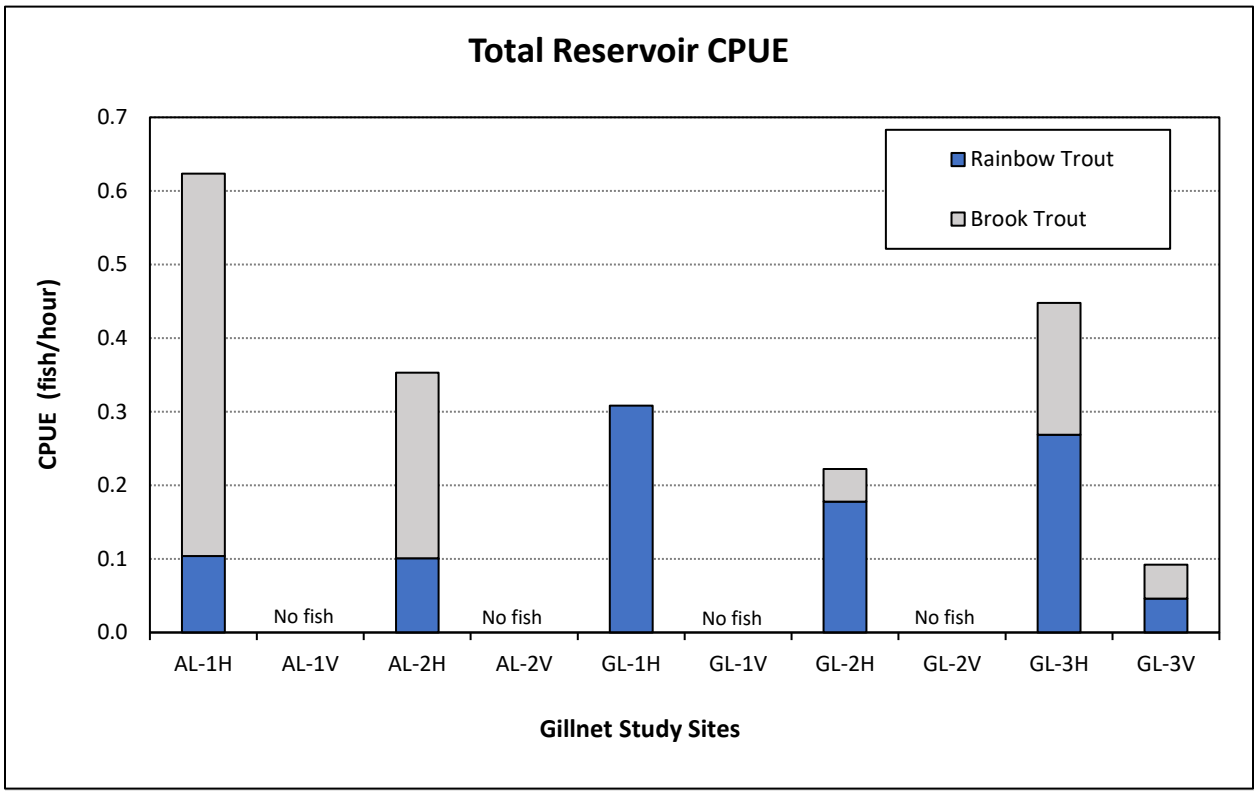
[1] RBT = Rainbow Trout, BRK = Brook Trout

Table B-3. Catch per Unit Effort for Reservoir Gillnetting.

Date	Study Site	Total Soaking Time (hrs.)	Number of Fish[1] Captured / Net Hour	
			RBT	BRK
Agnew Lake				
8/30/2023	AL-1H	19.25	0.10	0.52
	AL-1V	18.50	-	-
	AL-2H	19.83	0.10	0.25
	AL-2V	19.08	-	-
	Total	76.66	0.05	0.20
Gem Lake				
8/29/2023	GL-1H	22.72	0.31	-
	GL-1V	21.82	-	-
	GL-2H	22.50	0.18	0.04
	GL-2V	21.60	-	-
	GL-3H	22.33	0.27	0.18
	GL-3V	21.75	0.05	0.05
	Total	132.72	0.14	0.05

[1] RBT = Rainbow Trout, BRK = Brook Trout

Figure B-1. Gillnetting Catch Per Unit Effort (CPUE) (Fish per Hour) for Fish Species in Gem Lake and Agnew Lake.



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APPENDIX C
Fish Barriers and Migration

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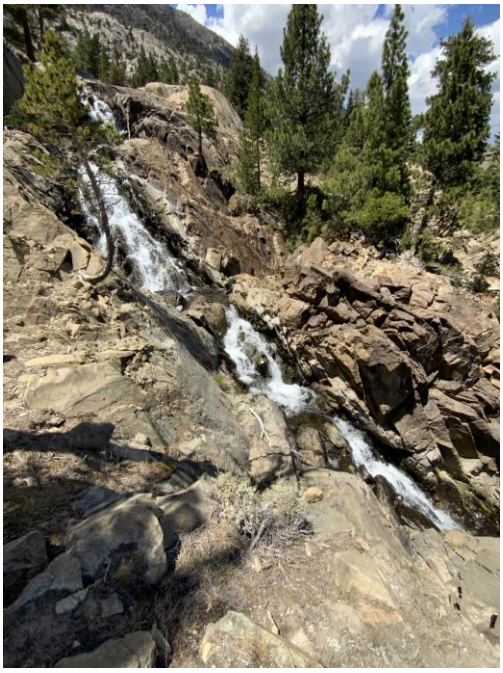
FP1 (Gage Weir Downstream of Silver Lake) – This is a compound barrier consisting of a cascade (top left, bottom left) and a flat weir spillway (top right, bottom right). A combination of velocity, depth, and vertical leap barriers limits passage of some fish species and life stages under some flow conditions. Stadia rod is shown for scale. The weir spillway consists of an approximately 1-foot drop over a flat crest into a concrete apron with approximately 1-foot water depth at the pictured flow (bottom right). Water depth immediately above the weir is approximately 0.5 feet (top right).

FP2 (Silver Lake Inflow Sediment Delta) – The sediment delta occurring where Rush Creek enters Silver Lake may present a depth barrier when low lake levels combine with low creek flows. A depth barrier is most likely to occur when lake surface elevation approaches 7,220.5 feet. The aerial image above shows the sediment delta and bathymetry points measured using high-precision global positioning system (GPS) survey equipment.

Highway 158 Crossing – Analysis indicates this culvert crossing does not present a barrier to fish movement.



FP3 (Horsetail Falls Barrier Reach) – The downstream end of this barrier reach occurs at a log jam in Rush Creek near the Rush Creek Powerhouse with a waterfall a short distance upstream (left photo). The reach is dominated by cascades, chutes, and waterfalls (right photo). The largest waterfall in the reach is Horsetail Falls. This barrier reach extends upstream to just below the Agnew Gage Weir.

