Rush Creek Project, FERC Project No. 1389

AQ 5 – Geomorphology Technical Study Report

January 2025

SOUTHERN CALIFORNIA EDISON®

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List of Acronyms

cfs	cubic feet per second
DRI	Desert Research Institute
ESSLIA	East Shore Silver Lake Improvement Association
EWI	Equal-Width-Increment
Forest Service	United States Forest Service
FD	fluid drag
FERC	Federal Energy Regulatory Commission
FG	resisting gravity forces
ft/s^2	foot per second squared
ft^2	square foot
ft^3	cubic foot
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
LWD	large woody debris
mm	millimeter
PAD	Preliminary Application Document
Project	Rush Creek Project
PSP	Proposed Study Plan
RM	river mile
RSP	Revised Study Plan
S ft/ft	slope foot per foot
SCE	Southern California Edison
sq. mi	square mile
SR-158	State Route 158
TSP	Technical Study Plan
TSR	Technical Study Report
USGS	United States Geological Survey

1 INTRODUCTION

The AQ 5 – Geomorphology Technical Study Report (AQ 5 TSR) describes the methods and results associated with implementation of the AQ 5 – Geomorphology Technical Study Plan (AQ 5 TSP) for the Rush Creek Project (Project). The AQ 5 TSP was included in Southern California Edison Company's (SCE) Revised Study Plan[1] and was approved by the Federal Energy Regulatory Commission (FERC) on October 26, 2022, as part of Study Plan Determination (FERC 2022). The AQ 5 TSR was designed to be reported in three parts, which started with the Geomorphology 2023 Part A TSR (submitted April 9, 2024, for stakeholder review), followed by Part B TSR that was cumulatively added to Part A (submitted on August 28, 2024 with the DLA filing), and culminating in this final report, AQ 5 TSR in the Final License Application. Each of the three parts A, B, and the Final TSR are cumulatively compiled together in this current report, including recent data collection and analysis performed in summer/fall 2024. Additional geomorphology data collected as part of the DEC 1 – Full Decommissioning Study (Phase II work) in summer/fall 2024, including characterization of the types and quantities of accumulated sediment that could be released from behind each Project dam, is reported in the DEC 1 – Full Decommissioning Study (DEC 1 Study; SCE 2025a).

2 STUDY OBJECTIVES

Study objectives include the following:

- Characterize the existing stream channels (morphology, mesohabitat types, and sediment conditions) in the Project-affected stream segments.
- Characterize sediment capture/deposition in the Project reservoirs. This objective is addressed in the DEC 1 Study.
- Develop information to assist in the identification of flows necessary to maintain geomorphic processes in the Project-affected stream segments.
- Identify historical and existing sources of sediment within and adjacent to Project-affected stream segments, Project reservoirs, and other Project facilities, including major gullies; areas of vegetation and/or soil loss; hillslope destabilization; and erosion associated with ongoing operation and maintenance of the Project. Natural sources of sediment unrelated to the Project will also be documented in the Project vicinity.
- Provide a geomorphic analysis, as needed, to evaluate:

[1] SCE filed a Proposed Study Plan (PSP) on May 26, 2022. Four comment letters were filed on the PSP; and six study plans were revised. Therefore, SCE filed a Revised Study Plan (RSP) on September 23, 2022. FERC subsequently issued a Study Plan Determination on October 26, 2022, approving all study plans for the Rush Creek Project.

- Potential restoration of the Rush Creek channel within the former lakebed of Waugh Lake, which is addressed in AQ 1 – Instream Flow Technical Study Report (AQ 1 TSR; SCE 2025b);
- Potential enhancement of the Rush Creek and South Rush Creek channels near State Route 158 (SR-158) to address localized flooding, which is addressed in AQ 1 TSR; and
- Sediment scour/deposition in Rush Creek near the Silver Lake inlet, which is addressed in AQ 1 TSR.

3 STUDY IMPLEMENTATION

Study elements described in the AQ 5 TSP were initiated in 2023. A portion of the study was completed in 2023, with remaining study elements completed in summer/fall 2024. A summary of the study elements that have been completed and any deviations or proposed modifications to the AQ 5 TSP are discussed in the following subsections.

3.1 STUDY ELEMENTS COMPLETED

All study elements were completed and reported in this TSR or in other TSRs as specified above in the Study Objectives.

3.2 VARIANCES FROM THE AQ 5 – GEOMORPHOLOGY TECHNICAL STUDY PLAN

There have been no variances from the AQ 5 TSP. There were three additional sediment study elements included in the AQ 5 TSR, as follows:

- Sediment cores were collected in Rush Creek upstream of Silver Lake and the Silver Lake inlet delta to provide particle size input data for the AQ 1 TSR sediment transport modeling.
- An assessment of temporal changes in sediment deposition at the Silver Lake inlet delta was conducted using historical aerial imagery.
- Suspended sediment sampling was used to determine sediment concentrations and particle sizes carried by Rush Creek, South Rush Creek, and Reversed Creek, which provide input data for the AQ 1 TSR sediment transport modeling.

4 STUDY AREA AND STUDY SITES

- The study area for geomorphology includes Project-affected stream segments, Project reservoirs, and Project facilities. Geomorphology field sampling sites are identified on Map AQ 5-1 and Table AQ 5-1.
- For study elements within the Ansel Adams Wilderness, SCE provided a complete catalog of all temporary installations or equipment including, but not limited to, transect markers, their locations, timeline of scheduled use, and recommended disposal methods or removal, prior to any installation. SCE will also provide

confirmation of removal of any temporary installations to the United States Forest Service (Forest Service) at the end of the study period.

5 STUDY APPROACH

The following describes the geomorphology study approach which includes data collection and analyses for: (1) characterizing channel conditions in the Project-affected stream segments; (2) evaluating sediment capture/deposition in Project reservoirs; (3) identifying flows necessary to maintain geomorphic processes; (4) identifying historical and existing sediment sources and Project-related erosion areas; (5) development of potential restoration of the Rush Creek channel within the former lakebed of Waugh Lake; (6) development of potential enhancement of channels near SR-158; and (7) evaluation of sediment deposition/transport in Rush Creek near the Silver Lake inlet.

5.1 CHANNEL CONDITION IN THE PROJECT-AFFECTED STREAM SEGMENTS

5.1.1 Stream Segment Classification and Mesohabitat Typing

In each of the Project-affected stream segments the following was completed:

- Refined the desktop channel characterization, as needed, of each stream segment (and unique reaches[2] within each segment) presented in the Preliminary Application Document (PAD; SCE 2021) Section 4.8, Geomorphology using the Montgomery-Buffington (1997) process-based categories.
- Estimated the Rosgen Level II classification (channel pattern, entrenchment ratio, width/depth ratio, sinuosity, channel material, slope) for each stream segment/reach using available data and data collected at the sampling locations in Table AQ 5-1 (Rosgen 1996). The primary data necessary to distinguish stream types was collected in the reach between Rush Meadows Dam to Gem Lake.
  - Measurements were taken at three surveyed transect locations in each major stream segment and used to verify field stream classification estimates. Measurements from each transect included bankfull entrenchment ratio and width/depth ratio based on bankfull field indicators recorded at the time of the survey. Channel slope was generally derived from the high-water surface elevation measurements recorded upstream/downstream of the transects during the AQ 1 – Instream Flow Technical Study Plan (AQ 1 TSP) or those recorded during the geomorphic transect survey. Pebble counts were conducted at each transect to characterize the particle size distribution and used to classify the stream and evaluate initiation of sediment transport. The median particle size (D_{50}) and dominant particle texture from each pebble count was used to verify the Rosgen Level II channel material designation (i.e., bedrock, boulder, cobble, gravel, sand) at each transect and the accompanying reach. Channel sinuosity

[2] Reaches as used in this document are shorter sections of river within a longer stream segment (length of stream with homogeneous flow) that are delineated due to differences in fluvial geomorphology (e.g., stream gradient, channel confinement) or locations selected for collection of study data.

(based on the ratio of stream length to valley length) was measured in Google Earth for differing reaches where transects were located.

- Mesohabitat typing was completed and is presented in the AQ 1 TSR. Mesohabitat was initially mapped using aerial and helicopter imagery and adjusted as necessary in the field during a walking assessment of all river segments using the detailed level of mesohabitat typing outlined in McCain et al. (1990) (i.e., a potential of 22 mesohabitat types). An overlap (10%; 1 mile) between on-ground and helicopter/aerial photography delineated mesohabitats was used to calibrate/validate the helicopter/aerial photography derived mesohabitat classifications.

    - These habitat types were collapsed into a lower level of detail to facilitate river stratification for instream flow modeling. SCE aggregated the McCain et al. (1990) mesohabitat types into six types (pool, run, low-gradient riffle, high-gradient riffle, cascade, and falls/chutes) for stratification of the study sites and stream segments.

5.1.2 <u>Sediment Conditions in the Project-affected Stream Segments</u>

The amount of fine sediment in pools and the particle size composition and fine sediment content in spawning gravels was determined in the Project-affected stream segments. In addition, sediment composition for Rush Creek above Silver Lake (upstream to river mile [RM] 17.2) and in the Silver Lake inlet delta was quantified for input to the AQ 1 TSR. The methods are described below.

Fine Sediment in Pools

- Conducted quantitative sampling of residual fine sediment in five pools at each of the sampling locations (Table AQ 5-1 and Map 5-1) using the V* methodology (Hilton and Lisle 1993).

Particle Size Composition and Fine Sediment Content in Spawning Gravels

- The particle size distribution and fine sediment content of spawning gravels was quantified in stream reaches within the Project-affected stream segments using bulk sampling techniques (McNeil and Ahnell 1960). The locations are listed in Table AQ 5-1 and Map 5-1.

    - Bulk samples were collected in three representative spawning gravel patches of unspawned gravel riffles using a modified McNeil sampler (i.e., bottomless bucket) to depths that approximate that of a trout egg pocket (3 to 5 inches). Coarse sediments (≥16 millimeters [mm]) were air dried sieved and weighed on-site. Finer sediments were packaged for transport from the field site and delivered to Desert Research Institute (DRI) laboratory where they were dried and analyzed by a laser particle analyzer (Malvern Mastersizer 2011) for sediment sizes <2 mm. Samples >2 mm were processed using a standard set of wire mesh sieves (approved by the American Society of Testing Materials), representing one-half phi interval size classes.

- One “side-by-side” replicate pair of bulk samples was taken at each of the study sites to provide a measure of the variability in particle size composition within the same gravel deposit.