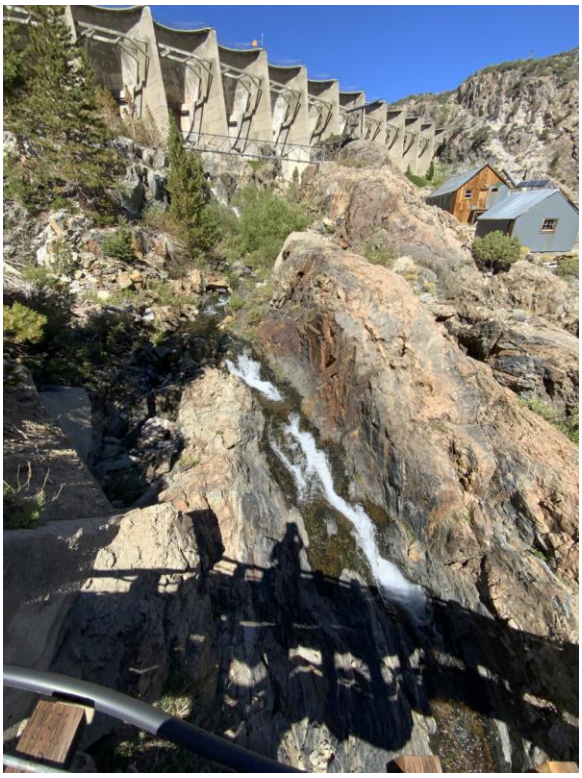
FP4 (Agnew Gauge Weir) – Similar to the gauge below Silver Lake, this is a compound barrier consisting of a concrete spillway with multiple flat spill edges. A combination of velocity, depth, and vertical leap barriers limits passage of some fish species and life stages under some flow conditions. Analysis indicates the drop height (2.5 feet with 2- to 3-foot-deep plunge pool) is within the leap abilities of only adult trout, and the shallow (approximately 2 inches), high-velocity spillway lip prevents passage of adult trout under low-flow conditions and juvenile trout under all conditions. This barrier is potentially passable for adult trout only under certain flow conditions. The presence of natural barriers a short distance below this barrier may prevent trout from accessing the Agnew Gage Weir from downstream.

FP5A (Cascade below Agnew Dam Outlets) – An approximately 13-foot-high cascade barrier, shown with 25-foot rod for size reference, occurs immediately below Agnew Dam. This cascade prevents fish from reaching the base of Agnew Dam. Brook trout were observed in the field attempting, and failing, to ascend this barrier.

FP5B (Agnew Dam Outlets) – The two outlets created in 2017 consist of a 2.5-foot drop over a square edge into an approximately 1-foot-deep plunge pool at the flow pictured. Depth of flow through the outlets is approximately 1 inch. The outlets could present potential depth and vertical leap barriers to fish. However, access to the outlets is blocked by a cascade barrier downstream.

FP6 (Agnew Lake Inflow Sediment Delta) – At low flows, occurring during the late summer and autumn, the sediment delta at the upper end of Agnew Lake may contain depth barriers. A critical riffle with 1 inch of water depth is pictured in August. This seasonal depth barrier is more likely to impact autumn spawners such as brook trout.

FP6–FP7 (Agnew–Gem Barrier Reach) – The reach upstream of the Agnew Lake sediment delta is dominated by cascades, chutes, and waterfalls upstream to the foot of Gem Dam. Fish occur in plunge pools, but numerous barriers prevent upstream migration.



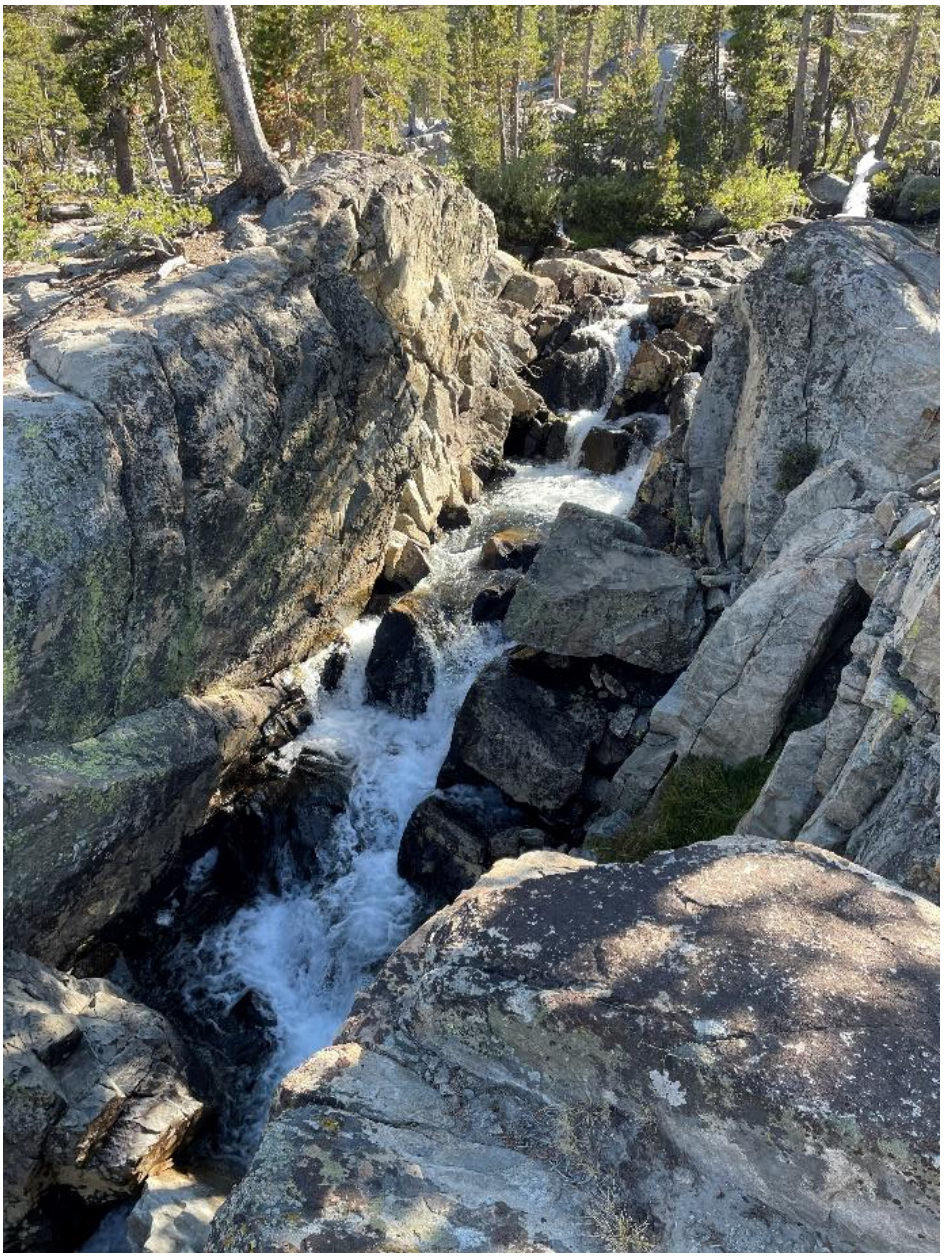
FP7 (Gem Dam) – Gem Dam represents a complete barrier to migration. Low-level release valves in the dam are not passable. However, numerous barriers in the high-gradient reach downstream of the dam prevent fish from accessing the downstream side of the dam.

FP8 (Cascade/Waterfall at Gem Lake Inflow) – A steep cascade/waterfall feature occurs at the upper end of Gem Lake where Rush Creek enters the lake. The size of the falls is dependent on the lake level, but generally the falls encompass over 100 feet of stream, with some near-vertical sections.

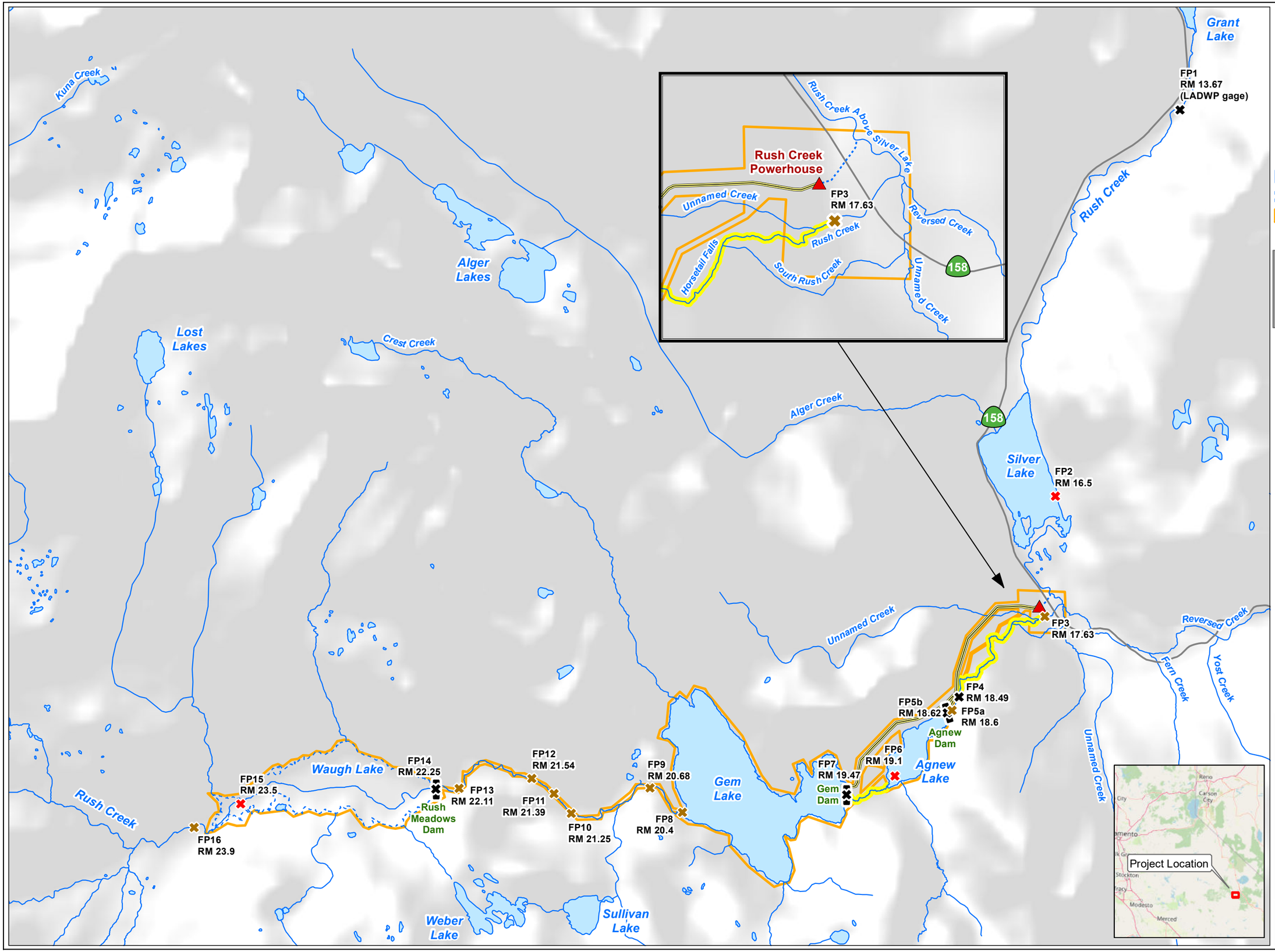
FP9–FP13 (Barriers in Rush Meadows Reach) – Multiple naturally occurring barriers, including cascades, chutes, and waterfalls, exist in the reach between Rush Meadows Dam and Gem Lake. Five barriers were mapped from FP9 (top left) to FP13 (bottom right), but other smaller partial barriers also exist within the reach.

FP14 (Waugh Dam) – Waugh Dam represents a complete barrier to migration.

FP15 (Waugh Lakebed Critical Riffles) – Rush Creek meanders through the Waugh Lakebed in sinuous, braided channels. In some locations, these channels form wide, shallow riffles that may represent depth barriers at low flows. The critical riffle pictured is approximately 2 inches deep. Critical riffles occurring in the late summer or autumn are more likely to present barriers to autumn-spawning species such a brook trout.



FP16 (Cascades Upstream of Waugh Lake) – High-gradient cascade reaches occur upstream of Waugh Lake, above the reservoir's influence. These high-gradient reaches prevent or limit migration.



SCE Facilities

- Dam
- Powerhouse
- Flowline / Penstock
- Tailrace

Other Features

- Highway
- River/Stream
- Lake/Reservoir
- Dry Lake/Reservoir
- FERC Boundary

Fish Passage Barrier Assessment*

- Infrastructure Barrier
- Natural Barrier
- Critical Riffle
- Barrier Reaches

*Includes barriers quantified as impassable and potentially impassable.

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Rush Creek Project (FERC 1389)

Map C-1

Fish Passage Barrier Locations

0 0.25 0.5 Miles

Projection: UTM Zone 11
Datum: NAD 83

Date: 7/8/2024

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APPENDIX D
Fish Population Sampling Data

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Table D-1. Summary of Fish Sampled at Stream Sampling Sites.

Sampling Site	Date	Sample Type	Species		
			RBT	BNT	BRK
RC23.9	9/26/2023	E	0	-	77
RC23.4 (Waugh Lakebed)	9/26/2023	E	1	-	25
RC21.65	9/25/2023, 9/27/2023	E	17	-	38
RC18.55	9/27/2023	E	23	-	110
		S	9	-	40
RC17.55	9/29/2023	E	39	75	41
RC17.05	9/29/2023	S	12	18	2
RC13.9	9/28/2023	E	0	172	0
		S	83	77	0
SRC0.15	NA	-	-	-	-

Notes: BNT = Brown Trout
BRK = Brook Trout
E = Electrofishing
NA = Not sampled in 2023.
RBT = Rainbow Trout
S = Snorkeling

Table D-2. Average Length and Number of Scale-Aged Trout at Stream Sampling Sites.