- The particle size composition of spawning gravel samples was plotted as cumulative distribution curves and histograms and the D_{50}, D_{16}, and D_{84} particle sizes were determined.

- Particle size composition and fine sediment content were compared to standards from the scientific literature (Kondolf 1988, 2000). Most trout (rainbow and brown) spawning occurs in medium to coarse gravel (Udden-Wentworth scale) 8 to 64 mm (Kondolf, Sale, and Wolman 1993; Reiser and Bjornn 1979; Grost et al. 1991). Fine sediment (<1 mm and <6.4 mm) in the gravel can affect egg incubation (e.g., reduce water flow and dissolved oxygen delivery to eggs) and fry emergence. Fine sediment criteria developed by Kondolf (1988, 2000) were used for this study to determine if gravels would support high spawning success (at least 50% survival rate), as follows:

    - Percentage finer than 1 mm should be less than 14%; and

    - Percentage finer than 6.4 mm should be less than 30%.

- Gravel within a constructed redd typically has less fine sediment than it does before spawning (Kondolf 2000) because the process of redd construction winnows fine sediments from the unspawned gravel deposit. To account for this cleansing effect, the amount of fine sediment in the bulk samples was adjusted using regression equations developed by Kondolf (2000):

    - Percent of fine sediment <1 mm in spawned gravels = 0.67 x Initial gravel percent <1 mm particle size

    - Percent of fine sediment <6.4 mm in spawned gravels = 0.58 x Initial gravel percent <6.4 mm particle size

- The fine sediment content at each potential spawning gravel site prior to spawning, and as predicted after redd construction, were analyzed.

Particle Size Composition of Sediment in Rush Creek above Silver Lake / Silver Lake Delta

- Sediment core samples from the Silver Lake inlet delta and the Rush Creek channel bed (upstream to RM 17.2) were sampled and characterized using the following approach:

- A slide hammer actuated multi-stage sediment sampler was used to collect 3-inch-diameter by approximately 12-inch-long core samples from three locations on the delta fan and seven locations (including one replicate sample) along the main channel (Appendix A).

- Sample locations were selected across the delta area to determine the range of potential sediment sizes deposited. Along the Rush Creek channel bed, sampling locations were selected to represent varied channel morphological bed features.

- Cores samples were photographed to document any indications of stratigraphy at each sample location.

- Field core samples were processed at DRI laboratory. Each sample was dried and analyzed by a laser particle size analyzer (Malvern Panalytical Mastersizer 3000) for sediment sizes less than 2 mm. Samples greater than 2 mm were processed using a standard set of wire mesh sieves (approved by the American Society of Testing Materials), representing one-half phi interval size classes.

- Particle size composition was plotted for each core sample as cumulative distribution curves and histograms. The particle size composition representing the D_{50}, D_{16}, and D_{84} and the geometric mean were analyzed.

5.2 SEDIMENT CAPTURE/DEPOSITION IN PROJECT RESERVOIRS

The capture/deposition of sediment in Project reservoirs (Waugh, Gem, and Agnew lakes) was evaluated based on a review of existing sediment management information and data collected from field studies.

- Existing sediment management conducted by SCE Operations and Maintenance personnel was summarized based on a discussion with SCE (Carr, pers. comm. 2023).
- The following tasks under this study element are reported in the DEC 1 Study:
  - Mapping of sediment facies in the exposed reservoir bed areas was conducted and the depth of the fine sediment deposition along the facies was measured to estimate sediment volume.
  - In Waugh Reservoir, tree stump mapping (completed during implementation of the TERR 1 – Botanical Resources Technical Study Plan (TERR 1 TSP) will be used to assist in identification of sediment deposition.
  - Characterization of the types and quantities of any accumulated sediment that could be released from behind each dam (Waugh Lake, Gem Lake, and Agnew Lake) as part of the evaluation of full decommissioning of the dams was implemented in the summer/fall of 2024 and reported in the DEC 1 Study.

5.3 IDENTIFY FLOWS NECESSARY TO MAINTAIN GEOMORPHIC PROCESSES IN PROJECT-AFFECTED STREAM SEGMENTS

Evaluation of flows that are necessary to maintain geomorphic processes in the Project-affected stream segments was developed by comparing impaired and unimpaired hydrologic regimes and modeling sediment transport conditions under the different flow regimes.

5.3.1 Compare Impaired and Unimpaired Hydrologic Regimes

Proposed Action, historical, existing, and unimpaired hydrology data are presented in AQ 2 – Hydrology Technical Study Report (AQ 2 TSR; SCE 2025c), including the following:

- Modeled mean daily discharge time series hydrographs and daily, monthly, and annual flow exceedances.
- Mean daily flows converted to 15-minute peak flows using a ratio multiplier. Flood frequency analysis based on peak flows to determine annual exceedance probabilities (i.e., recurrence intervals[3]).

The AQ 2 hydrology modeling was used to assess how alterations of the magnitude and duration of stream flows affect sediment movement and channel maintenance processes in Project-affected stream reaches. The average number of days per year the Rush Creek 1.5-year recurrence flow was equaled or exceeded for unimpaired and regulated hydrologic regimes was calculated. The 1.5-year recurrence flows were used because the transport of channel substrate, which is important for channel maintenance, typically occurs about once every one to two years (Schmidt and Potyondy 2004).

5.3.2 Evaluate Initiation of Sediment Transport and Bedload Transport under Different Flow Regimes at Selected Stream Segment Study Sites

- In coordination with implementation of the AQ 1 TSP and TERR 1 TSP, three representative cross-sections were selected in each of four different stream reaches of Rush Creek (Table AQ 5-1) to collect data for initiation of sediment transport analyses.
    - The channel and floodplain topography were surveyed at each transect.
    - Bankfull indicators were field identified and surveyed as well as the left and right edges of water and the elevation of riparian vegetation.
    - Pebble counts measurements were made in the channel at each transect from which bed surface particle size statistics were calculated (e.g., median grain diameter D_{50}.

[3] The recurrence interval, also known as the return period, is the average interval of time in years for which the discharge magnitude of a given flood will be equaled or exceeded.

- Three or more water surface elevations at flows identified in AQ 1 TSP were collected (see details in the AQ 1 TSR).
- Longitudinal water surface slopes were surveyed for three or more different flow levels at each transect.
- Initiation of sediment transport (motion) and bankfull flow was determined at the study sites using Manning's equation and critical bed shear stress as follows to calculate discharge, Q (cubic feet per second [cfs]):

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

  - The modeling approach used measurements of water surface elevation, water surface slope, and discharge as calibration data. The surveyed water surface slopes, S ft/ft (slope foot per foot) were fit to a power function. From the known surveyed water surface elevations, the flow areas A (square feet [ft^2]), and hydraulic radius', R (feet), were calculated. With this information, the only variable to determine in Manning's equation was the friction coefficient, n. The n value was adjusted until the calculated discharge matched the field measured discharges.
  - At discharges above those measured, the method for selecting an appropriate n value used guidance from Barnes (1967) which uses standardized channel photos of predetermined n-values, as well as calculating n from the bed surface sediment D84 particle size (Jarrett 1984; Limerinos 1970). These n values were compared with the calibrated n value of the highest measured discharge to select a final representative *n* value.
- Whether or not a particle on the stream bed will be entrained by the flow or remain in place generally depends on: (1) randomness (grain placement and turbulence), and (2) balance of driving fluid drag (F_D) and resisting gravity forces (F_G), according to the formula:

$$F_D \propto \tau_0 D^2, \text{ and } F_G \propto (\rho_s - \rho) g D^3$$

and

$$\frac{F_D}{F_G} \propto \frac{\tau_0}{(\rho_s - \rho) g D} = \Theta = \tau^*$$

- Where D is grain diameter (feet) and ρ_s is sediment density (slugs/cubic feet [ft^3]) constant. The dimensionless bed shear stress (Θ, commonly called the Shields number, or τ^*) is a measure of sediment mobility. The Shields number is the ratio of the fluid forces on a bed sediment particle of given size to the gravitational forces resisting motion.

- Bed shear stress was calculated using the equation:

$$\tau_0 = \rho g R S$$

- Where τ_0 is boundary shear stress (pounds/ft^2), ρ is fluid density constant (slugs/ft^3), g is gravity acceleration constant (foot per second squared [ft/s^2]), R (feet) is the hydraulic radius, and S (ft/ft) is the energy gradient (for which the water surface slope was used).

- Shear stress was calculated for each station along the surveyed transects by determining the hydraulic radius and multiplying it by the water surface slope. This method determines shear stress incrementally across the channel width rather than using a single cross-sectionally averaged value (i.e., calculated shear stresses are higher in the deepest portion of the channel).

- If τ^* was greater than the threshold required for sediment motion (τ^*_c , critical dimensionless bed shear stress), then initiation of sediment transport was predicted to occur. The critical dimensionless bed shear stress, τ^*c, was calculated from the Reynolds number (Rep) of the median (D_{50}) particle size of the pebble counts, and τ^*c was calculated from a Shields curve equation (Wilcock 2004) that flattens out around 0.047 as particle size approaches coarse gravel (32–64 mm) and coarser particles.

- Bedload transport rates (tons/day) were calculated for the four hydrologic scenarios using the Wilcock and Crowe (2003) surface-based bedload transport model to compare and contrast sediment transport between the scenarios. The bed surface particle size gradations used in the analysis were from the pebble counts made at the channel transects. Bedload transport was calculated for all mean daily discharges in the four modeled hydrology scenarios and then summed to determine average annual sediment loads (tons/year) over the 33-year period from water year 1990–2022.

5.4 Identify Historical and Existing Sources of Sediment and Project-Related Erosion Areas

- The location and relative volume of historical and existing sediment recruitment to channels from hillslope mass wasting and bank erosion processes was documented in the Project-affected stream segments as follows:

  - Significant sediment recruitment from mass wasting, and/or bank erosion sites were mapped via aerial reconnaissance, ground survey, and/or aerial photography.

  - The sediment sources were identified as either a natural watershed process or Project-related effects.

    - Potential sediment sources were characterized as actively or inactively contributing sediment and, if so, how much (e.g., low, moderate, high delivery potential to the stream channel).

- Historical and/or ongoing erosion at the Project facilities (Table AQ 5-2) was mapped via ground and aerial survey. Sediment capture and potential erosion and transport from Project reservoirs is addressed in the DEC 1 Study and AQ 1 TSR. Characterization of the types and quantities of any accumulated sediment that could be released from behind each dam (Waugh Lake, Gem Lake, and Agnew Lake) as part of evaluation of full decommissioning the dams was implemented in the summer/fall of 2024 and is reported in the DEC 1 Study.

- Detailed methods used to characterize mass-wasting features, streambank erosion, trail erosion, road-related erosion, and erosion associated with SCE Project facilities were as follows:

- Mass-wasting sediment sources were mapped using aerial photography from Google Earth. The imagery used for Waugh Lake basin was from September 14, 2013 (showed the least amount of snow), and all other basins were mapped using imagery from September 13, 2019. Mass-wasting sites were organized according to drainage basins whose boundaries are defined by each of the Project reservoirs:

    - Waugh Lake Basin includes Marie Lakes, Rush Creek, Rodgers Lakes, Davis Lakes, and several unnamed tributaries and cirque lakes.

    - Gem Lake Basin includes Crest Creek, Rush Creek, Clark Lakes, and unnamed tributaries and cirque lakes.

    - Agnew Lake Basin includes only Rush Creek as a sub-basin drainage.

    - Below Agnew Lake Basin includes Rush Creek and an unnamed tributary as sub-drainages.

    - Silver Lake Basin includes Alger Lakes, Alger Creek, Rush Creek, and unnamed tributaries and cirque lakes.

    - June Lake Basin includes Yost Creek, Fern Creek, Reversed Creek, and South Rush Creek.

- Mapped mass-wasting features were defined as having low or high potential for sediment delivery to streams and lakes based on the following criteria:

    - Low sediment delivery potential sites do not have any portion of the mass-wasting perimeter in direct contact with any streams or lakes, and the earth material was predominantly stored on hillslopes.

  - High sediment delivery potential sites were those where the mass-wasting feature was in direct contact with either streams, lakes, or reservoirs.
  - High sediment delivery potential sites with unimpeded sediment delivery to Silver Lake. This category is a subset of high sediment delivery sites that encompass three basins in the lower Rush Creek watershed including Below Agnew Lake, Silver Lake, and June Lake basins. These basins contain some mass-wasting sites that have perimeters in direct contact with waterways which flow relatively unimpeded into Silver Lake, with limited opportunities to store those sediments before reaching Silver Lake. These three basins do not include any major lakes or reservoirs where transported sediments could be trapped or stored.

- Streambank erosion in Rush Creek and South Rush Creek was visually observed during Rosgen Level II surveys and other field studies (V*, spawning gravel and bed material sampling). Bank erosion on Reversed Creek from the outflow of Gull Lake to confluence with Rush Creek was observed where public access allowed inspection of the channel from nearby road crossings and by foot downstream from the SR-158 crossing. The lowermost reaches of Yost and Fern Creek were observed at locations where these streams were accessible from the road along the valley floor near their confluence with Reversed Creek. Other tributaries to Rush Creek were not inspected in the field.

- Trail conditions (surface erosion, cut/fill slopes, drainage features, stream crossings) were generally observed in the process of travelling by foot and by horseback to study sites. Geographic Information System (GIS) mapping of Forest Service trails[4] is presented and was used to quantify length of trails present in the watershed and potential for sediment delivery to streams.

- Roads in the vicinity of the Project were inspected to characterize their condition and potential to deliver sediment to Rush or Reversed creeks. Aerial photography was analyzed to identify potential erosion related to roads that are situated on slopes just above the valley floor. Total miles of roads, and whether roads are surfaced or native earth material was distinguished using GIS aerial mapping. Road-related erosion potential for sediment contribution to waterways was characterized specifically in relation to waterways that might contribute to sedimentation of Silver Lake.

- Project infrastructure related erosion assessment was conducted by field inspection of Project features identified as potentially causing erosion, including the tramway, penstock drains/channels below Gem Dam, emergency penstock cut, flow pipeline, and dam-related maintenance infrastructure and access trails. At locations where evidence of active ongoing or past inactive erosion were identified, the erosion process observed (slumps/failures, rilling, gullying, or sheet-surface runoff), how the infrastructure feature influenced erosion (e.g.,

[4] Inyo National Forest System Trails, Forest Service, Pacific Southwest Region, California, Region 5

concentrating flow, diverting/re-directing flow, cut-slope erosion or fill-slope failures associated with construction, etc.), and whether sediment was delivered to stream channels or predominantly stored on-site was characterized.

- Project reservoir shoreline erosion was addressed via facies mapping along the reservoir shorelines. Facies mapping for Waugh, Gem, and Agnew lakes is reported in the DEC 1 Study. Characterization of the types and quantities of any accumulated sediment that could be released from behind each dam (Waugh Lake, Gem Lake, and Agnew Lake) as part of evaluation of full decommissioning the dams is reported in the DEC 1 Study.

- Two sediment related study elements were conducted that were not identified in the AQ 5 TSP, including:

    - Suspended sediment sampling was conducted at five locations along the valley floor: (1) Reversed Creek near the SR-158 crossing into the wetland meadow (2) South Rush Creek (3) unnamed tributary to South Rush Creek (4) mainstem Rush Creek just upstream from SR-158, and (5) SCE Powerhouse tailrace. Six sampling events were conducted over a range of discharges during the runoff period between late May and September 2023. The sampling was performed with a DH-48 hand-held sampler[5] using the Equal-Width-Increment (EWI) method as proscribed by the United States Geological Survey (USGS) (Edwards and Glyson 1999). Suspended sediment samples were sent to DRI laboratory for analysis of sediment concentrations and particle sizes.

    - Silver Lake USGS Sediment Deposition Report (1997) and 2024 Update. A source of sediment recruitment information prepared for this TSR is an update on a USGS report (Blodgett 1996) assessing the history of sediment deposition at the inlet to Silver Lake. The USGS report provides historical information on the progressive amount of sediment deposition at the Silver Lake inlet delta, which was updated in this current report using recent aerial photography.

5.5 Evaluation of Potential Rush Creek Channel Restoration in the former Lakebed of Waugh Lake

- Coordinated with the AQ 1 TSP, which includes Light Detection and Ranging (LiDAR), aerial photogrammetry, and/or total station channel surveys and hydraulic modeling of the channel in the Waugh Lake lakebed to assist in the evaluation of potential channel change related to sediment erosion/deposition.

- This information will be used to assist in the evaluation of potential restoration of the Rush Creek channel within the former lakebed of Waugh Lake.

[5] All samples were collected with a 6.3mm (¼ inch) nozzle opening fitted on the DH-48 sampler so that suspended sediments up to 6.4 mm could be captured. This is the largest diameter nozzle available for suspended sediment sampling.

5.6 Evaluation of Potential Enhancement of Rush Creek and South Rush Creek Channels Near SR-158

- In coordination with implementation of the TERR 1 TSP and AQ 1 TSP, large woody debris (LWD)/downed trees and riparian vegetation within the stream channels near SR-158 related to potential flow conveyance effects was characterized and mapped using a Trimble GPS unit. Areas of interest were photographed and georeferenced using the Gaia GPS smartphone application.

- Stream channels were walked, and aggregates of LWD were characterized in terms of the number of pieces greater than or equal to 3-inch diameter at breast height (Chin et al. 2008), and the position of LWD relative to the bank full stage. Mapping and characterizing LWD is provided in this AQ 5 TSR and subsequently used in AQ 1 TSR to address effects on flow conveyance.

- Coordinate with the AQ 1 TSP, which includes LiDAR, aerial photogrammetry, and/or total station surveys and hydraulic modeling of the channels to assist in evaluating potential enhancement needs (e.g., berms, channel modification, clearing of the channel) and evaluation of fluvial geomorphic change in the Rush Creek and South Rush Creek channels.

5.7 Evaluation of Sediment Deposition/Transport in Rush Creek Near the Silver Lake Inlet

- Coordinate with the AQ 1 TSP, which includes LiDAR, aerial photogrammetry, and/or total station surveys of the channel and hydraulic modeling of the channel to evaluate sediment scour/deposition and potential fluvial geomorphic change at the Silver Lake inlet under the Proposed Action, historical, existing, and unimpaired hydrology conditions.

6 STUDY RESULTS

6.1 Channel Condition in the Project-Affected Stream Segments

6.1.1 Stream Segment Classification and Mesohabitat Typing

The desktop channel characterization using Montgomery-Buffington (1997) process-based categories (presented in PAD Section 4.8, Geomorphology) was updated as necessary (Table AQ 5-1). Updates primarily consist of identifying additional categories within some reaches indicative of the diversity documented during the field mapping of Rosgen stream types.

Map AQ 5-1 shows the characterization of Level I Rosgen stream types for Rush Creek downstream of Rush Meadows Dam and South Rush Creek. More detailed Rosgen Level II stream type classifications are mapped in Appendix A. Table AQ 5-3 summarizes the stream types for each Project reach by RM. Table AQ 5-5 provides a summary of the pebble count results for D16, D50, and D84 size class indices. Particle size distribution curves and size class indices summaries for each sample location is provided in Appendix B.

The length of Rush Creek generally consists of A, B, or C stream types (with exception to a very short segment of a D stream type flowing over the alluvial fan into Agnew Lake). The detailed stream classification indicates potential areas where successional shifts in channel morphology may be occurring (e.g., where the channel transitions from a C4 to a B4c and back to a C4).

Plots of the three transects surveyed in each of the mainstream segments (18 transects total) are provided in Appendix C. Plots show bankfull and flood prone elevations. A table of the parameters used to classify the Rosgen Level II stream type for each transect (entrenchment ratio, width/depth ratio, channel sinuosity, channel slope, and median/dominant particle size) is provided below each survey plot in Appendix C and summarized for all transect locations in Table AQ 5-6.

6.1.2 Sediment Conditions in the Project-affected Stream Segments

Fine Sediment in Pools

The results of the V* measurements are provided in Table AQ 5-7, which summarizes the residual pool measurements, the volume of fine sediment stored within the pool, the calculated V*, and reach weighted average V*w. Appendix A depicts the locations where the pools were sampled and Appendix D contains photographs of the V* pools.

The Rush Creek Above Silver Lake (Downstream of Reversed Creek Confluence) reach is a low gradient meadow/wetland dominated by fine and sediment and did not contain pools that meet the Hilton and Lisle (1993) pool selection criteria, therefore V* surveys were not performed in this reach. The V* methodology states that pools must have: (1) a well-defined armored boundary at depth; and (2) avoid measuring potential pools with unclear boundaries (i.e., well-defined pool head and pool tailout/riffle crest), such as long glides. These criteria were not met in this reach. A well-defined armored boundary beneath surface fine sediments was not detectable. Measured sediment depths were typically between 4 and 6 feet, so that an armor layer could not be reached and likely does not exist at depth below the pool bottom. Residual pool volumes (i.e., at point of zero flow) could not be defined due to the fine mobile bed material and lack of well-defined controlling riffle crest; however, the pool water depth was substantial, ranging from 1.5 to 6.5 feet deep.