Sampling Site	Average Length in Millimeters at Age (sample size)											
	Rainbow Trout				Brown Trout				Brook Trout			
	0+	1+	2+	3+	0+	1+	2+	3+	0+	1+	2+	3+
RC23.9	0	0	0	0	-	-	-	-	0	128 (9)	205 (1)	0
RC23.4 (Waugh Lakebed)	74 (1)	0	0	0	-	-	-	-	104 (3)	109 (4)	171 (3)	0
RC21.65	0	116 (7)	150 (6)	200 (2)	-	-	-	-	0	122 (6)	157 (4)	0
RC18.55	0	123 (3)	174 (2)	201 (2)	-	-	-	-	0	138 (2)	172 (3)	0
RC17.55	82 (1)	122 (3)	157 (2)	266 (1)	98 (2)	112 (4)	0	0	98 (2)	112 (4)	0	0
RC13.9	94 (1)	111 (2)	238 (1)	0	79 (9)	0	162 (1)	0	-	-	-	-

APPENDIX E
Length Frequency Histograms

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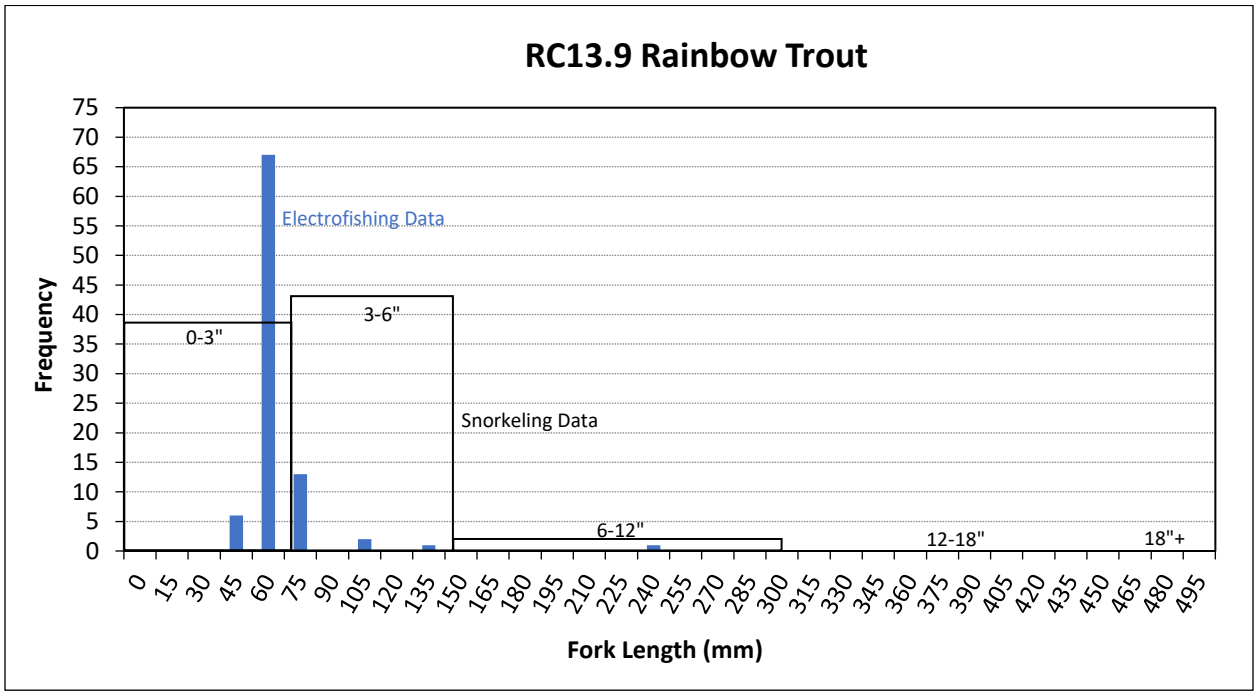
Figure E-1. Length Frequency Histograms for Rainbow Trout and Brown Trout Observed during Electrofishing and Snorkel Sampling at RC13.9, below Silver Lake.