For all other sampled V* reaches, fine sediment in pools were generally limited to a small proportion of the residual pool volume. In 23 of the 28 sampled pools, V* values were less than 0.10, indicating very little fine sediment storage. Excluding 3 pools sampled in the reach above Rush Meadows Dam in Waugh Lake, four sampling sites had V* values greater than 0.10, with the highest value of 0.27. Reach-weighted average V*w values were equal to or less than 0.15 for all sampled reaches, indicating low fine sediment storage in the Project-affected streams.

Three V* pools were measured in the reach of Rush Creek in Waugh Lake (summer 2024). Pools 1 and 2 have very low V* values, 0.03 and 0.00 respectively, indicating nominal deposition of fine sediment within the residual pool volumes. Pool 3 is an outlier with a much higher V* value of 0.60 indicating substantial storage of fine sediment. Pool 3, the largest pool in this reach, did not meet the V* selection criteria discussed above, as it lacked a detectable armored boundary layer at depth beneath the fine sediment. Measured sediment depths in Pool 3 exceeded 10–11 feet at some locations, making it difficult to distinguish between an armor layer and frictional resistance from measuring in very deep finer sediments, indicating that an armor boundary layer may not be present. As such the V* value for Pool 3, although calculated and reported here (see Table AQ 5-7), should be entirely discounted.

For all individual V* measured pools, the thickness of fines present ranged from trace amounts (<0.1 foot) to 2.2 feet thick. V* values were below 0.20 with one exception. Pool 3 in the Below Agnew Dam reach had a V* value of 0.27 (see Table AQ 5-7). This pool is formed by the backwater of a Project weir and is not a natural pool. Fine sediments can be impounded by weir structures, therefore this pool is not considered representative of natural pools in the study reach.

Based on visual observations of the pool substrate, the majority of pools contained cobbles, or very coarse gravels and some sands. Bedrock and/or boulders were also observed in the higher elevation reaches, though not always observed within each of the pools surveyed. In most cases, the fine sediment was located within the interstitial spaces of the coarse bed material, along the margins of the residual pool in slack water areas, or in the velocity shadow of larger bed material.

Pool volumes were surveyed in South Rush Creek during the fall when there was no flow. For all pools, the average thickness of fine sediments present ranged from trace amounts (<0.1 foot) to 0.8 foot thick. V* values were all below 0.1 indicating low fine sediment storage, except for one pool with a calculated V* value of 0.24.

Particle Size Composition and Fine Sediment Content in Spawning Gravels

Spawning gravel habitat was limited in high gradient sections of the river. Only two of three representative gravel patches were sampled in the Rush Creek Below Rush Meadows Dam reach due to limited availability of observed spawning gravels and spawning habitat. A second replicate sample was collected to fulfill monitoring criteria in the reach. Rush Creek Above Silver Lake (Downstream of Reversed Creek Confluence) was not sampled because suitable spawning gravel sizes were not available. This is a low gradient reach where the channel is dominated by sand sized particles.

The results from the analyses of bulk sediment samples of spawning gravels are presented in Table AQ 5-8. Histogram and cumulative particle size distribution curves from each bulk sample are available in Appendix E. The amount of fine sediment within the potential spawning gravel sample is shown in Table AQ 5-9. Appendix A depicts the locations where spawning gravels were sampled.

The median (D_{50}) of the 24 bulk samples collected ranged from 9 to 39 mm (see Table AQ 5-8). The geometric mean of the Rush Creek spawning gravel samples ranged between 5.2 to 25.6 mm. The size range of spawning material used by trout can vary depending on fish size, with larger fish capable of spawning in larger sized gravels. In a study of spawning gravel sizes utilized by salmon and trout of various species both within and outside of the United States, rainbow trout spawning gravel D_{50} ranged between 10.5 and 46.3 mm (Kondolf and Wolman 1993).

Fine sediment was generally within the criteria to support high reproductive success. Fine sediment <1 mm was relatively low in all of the gravel samples, with one of the unspawned gravel samples exceeding the 14% criteria. After accounting for winnowing of fine sediments during spawning, all gravel samples ranged from 0.0 to 10.1% fine sediment <1 mm size (Table AQ 5-9).

Fine sediment content for 17 of the 24 unspawned gravel samples were within the <30% criteria for the <6.4 mm particle size, with 7 samples exceeding the criteria. Three samples exceeding the criteria were in the Rush Creek above Waugh Lake reach, two were in the Rush Creek above Silver Lake reach, and two were in the Rush Creek below Silver Lake reach. After accounting for fine sediment reduction due to winnowing during spawning all 24 samples were within the <30% criteria (see Table AQ 5-9).

Particle Size Composition from Core Sampling of Rush Creek Streambed Upstream of Silver Lake

Seven sediment core samples were collected along Rush Creek from approximately RM 17.16 down to the active delta at Silver Lake near RM 16.55 (Appendix A). Three samples were distributed across the active delta representing the deeper channel entering the delta where coarser substrate was observed on the surface, the west less prominent lobe, and the east more prominent elongated portion of the delta (Appendix A). The particle size distribution and cumulative frequency curves for each core sample are provided in Appendix F. Table AQ 5-10 summarizes the D_{16}, D_{50}, D_{84} size class indices, and percent composition of silt/clay, sand, and gravel for each sample location and lists the dominant particle size class and associated percent frequency.

There is no consistent gradation of larger to smaller particle sizes from upstream to downstream over the 0.67-mile channel sampling length. Despite some differences, the D_{50} and dominant substrate is consistently very coarse sand (with exception to SLCS-1R which is very fine gravel and SLCS-12 which is coarse sand). All samples were comprised of at least 73% sand except sample SLCS-1R which was 58% sand. The mean particle size (D_{50}) averaged 1.3 mm (sand) and ranged from 0.8 to 1.5 mm. There were no apparent differences in particle size in the upper 12 inches of the bed material sampled on the active delta (average D_{50} of 1.4 mm with a range of 1.3 to 1.5 mm).

Layer stratification was observed at two sample locations in the middle of the sampling reach (locations SLCS-10 and 11, Table AQ 5-10). In general, three major strata were observed along the length of the channel. Typically, there was a lens of very coarse to coarse sand at the streambed surface, but at various locations, a more cohesive layer comprised of fine sand, silt, and clay was present. This layer appears to be more characteristic of the bank and meadow soil that surrounds the channel (Appendix D, Photo-38). The third strata observed in the lower depth of core sample SLCS-10 and in other areas where more scour was occurring appears to be a compacted decomposed glacial till consisting of uniform gradation of sand sized particles. The lighter grey color of gleyed substrate is apparent in several of the pools where underwater photos were taken to document unsuitable conditions for conducting a V* analysis (Appendix D, Photo-40).

6.2 SEDIMENT CAPTURE/DEPOSITION IN PROJECT RESERVOIRS

Sediment management and debris maintenance activities at Project reservoirs and facilities were discussed with SCE (Seth Carr, December 11, 2023). SCE does not perform any sediment management or maintenance activities associated with reservoirs or any other facilities. SCE does perform maintenance activities related to LWD, mostly to remove the debris to maintain safe function of the spillways and flow outlets at the reservoirs. Maintenance activities are summarized in Table AQ 5-11.

Mapping of sediment facies in the exposed reservoir bed areas was conducted, and the depth of the fine sediment deposition facies was measured to estimate sediment volume. Results are reported in the DEC 1 Study.

Characterization of the types and quantities of accumulated sediment that could be released from behind each dam (Waugh Lake, Gem Lake, and Agnew Lake) as part of the evaluation of full decommissioning of the dams was implemented in the summer/fall of 2024 and reported in the DEC 1 Study.

6.3 IDENTIFY FLOWS NECESSARY TO MAINTAIN GEOMORPHIC PROCESSES IN PROJECT-AFFECTED STREAM SEGMENTS

6.3.1 Compare Impaired and Unimpaired Hydrologic Regimes

Hydrology data comparing modeled Proposed Action, historical, existing, and unimpaired conditions are presented in the AQ 2 TSR. High flow frequency analysis results are presented in Table AQ 2-9. Results analyzing the average number of days per year the Rush Creek 1.5-year recurrence flow was equaled or exceeded for the unimpaired and impaired hydrologic regimes are presented in Table AQ 5-12 and summarized below:

- **Rush Creek Below Rush Meadows Dam** – The 1.5-year recurrence flow of 217 cfs was equaled or exceeded an average of 9.3 days per year for the unimpaired condition and the Proposed Action was the same as unimpaired. The existing and historical hydrology show a -34% and -25% (6.2 days/year and 7 days/year) decrease in frequency compared to unimpaired conditions, respectively.

- **Rush Creek Below Agnew Dam** – The 1.5-year recurrence flow of 334 cfs was equaled or exceeded an average of 22 days per year for the unimpaired condition. The Proposed Action, existing, historical hydrology show a -65%, -68%, and -83% (7.8 days/year, 7.1 days/year, and 3.7 days/year) decrease in frequency compared to unimpaired conditions, respectively.

- **Rush Creek Upstream of Reversed Confluence** – The 1.5-year recurrence flow of 249 cfs was equaled or exceeded an average of 11.2 days per year for the unimpaired condition. The Proposed Action, existing, historical hydrology show a -71%, -74%, and -87% (3.3 days/year, 2.9 days/year, and 1.5 days/year) decrease in frequency compared to unimpaired conditions, respectively.

- **Rush Creek Below Silver Lake** – The 1.5-year recurrence flow of 396 cfs was equaled or exceeded an average of 16.5 days per year for the unimpaired condition. The Proposed Action, existing, historical hydrology show a -30%, -33%, and -61% (11.6 days/year, 11.1 days/year, and 6.4 days/year) decrease in frequency compared to unimpaired conditions, respectively.

6.3.2 Evaluate Initiation of Sediment Transport under Different Flow Regimes at Selected Stream Segment Study Sites

Initiation of sediment transport analysis at the Rush Creek transects for the four assessment reaches is reported four different ways, which include bankfull flow, the critical sediment size transported at bankfull, spawning gravel mobilization, and D_{50} particle size mobilization. The spawning gravel and D_{50} particle mobilization analyses were conducted on a select subset of the transects in the assessment reaches that represent the lower gradient sections of the channel rather than high gradient, high energy channel sections. The four data sets include:

- **Bankfull flow** – The field identified bankfull flow (Table AQ 5-13) was used as a reference flow in relation to initiation of sediment transport. Bankfull is an indicator of the flow that moves the most sediment in a channel and initiation of sediment transport occurs a lower flow.