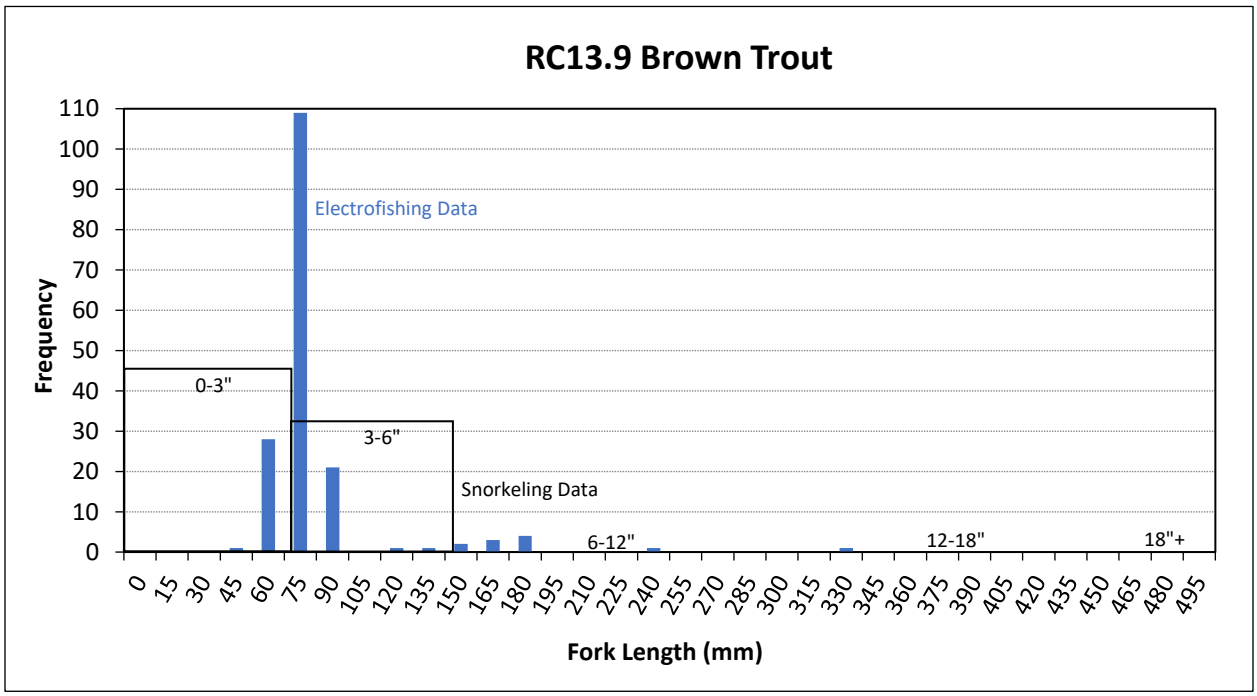
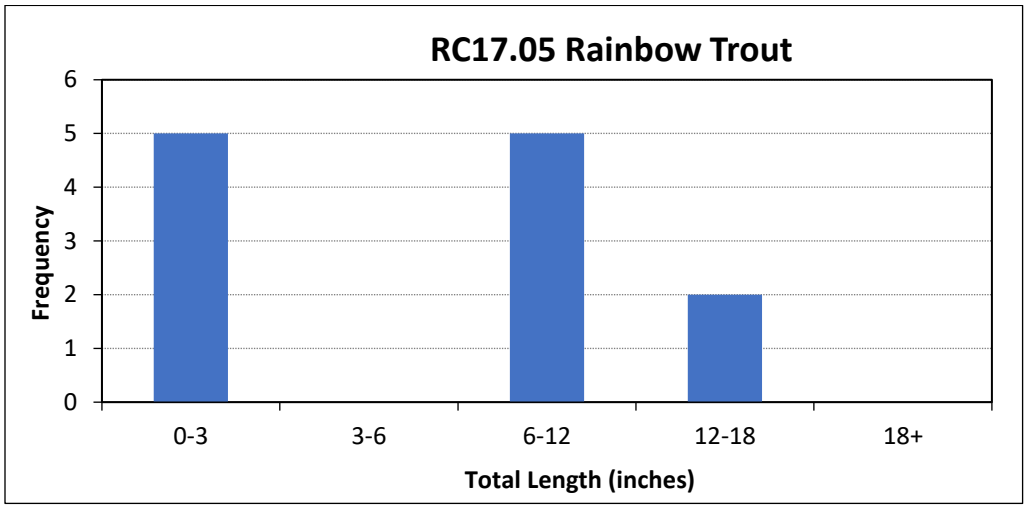
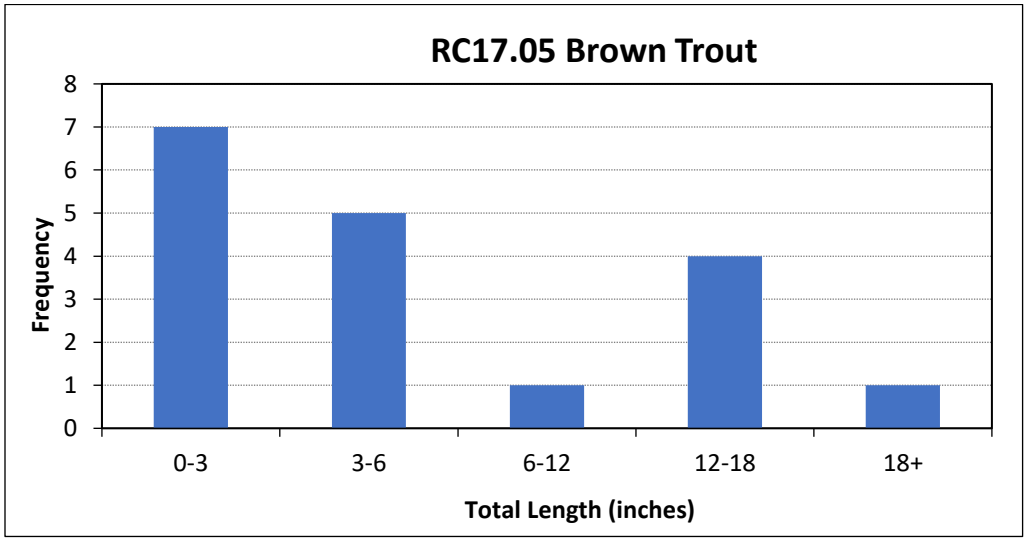


Figure E-2. Length Frequency Histograms for Rainbow Trout, Brook Trout, and Brown Trout Observed during Snorkel Sampling at RC17.05, above Silver Lake.





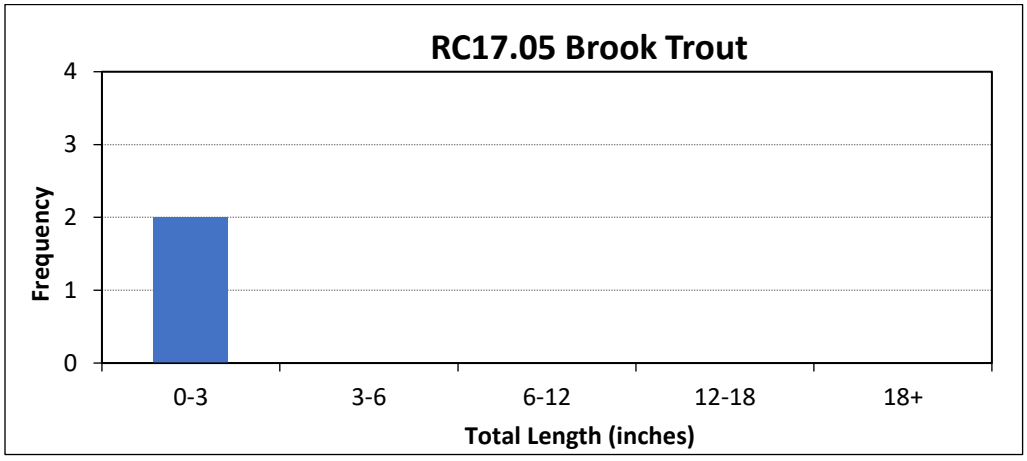
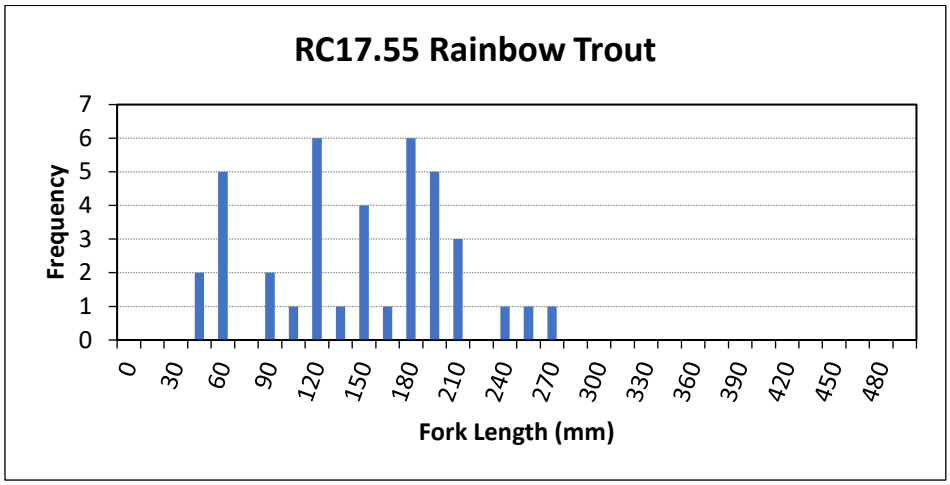
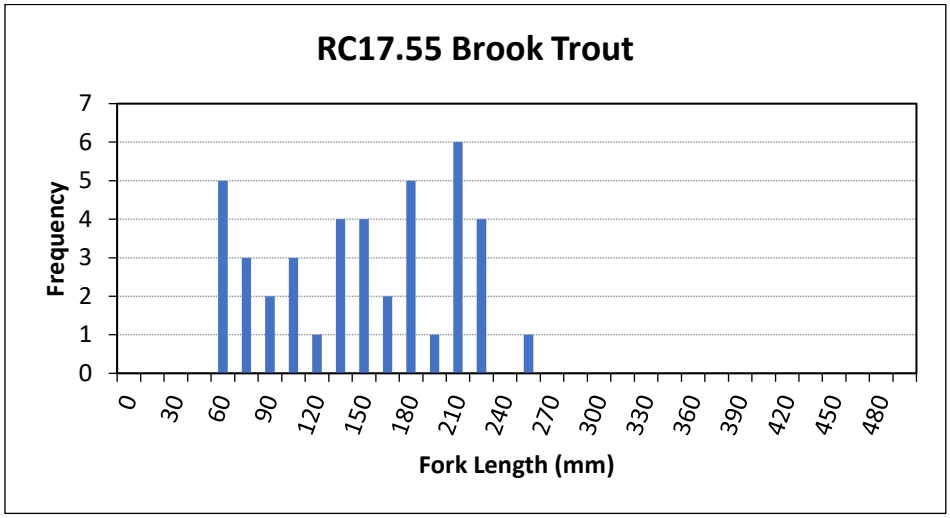


Figure E-3. Length Frequency Histograms for Rainbow Trout, Brook Trout, and Brown Trout Observed during Electrofishing Sampling at RC17.55, above Silver Lake.





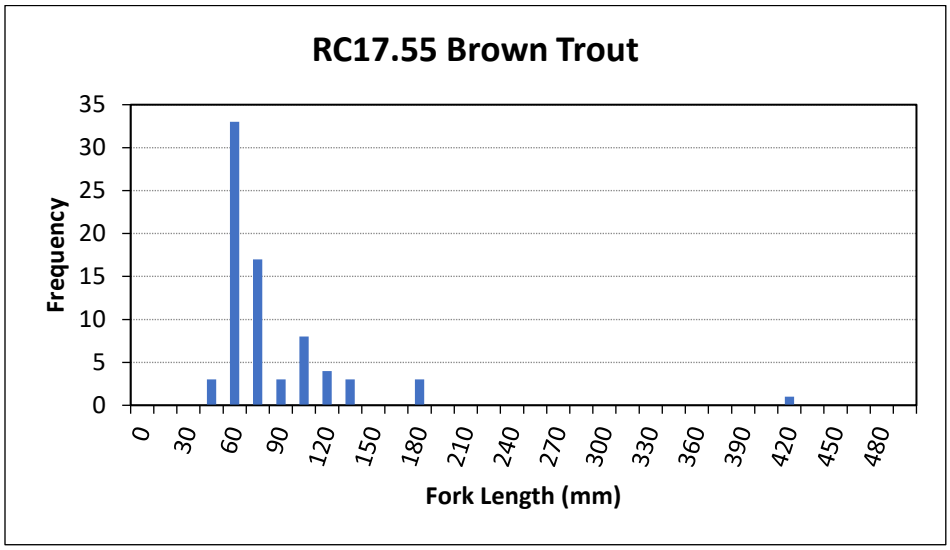
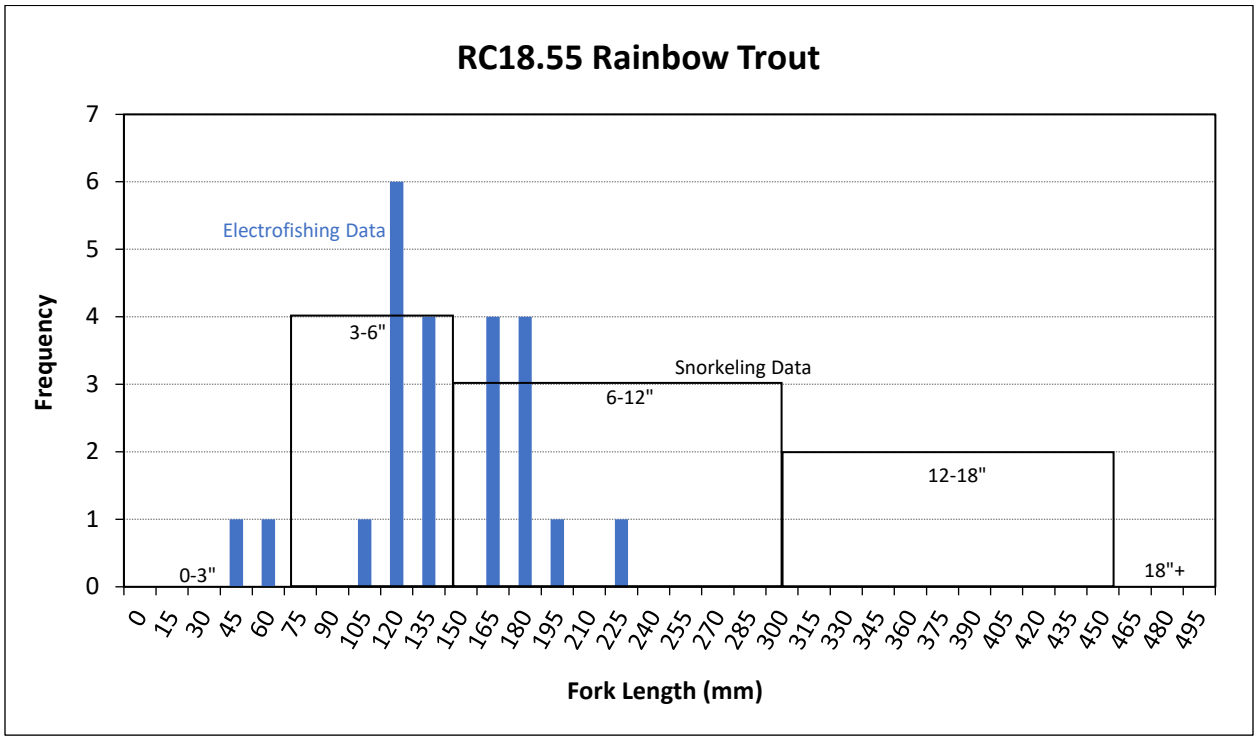


Figure E-4. Length Frequency Histograms for Rainbow Trout and Brook Trout Observed during Electrofishing and Snorkel Sampling at RC18.55, below Agnew Dam.