- **Largest particle size** – The largest particle size for which initiation of sediment transport occurs for a given flow is referred to as the critical grain diameter ($D_{critical}$). The $D_{critial}$ size that is mobilized by a bankfull flow was calculated with results displayed in Table AQ 5-13. The results are compared with the bed surface sediment sizes obtained from the pebble counts (Table AQ 5-5 and Appendix B).

- **Spawning gravel** – To evaluate the mobility of spawning size gravel important for trout habitat, calculations were made to determine the discharge needed to mobilize a 32 mm particle (coarse gravel) over a minimum of 25% of the active channel bed (Table AQ 5-14). Although trout utilize gravel sizes that span a wide range, 32 mm was selected as a representative size within the range. The average number of days per year (1990 to 2022) the mean daily discharge was high enough to mobilize the 32 mm particle was determined for each of the four unimpaired and impaired flow scenarios and is presented in Table AQ 5-14.

- **D_{50}** – Calculations were also performed to determine the discharge needed to mobilize the D_{50} particle (from the pebble count data) over a minimum of 25% of the active channel bed (Table AQ 5-14). This analysis provides insight on how mobile, or immobile, the bed surface sediment is in relation to the discharge associated with the field identified bankfull elevation. The average number of days of mobilization of the D_{50} over the 1990–2022 period for the four modeled flow scenarios is also presented in Table AQ 5-14.

A summary of the initiation of sediment transport is data at the four assessment reaches is provided below:

- **Rush Creek in Waugh Lake above Rush Meadows Dam** – Analysis was performed for the uppermost transect of the three transects surveyed in Waugh Lake (G3). Two other cross-sections (G1 and G2) were predominantly sand and, therefore, no pebble counts were performed and no initiation of motion analysis performed. The Waugh Lake (G3) transect has a 1.3% slope. The D_{50} from the pebble counts at this transect was 90 mm. Since this unvegetated transect is located at the upper end of Waugh Lake and is periodically inundated under high lake levels, no field bankfull indicators could be identified. Thus, initiation of motion was not calculated for the bankfull elevation at transect G3. The active channel width of 60 ft is based on the transect topography and the area where sediment deposition was observed.

  A discharge of 45 cfs mobilized a 32 mm particle across a minimum of 25% of transect G3's active channel width (Table AQ 5-14). Under the unimpaired hydrology, the 32 mm particle was mobilized an average of 78 days/year at G3. A discharge of 761 cfs was required to mobilize the D_{50} (90 mm) particle across a minimum of 25% of the active channel. A discharge of 761 cfs is greater than the maximum mean daily discharge for the unimpaired hydrology.

- **Rush Creek Below Rush Meadows Dam** – The calculated flow corresponding to the field identified bankfull elevation ranged from 247 cfs to 286 cfs with a reach average of 263 cfs for the three transects. At the two relatively steep transects (G1T1, 2.36% slope, and G3T3, 2.94% slope), The $D_{critical}$ was 126 mm (small cobble) and 151 mm (large cobble), respectively. The D_{50} from the pebble counts at these two transects was 121 mm and 122 mm. At G3T3 (0.80% gradient) the $D_{critical}$ was 48 mm (very coarse gravel) and the D_{50} was 94 mm.

  A discharge of 67 cfs mobilized a 32 mm particle across a minimum of 25% of transect G2T2 (Table AQ 5-14). Under the unimpaired and Proposed condition hydrology, the 32 mm particle was mobilized an average of 60 days/year at G2T2. A discharge of 650 cfs was required to mobilize the D_{50} (94 mm) particle across a minimum of 25% of the active channel. A discharge of 650 cfs is greater than the maximum mean daily discharge for both the unimpaired and Proposed condition hydrology.

- **Rush Creek Below Agnew Dam** – The calculated flow corresponding to the field identified bankfull elevation ranged from 37 cfs to 40 cfs with a reach average of 39 cfs for the three transects. The coarse bed sediment in this reach is illustrated by the D_{50} values from the pebble count data that range from 94 mm to 106 mm. The calculated $D_{critical}$ varies widely, from 18 mm (coarse gravel) to 70 mm (small cobble) because the channel slope values for the three transects also vary widely (from 0.71% to 3.84%).

A discharge of 8 cfs and 32 cfs mobilized a 32 mm particle across a minimum of 25% of two of the transects (G2T10 and G3T12) (Table AQ 5-14). Under the unimpaired condition hydrology, the 32 mm particle was mobilized an average of 237 days/year at G2T10 and 118 days/year at G3T12. The 32 mm particle was mobilized -77% and -74% less often under the Proposed condition hydrology at these two transects.

The discharge required to mobilize the D_{50} particle was 105 cfs at G2T10 (106 mm) and 675 cfs at G3T12 (101 mm). The wide range is attributed to the large differences in water surface slope between the two transects, with G2T10 being more than twice as steep as G3T12. Under the unimpaired condition hydrology, the D_{50} particle was mobilized an average of 59 days/year at G2T10 and 0.5 days/year at G3T12. The D_{50} particle was mobilized -70% and -59% less often under the Proposed condition hydrology at these two transects.

- **Rush Creek Upstream of Reversed Creek Confluence** – The calculated flow corresponding to the field identified bankfull elevation was 11 cfs at transect G1T4 and 75 cfs at G2T6 and 61 cfs at G3T8. Field observation indicates the relatively low bankfull flow at G1T4 may be affected by backwater conditions at higher flows, and thus is considered an outlier and not representative of the reach conditions. The average bankfull flow for the reach was 68 cfs, excluding G1T4. The $D_{critical}$ at G2T6 was 86 mm (small cobble) and at G3T8 is 11 mm (medium gravel). The pebble count D_{50} was 56 mm and 43 mm, respectively, at these two transects. The steep slope of 3.42% at transect G2T6 is much higher than the other two transects, and thus generates the shear stress to transport relatively coarse particles.

  A discharge of 132 cfs mobilizes a 32 mm particle across a minimum of 25% of transect G3T8 (Table AQ 5-14). Under the unimpaired condition hydrology, the 32 mm particle was mobilized an average of 46 days/year at G3T8. The 32 mm particle was mobilized -68% less often (14 days/year) under the Proposed condition hydrology.

  The discharge required to mobilize the D_{50} (43 mm) particle across a minimum of 25% of the active channel exceeds the capacity of the surveyed transect. At channel capacity (approximately 207 cfs) the D_{50} particle is mobilized over 7.1% of the active channel.

- **Rush Creek Below Silver Lake** – The calculated flow corresponding to the field identified bankfull elevation ranged from 249 cfs to 310 cfs with a reach average of 281 cfs for the three transects. The $D_{critical}$ at the bankfull flow ranged from 22 mm (coarse gravel) to 43 mm (very coarse gravel). The D_{50} bed particle size from the pebble counts ranged from 39 mm to 59 mm.

  A discharge of 60 cfs to 67 cfs mobilized a 32 mm particle across a minimum of 25% at two of the transects G1T1 and G3T18 (Table AQ 5-14). Under the unimpaired condition hydrology, the 32 mm particle was mobilized an average of 107 days/year and 100 days/year at these two transects, respectively. The 32 mm particle was mobilized +31% and +16% more often under the Proposed condition hydrology (see Table AQ 5-14).

The discharge required to mobilize the D_{50} particle ranged from 159 cfs to 386 cfs at two of the transects. At the lower gradient transect G2T6 not included in Table AQ 5-14, even at a channel capacity flow of approximately 800 cfs, the largest particle sizes mobilized was 37 mm, which is just smaller than the D50 of 39 mm. Under the unimpaired condition hydrology, the D50 particle was mobilized an average of 17 days/year at G1T1 and 54 days/year at G3T18. The D50 particle was mobilized -30% less often under the Proposed condition hydrology.

6.3.3 Evaluate Annual Bedload Transport Rates under Different Flow Regimes at Selected Stream Segment Study Sites

Results of bedload transport analysis (Wilcock and Crowe 2003 transport equation) for the four flow scenarios of unimpaired and impaired average daily flow hydrology (1990 to 2022) are presented in Table AQ 5-15. The table shows the average annual transport rate (tons/year) for each particle size fraction in the pebble count data and the total average annual rate determined by summing the fractions. The percent change in total annual average bedload transport for the Proposed Action, existing, and historical hydrology scenarios compared to the unimpaired flow scenario is also included in the table. A summary for each reach is provided below:

- **Rush Creek Below Rush Meadows Dam** – At transect G2T2 the total average annual bedload for the unimpaired condition and Proposed condition hydrology was 12,702 tons/year. The historical condition hydrology shows a -12% decrease in bedload

- **Rush Creek Below Agnew Dam** – At transect G2T10 the total average annual bedload for the unimpaired condition hydrology was 5,674 tons/year. The historical condition hydrology shows a -83% decrease in bedload and for the Proposed condition hydrology the bedload decreases by -67%.

  At transect G3T12 the total average annual bedload for the unimpaired condition hydrology was 6.7 tons/year. The historical condition hydrology shows a -91% decrease in bedload and for the Proposed condition hydrology the bedload decreases by -73%.

- **Rush Creek Upstream of Reversed Confluence** – At transect G3T8 the total average annual bedload for the unimpaired condition hydrology was 1,494 tons/year. The historical condition hydrology shows a -81% decrease in bedload and for the Proposed condition hydrology the bedload decreases by -70%.

- **Rush Creek Below Silver Lake** – At transect G1T1 the total average annual bedload for the unimpaired condition hydrology was 16,029 tons/year. The historical condition hydrology shows a -30% decrease in bedload and for the Proposed condition hydrology the bedload decreases by -17%.

At transect G3T18 the total average annual bedload for the unimpaired condition hydrology was 36,560 tons/year. The historical condition hydrology shows a -5% decrease in bedload and for the Proposed condition hydrology the bedload decreases by -2%.

6.3.4 Key Conclusions of the Maintain Geomorphic Processes Analysis

The following are the key conclusions from the analysis performed to evaluate changes in channel maintenance processes between impaired and unimpaired hydrology:

Bankfull Flow

Field identified bankfull discharge in the Rush Creek Below Rush Meadows Dam reach average was 263 cfs. In the Rush Creek Below Agnew Dam reach average bankfull was 39 cfs and Rush Creek above Reverse Creek average measured bankfull was 49 cfs. Bankfull discharge increased to 281 cfs for the most downstream reach analyzed, Rush Creek Below Silver Lake.

The Rush Creek Below Agnew Dam to Reverse Creek reach (2.0 miles), which exhibited lower bankfull discharge (e.g., smaller channel), is a steep bedrock, non-adjustable channel, except for three small 0.1-mile segments (inflow delta to Agnew Lake, RM 19.1 to 19.2, immediately downstream of Agnew Dam, RM 18.5 to 18.6, and immediately above Reversed Creek, RM 17.5 to 17.6). The lower gradient segments represent only 15% of the reach. The bankfull cross-sections were located within these segments because the bedrock channel segments do not adjust or have bankfull indicators to measure.

1.5-Year Recurrence Interval Flow Frequency

The 1.5-year recurrence flow in Rush Creek downstream of Gem Dam and Agnew Dam showed the largest change in high-flow hydrology compared to unimpaired conditions. This occurs because Gem Lake stores water for hydropower generation. Under the existing hydrology, the average number of days flows were at or above the 1.5-year recurrence flow was 7.1 days/year versus 22 days/year for unimpaired conditions. The Proposed Action 1.5-year recurrence flow frequence would be slightly higher than existing conditions (7.8 days/year versus 7.1 days/year).

In Rush Creek below Rush Meadows Dam and below Silver Lake, the 1.5-year recurrence flows were less affected by the regulated hydrology. Under existing hydrology, the number of days at or above the 1.5-year recurrence flow was 6.2 days/year below Rush Meadows Dam and 11.1 days/year below Silver Lake compared to unimpaired conditions of 9.3 days/year and 16.5 days/year, respectively. Under the Proposed Action hydrology, the Rush Creek below Rush Meadows Dam 1.5-year recurrence flow frequency would increase and be the same as unimpaired. In the Rush Creek Below Silver Lake reach, the Proposed Action 1.5-year recurrence flow frequency would be slightly higher than existing conditions (11.6 days/year versus 11.1 days/year).

Spawning Gravel Mobilization

The flows required to mobilize 32 mm spawning gravel varied depending on the transect, which is expected since the transects all have different gradients and morphologies. In steeper reaches (e.g., high gradient riffles) spawning gravels are unlikely to be present, or if present are limited to pocket gravels among coarser substrate that shields gravel from transport. At the selected transects analyzed, a discharge of 132 cfs or less was capable of meeting the 32 mm transport criteria. Comparison of the frequency that 32 mm particles are mobilized under unimpaired and regulated flow conditions shows that below Rush Meadows Dam the Proposed hydrology regime and thus frequency of mobilization, will be the same as the unimpaired condition. The largest changes occur in Rush Creek below Gem Dam and Agnew Dam. Under the historical hydrology, the average number of days per year of mobilization was decreased by approximately -80% compared to the unimpaired conditions. Under the Proposed condition, the reduction would be closer to unimpaired, -70%. In Rush Creek below Silver Lake, the historical hydrology shows an increased frequency of mobilization of about +52%, while under the Proposed hydrology the increase is about +24% compared to the unimpaired condition. The increased mobilization is due to both the historic and Proposed hydrologic regimes having more days of flows around the 60 cfs to 70 cfs needed to mobilize 32 mm gravel in this reach compared to the unimpaired regime.

D_{50} Particle Mobilization

Similar to the 32 mm spawning gravel results, the discharge required to mobilize the bed surface D_{50} particle varied depending on channel slope and morphology. At some transects the D_{50} is mobilized at or near the bankfull flow (Rush Creek Below Silver Lake), but at other transects it can require a higher flow to mobilize the D_{50}. Similar to the results of the 32 mm mobilization analysis, comparison of the frequency that the D_{50} particle size was mobilized under unimpaired and regulated flow conditions shows that the largest decreases occurred in Rush Creek below Gem Dam / Agnew Dam reach. In Rush Creek below Silver Lake, mobilization of the D_{50} particle size would occur more frequently under the Proposed flow regime (25 days/year) than the historical flow regime (18 days/year), compared to 35 days/year for the unimpaired condition.

Annual Bedload Transport Rates

Downstream of Rush Meadows Dam the historical decrease in bedload transport was -12% but under the Proposed hydrology it would return to unimpaired conditions. The reductions in bedload transport were greatest in Rush Creek downstream of Gem Dam / Agnew Dam where transport under historical hydrology was reduced by about -85% compared to the unimpaired condition. Under the Proposed hydrology, the reduction was less, about -70%. Under the historical flow regime, average annual bedload transport was decreased approximately -18% in Rush Creek downstream of Silver Lake compared to the unimpaired condition. Under the Proposed hydrology bedload transport would increase from the historical condition and would be about -10% less than the unimpaired condition.

6.4 IDENTIFY HISTORICAL AND EXISTING SOURCES OF SEDIMENT AND PROJECT-RELATED EROSION AREAS

All sources of sediment considered (mass-wasting, bank erosion, roads, trails, Project-related infrastructure), cumulatively contribute to sediment loads. Field observations indicate that sediments, particularly finer sand sized (<2 mm) materials that are readily transported, are present throughout the watershed. Inspection of Rush Creek at the inlet to Waugh Lake showed considerable evidence of sand deposition along the bed, as did flatter geomorphic surfaces at the elevation of historically higher reservoir levels (prior to modification of the spillway and the seismic restrictions. The finer sediments here, as in all parts of the Rush Creek watershed, are likely derived from many large scale mass-wasting sites. Downstream of Rush Meadows Dam, there are small areas with sand deposition in the Rush Creek channel wherever the gradient flattens out or there are quiescent back-water areas, but little evidence of sand wherever the channel gradient is steeper. There are few and limited channel segments with sufficiently low-gradient where sand can effectively deposit (most of the streams in the watershed except along the valley floor are high-gradient transport reaches, see Table AQ 5-3), so sand is not often observed.

The same is true in the June Lake/Gull Lake sub-basin, where Reversed Creek traverses the valley floor. Reversed Creek is predominantly a gravel and cobble bed, but in places where the gradient briefly flattens out, sand is deposited. At the location of the Reversed Creek-Rush Creek confluence (RM 17.5), downstream to Silver Lake, the channel bed is completely sand dominated (see Table AQ 5-5). The gradient here is low and during high runoff periods the channel and meadow area upstream of Silver Lake is inundated, so that sand transported from all other parts of the watershed deposit in this area.

On a watershed scale, mass wasting is the greatest relative source of sediments, particularly those mass wasting sites that are in direct contact with drainage pathways, which accounts for 2,574 acres (4.0 square miles [sq. mi.]) of contributing area (see Section 6.4.1). Of that total in direct contact with waterways, there are 1,116 mass-wasting acres (1.7 sq. mi.) situated in the lower watershed (defined in Section 6.4.1 below), downstream of the Project reservoirs and downstream of any large natural lakes, that contribute to direct routing of sediments to Silver Lake. Sediments derived from mass-wasting sites in the upper watershed must pass through various lakes and the three Project reservoirs, where mass-wasting derived sediments in transport are likely captured and stored, before it can reach Silver Lake. As such, the 1,116 acres of mass wasting areas in the lower watershed are the most direct and largest contributors of sediment to Silver Lake. Yost and Fern Creeks are two streams that drain mass-wasting sites and transport their sediments to Reversed Creek, routing sediments into Rush Creek just upstream of Silver Lake.

All other sediment sources investigated, including roads, trails, streambank erosion, and erosion associated with SCE facilities all contribute relatively smaller amounts of sediment to the watershed and specifically to Silver Lake. No significant sites of erosion associated with any of these features were identified. Streambanks are well armored by bedrock and boulders throughout most of the watershed above the valley floor, so that they are subject to very little erosion. On the valley floor the finer grained streambanks have a greater potential for erosion, but of the streams observed (Yost, Fern, Rush, and Reversed Creeks) the streambanks are well-vegetated with relatively small areas of erosion.

Roads, which are generally known to be potential contributors of sediment (cut-slope and fill slope failures, road surface rilling, inboard ditch rilling and gullying, and inadequately designed culvert crossings), were also determined to be minor sources of sediment contribution. Most roads are located on the valley floor, which tend to generate less erosion than roads located on the steeper canyon side slopes, of which there are few in the watershed. No significant areas of erosion related to roads were identified within close proximity to Silver Lake. A comprehensive assessment of all roads in the watershed was not conducted but anecdotal evidence suggests that road construction, maintenance, and hydro-modification may have a cumulative effect on sediment production. Additionally, sediment production from land use modification and development in the June Lake/Gull Lake sub-basin, which has not been studied but likely also has a cumulative effect.

Although poorly designed trails can cause erosion, there are relatively few trails in the watershed, and where there was erosion observed it was minor, focused around site-specific stream crossings. The Rush Creek Trail crosses unstable areas of mass wasting, but erosion around the trail is associated with the mass-wasting itself, with no significant erosion caused by the trails.

None of the SCE infrastructure sites inspected were active, significant sources of erosion and sediment production.

Based on results of suspended sediment sampling (Section 6.4.5 below), the mainstem of Rush Creek, the Powerhouse tailrace, Reversed Creek, South Rush Creek, and the unnamed tributaries all contribute sand sized sediment loads to the valley floor and ultimately to Silver Lake. Considering that the suspended sediment sampling sites on mainstem Rush Creek, South Rush Creek, and the Powerhouse tailrace were located just upstream from SR-158, it is possible that some portion of the sediments transported through the upper watershed may pass through Gem and Agnew lakes. It is possible Agnew Lake, in particular, may not have a high sediment-trap efficiency. Sediment carried into Agnew Lake from the upper watershed or surface soil inundated by the reservoir and redistributed through littoral shoreline erosion may not be entirely retained and stored during high flows, but could make it to the outflow of the reservoir into the Rush Creek channel. Since the Rush Creek channel below Agnew Lake is predominantly bedrock, local sand production below the reservoir is likely low. The unnamed tributary entering Rush Creek near the powerhouse may be contributing suspended sediment. When bathymetry data is collected in 2024, it would be useful to assess sediment trap efficiency with a numerical model.

A summary of mass-wasting features, streambank erosion, roads and trail erosion, SCE infrastructure erosion, and suspended sediment sampling results is provided below. In addition, this section includes with an update on historical and recent changes to the progression of the delta deposit at the Rush Creek inlet to Silver Lake.