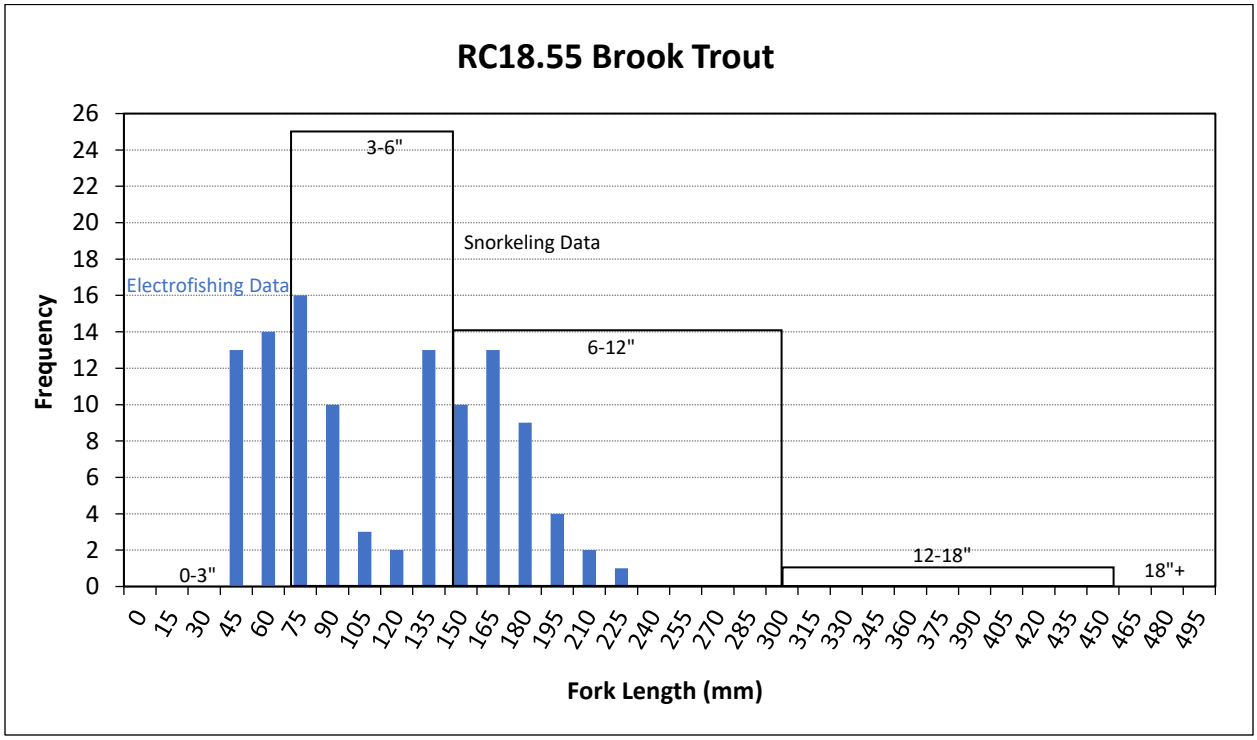
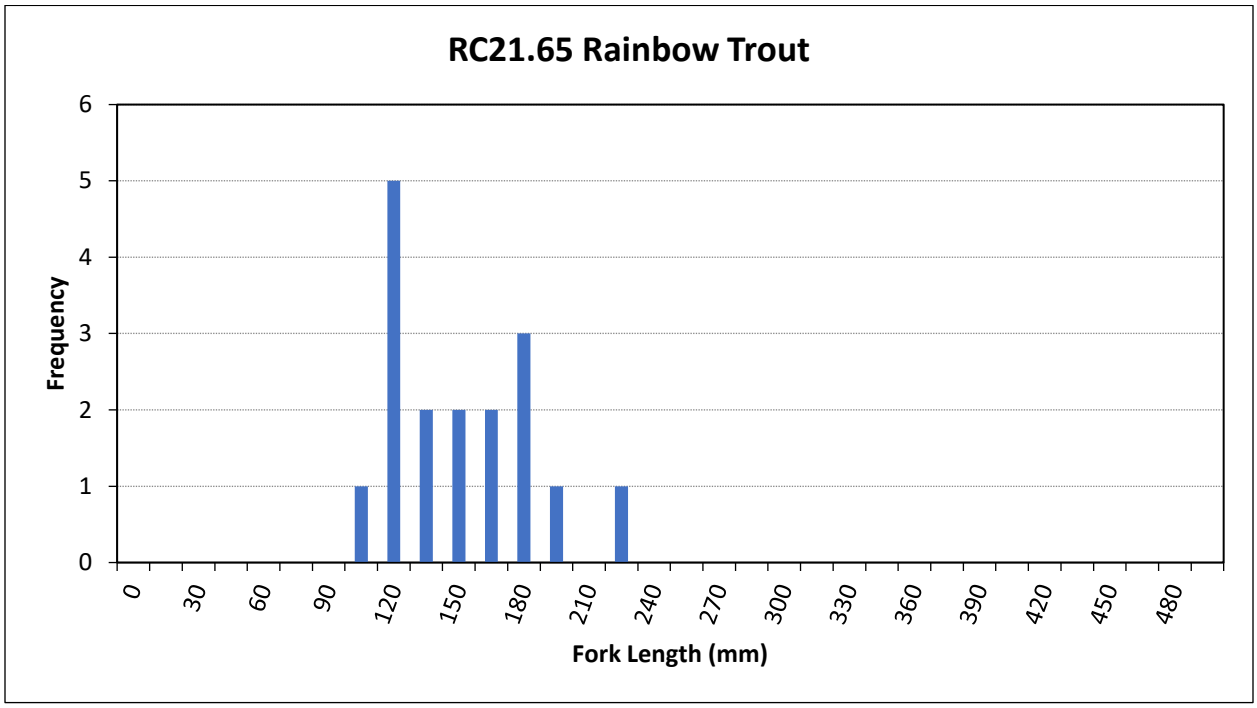


Figure E-5. Length Frequency Histograms for Rainbow Trout and Brook Trout Observed during Electrofishing Sampling at RC21.65, below Rush Meadows Dam.