6.4.1 Mass Wasting

Field observations identified a debris slide across the Rush Creek Trail crossing of an unnamed first order tributary along the north side of Waugh Lake (Photo AQ 5-1). Considerable amounts of earth material were deposited at the lake shoreline (Photo AQ 5-2 and Photo AQ 5-3). Debris fan deposits of coarser gravel, cobble, and boulders intermixed with finer sand-sized and smaller particles were deposited along the Waugh Lake shoreline in transverse alignments to the unnamed tributary. A pebble count was conducted on a transect across several of the debris fan deposits, showing a median particle size (D50) of 74 mm. The date of the debris slide is unknown, but a review of available historical aerial imagery found that the debris slide, pre-dates 2009. Debris slides such as this one typically occur episodically (decadal scale) on very steep, low-order channels. This is likely a common, though infrequent, process of sediment delivery throughout the Rush Creek Watershed.

As shown in Maps AQ 5-2a, 5-2b, and 5-2c, and Table AQ 5-16, 149 mass-wasting sites representing 4,400 acres were identified in the Rush Creek Watershed. Detailed mass-wasting site maps and basin specific data tables are provided in Appendix G. The upper watersheds include Waugh Lake, Gem Lake, and Agnew Lake, having drainage areas of 9,587, 4,422 and 807 acres, respectively. Within the upper watersheds, 96 mass-wasting sites totaling 2,181 acres were identified. The lower watersheds were separated into three drainage basins, including Below Agnew Lake, Silver Lake, and June Lake, with drainage areas of 873, 4,806, and 9,639 acres, respectively. Within the lower watersheds, 53 mass-wasting sites totaling 2,219 acres were identified.

- Mass-wasting sites were characterized as having low sediment delivery potential in cases where the sites did not have any portion of the mass-wasting perimeter in direct contact with any streams or lakes, with the earth material predominantly stored on hillslopes. High sediment delivery potential sites were those where the mass-wasting feature was in direct contact with either streams, lakes, or reservoirs (Photo AQ 5-4). There were 45 high sediment delivery potential sites identified in the upper watersheds, equaling 1,458 acres. The majority of these sites were in the Waugh Lake Basin, with 27 sites equaling 934 acres. Waugh Lake also receives episodic sediment input from the aforementioned debris flow, as evidenced by the characteristic debris flow levee deposits on the north shore of the lake. There were 12 high sediment delivery potential mass-wasting sites equaling 238 acres in the Gem Lake Basin, and 6 sites equaling 285 acres in the Agnew Lake Basin.

- Mass-wasting sites in the lower watersheds do not drain to any Project reservoir or to any large natural lakes, except to Silver Lake. Mass-wasting sites in the upper watersheds that are not stored on hillslopes but are connected to waterways, drain to either large natural lakes and/or to Project reservoirs. As such, sediment that may be delivered to waterways in the upper watersheds will eventually be transported to and stored within these large natural lakes and/or reservoirs. The trap efficiency of lakes and reservoirs are variable depending upon their size, depth, and configuration, so some waterbodies are likely more effective at trapping sediments than others. It is possible that some proportion of sediments that enter a stream (whether through mass wasting, streambank erosion, or any other erosion process), particularly smaller particle sizes such as sand, could be suspended and transported through lakes and reservoirs during high runoff periods.

The high sediment delivery mass-wasting sites in the lower watersheds have a unique distinction from those in the upper watersheds. These sites have perimeters in direct contact with waterways which flow relatively unimpeded into Silver Lake and there is limited opportunity for the sediments to be captured/stored before reaching Silver Lake. Maps AQ 5-2a, AQ 5-2b, and AQ 5-2c show that there are 28 of these high-delivery mass-wasting sites totaling 1,116 acres in the lower watersheds. The Silver Lake Basin contained most of the high sediment delivery sites, with 14 sites equaling 563 acres. The June Lake Basin contained 11 sites equaling 463 acres, and the basin designated as Below Agnew Lake contained 3 sites equaling 91 acres.

6.4.2 Streambank Erosion

Unlike mass wasting where some eroded sediments may be stored on hillslopes without entering waterways, all streambank erosion represents direct delivery of sediments to streams. Map AQ 5-3[6] shows the location of perennial and ephemeral/intermittent stream channels in the Project watershed. Table AQ 5-17 is a summary accounting of the number of miles of perennial channels,[7] organized by major drainage basin between each of the reservoirs.

The Waugh Lake sub-drainage Basin has by far the largest watershed area and associated length of perennial streams. As such, there is a greater potential for streams within this portion of the watershed to contribute sediments from streambank erosion. There is also a considerable network of ephemeral and intermittent streams (see Map AQ 5-3) extending from the Rodger’s Peak and Lyell Peak cirque basins at the watershed boundary that represent potential areas for bank erosion. Notably, materials eroded from this portion of the Rush Creek Watershed must pass through various natural lakes, as well as Project reservoirs, where transported sediments will be deposited, diminishing the sediment load carried further downstream. Of the delineated sub-basins, the Below Agnew, Silver Lake, and June Lake (below Gull Lake) drainages have the most direct routing of water and sediment to Silver Lake since there are no other lakes or reservoirs to interrupt sediment transport downstream of these sub-basins.

[6] Source: National Hydrography Dataset @ 1:24,000-scale, USGS, 2023 and National Geographic TOPO! 1:24,000-scale maps, 2013, some features further updated using 2018 high-resolution aerial imagery from the HxGN Content Program, Hexagon, Inc.

[7] The USGS National Hydrography Dataset (2023) did not have extractable stream length data for ephemeral and intermittent streams, although they are an important part of the drainage network for transport of water and sediment.

Streambank erosion does not represent a significant proportion of total sediment recruitment from the watershed to streams and to Silver Lake. Bank erosion on Rush Creek and tributaries to Rush Creek, particularly in the "high-country" wilderness, is limited due to considerable bedrock and boulder control, typical of A1/A2 and B1/B2 channel types. No significant bank erosion was observed in the field and none of the few instances of site-specific erosion identified are attributable to anthropogenic causes (excepting site-specific erosion associated with Project infrastructure, which is addressed separately after this section).

In the "low-country" Rush Creek, Reversed Creek, South Rush Creek, and other tributaries on the valley floor are lower gradient, more sinuous, with smaller sized bed material, and finer-grained deformable bank material compared with the non-adjustable channel types in the high-country. As such, these channel types (C4, C5) are more responsive to perturbations in the watershed and susceptible to erosion. However, field inspection of streams traversing the valley floor found streambanks to be well-vegetated without significant bank erosion, with only a few relatively minor site-specific locations of erosion observed.

Photographic examples of typical streambank conditions, both stable banks and sites of observed erosion, are provided in Photos AQ 5-5 through AQ 5-22.

6.4.3 Trail and Road-Related Erosion

Sediment sources and erosion sites associated with trails were characterized along the Rush Creek Trail from the trailhead at Silver Lake to where the trail crosses Rush Creek upstream of Waugh Lake and a short segment of the Spooky Meadow Trail where it crosses Rush Creek (Map AQ 5-4[8]). Erosional observations along trails are provided in Table AQ 5-18.

The Rush Creek Trail (non-Project trail) is a popular trail used by hikers, backpackers, and pack trains. Due to its high level of use the trail, particularly up to Agnew Lake, shows signs of surface erosion (concave trail bed) along much of its length in steep sections. In some places as observed around Waugh Lake, surface wear and erosion has made the trail bed incised which can divert upslope surface runoff down the trail accelerating the rate of erosion (Photo AQ 5-23). Water bars incorporated into the trail are sufficiently breaking up the surface runoff distance to minimize or prevent rill erosion from occurring. Sediment accumulates at the outlet of some water bars as shown in Photo AQ 5-24 and Photo AQ 5-25, but conveyance of sediment much beyond the trail was not observed as an issue.

The Rush Creek Trail (non-Project trail) traverses numerous and expansive debris slides that convey significantly higher quantities of rock and sediment downslope than the trails that bisect them. In some cases, the trail may intercept or divert runoff and fine sediment from these slides, but usually over short distances before being redirected downslope by

[8] Source: Inyo National Forest System Trails, Forest Service, Pacific Southwest Region, California, Region 5, 2013, some features further updated using 2018 high-resolution aerial imagery from the HxGN Content Program, Hexagon, Inc.

trail water bars. Sediment diverted from the Rush Creek Trail throughout much of its observed length appears to be stored on adjacent slopes with no indication of delivery to a stream channel with a few relatively minor exceptions. There are approximately six perennial stream crossings along the Rush Creek and Spooky Meadow trails that were observed (Map AQ 5-4) but sediment entering streams from the trails are generally limited by appropriate spacing of trail water bars that generally do not exceed 100 feet of trail length in either direction. Photo AQ 5-26 is an example of a trail/stream crossing where trail runoff and sediment enters Rush Creek. Nonetheless, when flow is present disturbance of the streambed and banks at these trail crossings do occur, particularly from horses and pack animals traversing the streams, resulting in infrequent and relatively minor sediment delivery. Except for minor sediment input to streams at trail crossings, trails do not appear to be contributing any significant sediment.

Erosion of the Lower Gem Dam Trail (Project trail) surface was observed where dry raveling of soil and rock from foot traffic on the steep slope causes most of the eroded sediments to be deposited and stored on the hillslope, where it is unlikely to reach the stream channel much further downslope (Photo AQ 5-27, Table AQ 5-18). Erosion observed from the access trail adjacent to and largely relating to the penstock and tramway are discussed separately, in association with infrastructure related erosion (Section 6.4.4).

A total of 42.3 miles of roads drain to Silver Lake of which 62% are classified as paved (impervious) and 38% are pervious roads surfaced with aggregate or unsurfaced (native soil) (Table AQ 5-19). Most of the roads drain to the inlet of Silver Lake (Map AQ 5-5[9]). Impervious and less pervious surfaces (such as unpaved roads with compacted soil) increase the hydrologic response in a watershed by eliminating or reducing the soil infiltration rate from precipitation (rain and snow) thereby increasing the amount of surface runoff that can flow to stream channels.

Roads were inspected (Appendix A) to characterize their condition and potential to deliver sediment to Rush or Reversed Creeks, and thence to Silver Lake. Locations observed in the field are primarily along SR-158, Nevada Street (both non-Project roads), and ancillary Project roads around the powerhouse. Table AQ 5-18 lists the locations identified in the field associated with the roads around Silver Lake that either are areas that are frequently disturbed by vehicle or foot traffic and were near Rush Creek or showed indication of erosion and therefore potential for sediment conveyance to streams.