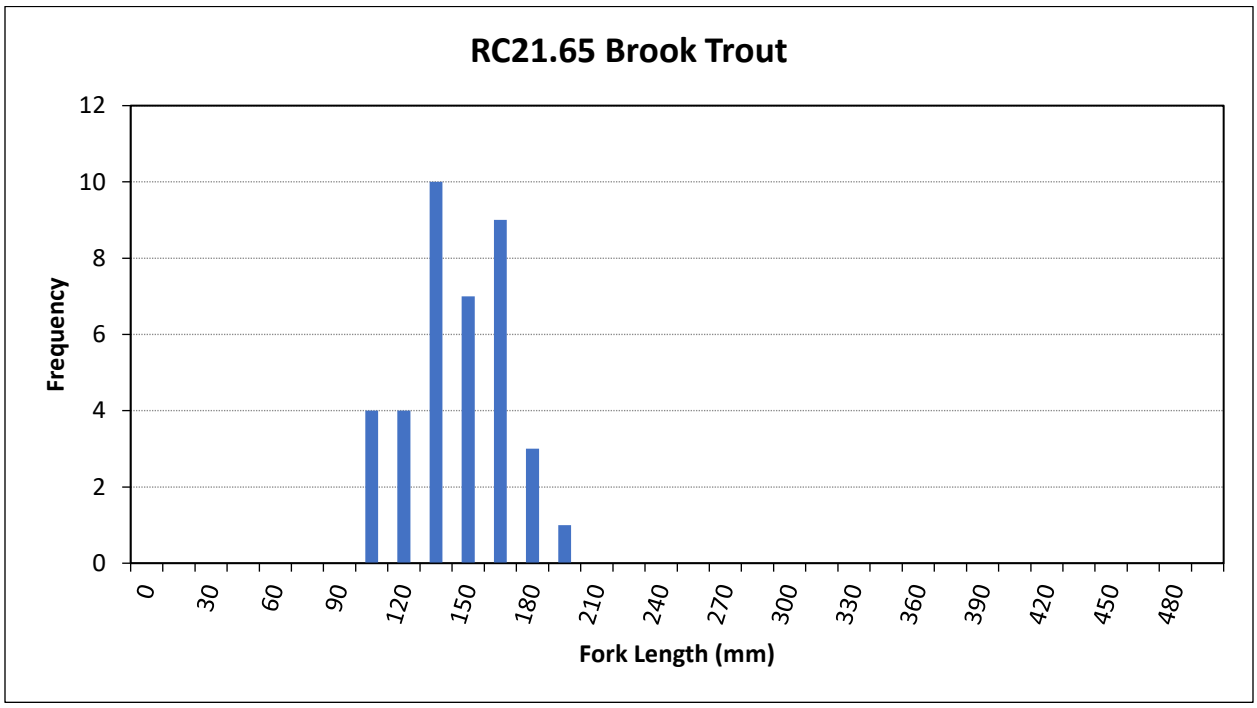
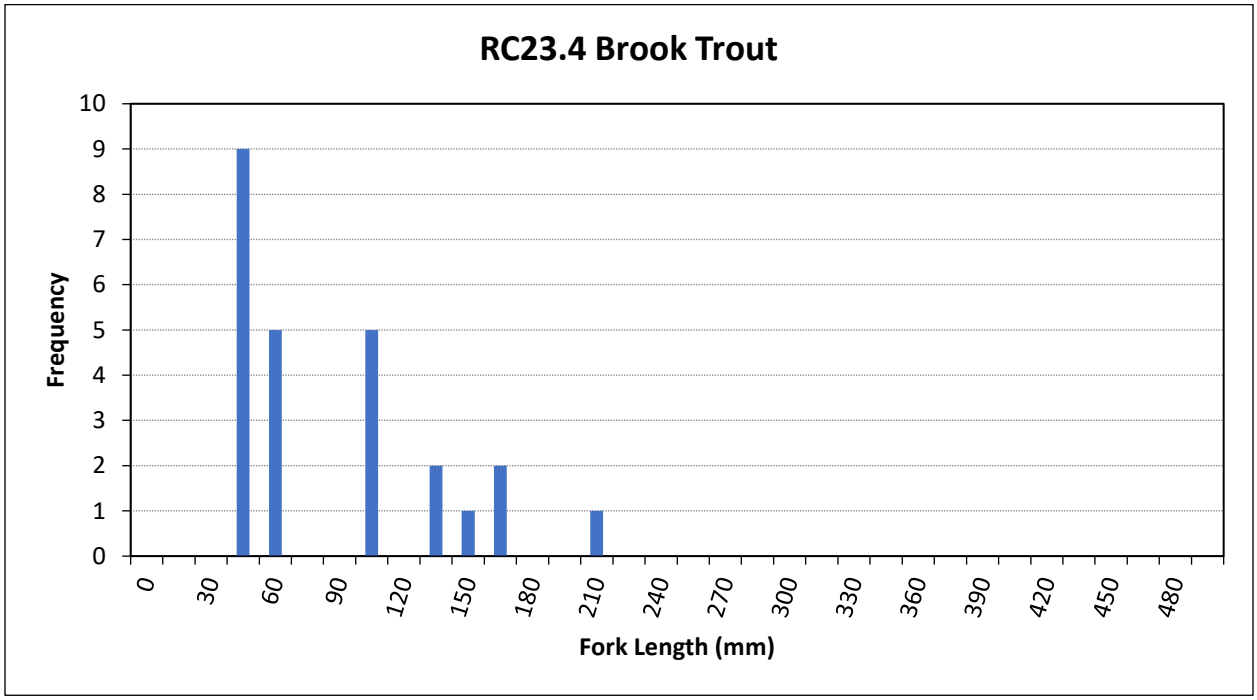
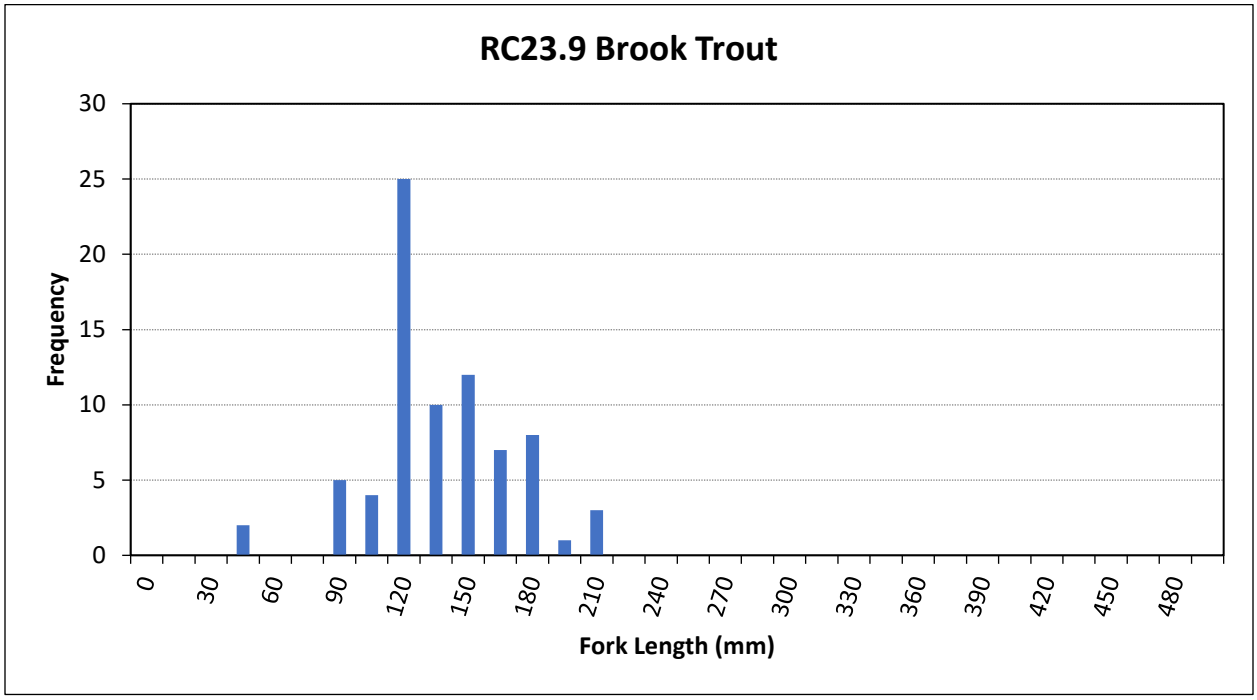


Figure E-6. Length Frequency Histograms for Brook Trout Observed during Electrofishing Sampling at RC23.0, in Waugh Lakebed.[1]



[1] Only one rainbow trout was observed at this site, so no histogram was created.

Figure E-7. Length Frequency Histograms for Brook Trout Observed during Electrofishing Sampling at RC23.9, above Waugh Lake.



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