Due to the volume of traffic on SR-158 (non-Project road) and pedestrians accessing the creek from the roadway, most of the turnouts along the highway were identified as potential sources of sediment. Most turnouts are confined to relatively small areas and have a gravel surface and thus have a minor contribution to the overall Rush Creek sediment load. Photos AQ 5-28 to 5-33 provides a visual characterization of the various turnouts along SR-158 that drain to a channel leading to the inlet of Silver Lake. The turnout and stream access point at location RE-1 (Appendix A) is the most frequently

9 TIGER/Line Shapefiles, U.S. Census Bureau, 2023, some features further updated and attributed using 2018 high-resolution aerial imagery from the HxGN Content Program, Hexagon, Inc. and Google Earth Street View, 2024 Google, Inc.

disturbed by vehicles and pedestrians as it is used as a river put-in for anglers and those paddling the stream. The location has some gravel offering limited soil protection but is devoid of vegetation from SR-158 down to the water edge (Photo AQ 5-28). Four turnout locations along SR-158 are also culvert crossings. Bank erosion that may be attributed to the culverts was documented at two locations: the inlet and outlet side of the tailrace culvert (Photo AQ 5-30) and less so on the outlet side of the Reversed Creek culvert (Photo AQ 5-33). Most other turnouts along SR-158 (Photos AQ 5-29, 5-31, and 5-32) have some minor vegetated buffer between the feature and waterway.

Second to SR-158, Nevada Street and roads that spur off Nevada Street (including Silver Meadows Lane) are the closest roads with potential to deliver sediment to Silver Lake. Nevada Street and its spur roads (all non-Project roads) are graveled, except a dirt spur road into the meadow area that is infrequently used. Nevada Street serves a number of houses along the east side of the lake and thus are frequented by traffic. Five locations where surface runoff was diverted off the road or noticeable erosion or sedimentation occurred was documented (Appendix A). Three example locations are described herein. Photo AQ 5-34 shows where road runoff is diverted across the road into a large, vegetated buffer draining to Reversed Creek (Location RE-8 in Appendix A). While some rills and erosion of an in-board ditch was occurring, there was no indication of silt or sand transport to Reversed Creek. Photo AQ 5-35 shows where a large amount of sediment was deposited across the road in 2023 from presumably the dirt/gravel road upslope. A nearby vegetated ditch carries surface runoff to Reversed Creek but there was no evidence that silt or sand sized sediments deposited on Nevada Street was conveyed to Reversed Creek. Photo AQ 5-36 is the third location along Nevada Street that conveys surface and shallow concentrated runoff from the road through a small culvert into the wetland adjacent to Rush Creek. Again, there was no indication of sediment conveyance much beyond the edge of the road and the large wetland buffer would prevent sediment from reaching Rush Creek. All locations documented on Nevada Street and the spur roads out into the meadow showed no signs of sediment conveyed much beyond the road due to the relatively low gradient and large vegetated buffers between the roads and waterways.

Aerial imagery was reviewed to look for indications of erosion and potential sediment conveyance to nearby channels from non-Project roads or trails in the watershed that were not field inspected. In no case was there clear evidence of sediment conveyance to a stream channel from an erosional source. Erosion of roads and trails are accumulative sources of sand and fine sediment, which was observed in Reversed Creek and Rush Creek at locations along the valley floor.

Photo AQ 5-37 shows an example of erosion on the cut slope of Canyon Trail Road (a non-Project road that traverses the hillslope at June Mountain ski resort) with likely conveyance of sediment to a steep ephemeral drainage. The ephemeral drainage traverses a steep alluvial fan, which may trap some sediment at the base of June Mountain, before it reaches Reversed Creek. It is unclear if there are any topographic benches, flat meadow areas, or detention basins associated with the ski resort sediment management plan that may also trap the sediment before entering Reversed Creek.

Photo AQ 5-38 is a second example showing surface drainage from Los Angeles Street, Hideaway Lane, and Arizona Street (non-Project roads) that likely contribute some sediment to nearby Reversed Creek. Photo AQ 5-39 shows a street view image showing where road runoff enters Reversed Creek from Los Angeles Street.

Overbank flows from Fern Creek (tributary to Reversed Creek) may periodically flood the (non-Project related) dirt parking lot at the Fern/Yost trail head. Rills appear in aerial imagery from 2023 that carry sediment back into Fern Creek downstream of the bridge (Photo AQ 5-40).

Any sand applied to SR-158 and county roadways during snowy or icy conditions is an annual contributor of sediment where it makes its way directly into streams or into roadside ditches where shallow concentrated flow can convey sediment to nearby stream channels or Silver Lake. Photo AQ 5-41 shows an example of a location where road runoff from SR-158 enters directly into Reversed Creek carrying roadway sand accumulated over the winter season.

6.4.4 Infrastructure Project-Related Erosion

Erosion associated with Project operations were documented from Gem Dam downstream to the powerhouse facilities. The focus was to document locations where recent erosional issues have occurred (within ±10 years). The assessment did not focus on locations where historical erosion occurred in the years following original construction of Project infrastructure but are no longer an issue. Some locations were noted as probable historical sources of sediment as well as more recent erosion sites. A total of 13 locations were identified in the field (Appendix A) and summarized in Table AQ 5-20 with references to representative site location photographs. The likelihood of recent sediment delivery to a stream (either Rush Creek or a tributary to Rush Creek) from an erosional source was documented at nine locations.

The first location, as indicated in Appendix A and shown in Photo AQ 5-42, has active surface erosion exposing a portion of the Gem to Agnew junction flowline and Project access trail between Rush Creek Trail and Gem Dam. Soil loss at this location is likely stored on the hillslope along with spoil material remaining from construction of the penstock. Photo AQ 5-43 shows a second location along the flowline closer to Gem Dam where fill is collapsing in around a shed surrounding the pipeline. The collapsing material appears to be destabilizing a portion of the gunite/shotcrete reinforced rock wall supporting the flowline. Freeze-thaw weathering may also be contributing to the process depositing sediment into the outlet channel below (Photo AQ 5-44). The outlet channel leading from the Gem flowline valve house is a historic source of sediment but has eroded down to a stable bedrock and boulder bed for most of its length. At its junction with Rush Creek, there may have been more recent erosion of fan deposits that resulted from plugging of the tramway culverts in 2017.

Recent erosion occurring along the Gem to Agnew Tramway is characterized at three locations identified in Appendix A. A small failure of the soil occurred above the right abutment concrete retaining wall supporting the Rush Creek tram bridge (Photo AQ 5-45).

Surface erosion is still occurring but is a relatively small area that could increase if the trees above the slope get wind thrown. Surface erosion along the length of the tramway is evident by the exposure of rails, particularly on steeper pitches (Photo AQ 5-46). The stretch between the tram bridge and culverts are most likely to contribute sediment to Rush Creek due to the proximity of the tramway to the stream. As previously mentioned, the two culverts that convey flow from the outlet of the Gem to Agnew valve to Rush Creek plugged in 2017 resulting in diversion of flow down the tramway eroding fill material that supported the tracks (Photos AQ 5-47 and 5-48). Some of the material eroded appears to have been deposited in the same drainage, but most was deposited on and below the tracks leading down into Rush Creek. Noticeable accretion is visible on the alluvial fan in Agnew Lake when comparing 2016 to 2019 aerial imagery. Most of the sediment deposited along the margins and outer lobe of the Agnew fan likely came from the tramway erosion in 2017.

Below Agnew Dam, the 2017 emergency cut in the flowline to release flows into Rush Creek eroded a channel to Rush Creek. Surveys in 2017 conducted following the Agnew flowline emergency cut indicated a 1,660 ft^2 area of soil was eroded by the flow release. This increased the disturbance area from the Gem Pressure Relief Valve House (upslope of the flowline cut) down to Rush Creek from 2,974 ft^2 prior to 2017 to 4,436 ft^2 following the 2017 emergency release. Based on the 2017 survey it is estimated that approximately 185 cubic yards of sediment may have been washed downstream into Rush Creek. Some of the sediment is visible behind the gaging station weir. While most of area surrounding the penstock cut is now exposed bedrock, boulder, and cobble and less likely to erode, some channel surface erosion can still occur if water is released from the flowline (Photo AQ 5-49).

Similar to the emergency cut in the Agnew flowline, construction of a new Gem reservoir release valve and 18-inch pipe into Rush Creek at the Agnew / Gem penstock cross-over valve house (downstream of Agnew Dam) in 2017 initially caused erosion of the left and right banks of Rush Creek as water sprayed across the valley (Photo AQ 5-50). Because the right bank is composed of mostly bedrock and scree collected in a fissure, comparison of aerial imagery does not suggest a significant amount of rock and sediment was transported downstream (estimated 60 cubic yards). Erosion on the left bank (estimated 35 cubic yards) consists mostly of surface and channel/gully erosion leading from the outlet of the 18-inch pipe that most likely occurs when opening and closing the valve (as most of the flow crosses over Rush Creek as can be seen in the 2023 aerial image (Photo AQ 5-50). Just downstream of the standpipe is a historic drainage channel leading from the Agnew junction valve house that has an eroded channel down to Rush Creek (Photo AQ 5-51). The channel is armored with coarse substrate and usage is infrequent, minimizing sediment delivery.

Erosion occurring along the Agnew Tramway consists mostly of surface erosion between the tracks and fill slopes, which is worse along steeper pitches. Photo AQ 5-52 shows the most likely area adjacent to Rush Creek where sediment from the tracks and spoils below the supporting rock/gunite retaining wall enter the stream. This location also receives rock and sediment transported downslope from natural mass-wasting processes as indicated in the aerial image in Photo AQ 5-52. Photo AQ 5-53 shows some of the typical surface erosion along steeper pitches of the tracks (e.g., below the Rush Creek Trail) as evidenced by exposed rails. Sediment generated from the tram in most places is stored on the adjacent rocky slopes some distance from any channel and thus has very little likelihood of reaching a waterbody. Photo AQ 5-54 shows a third location along the tramway where very minor surface erosion could enter an unnamed tributary to Rush Creek. Surface and rill erosion occurring on the lower most segment of the tramway flows down towards the powerhouse facilities but is unlikely to flow across the paved yard and back into the tailrace channel (Photo AQ 5-55).

No erosion or sediment issues were identified with access roads serving Project facilities near the powerhouse.

Overall, the amount of sediment generated from active erosion occurring from Project infrastructure observed in 2023 is relatively low especially in context to the input from natural mass-wasting sources. Most of the erosion is in response to either historical construction or disturbances that occurred in the 2017 water year. The source areas that recently produced the largest volume of sediment were between Gem Dam and Agnew Lake and most of that sediment is likely contained in Agnew Lake.

6.4.5 Suspended Sediment Sampling

Table AQ 5-21 provides the sediment concentration results and particle sizes for the suspended sediment sampling. Generally, higher flows are associated with higher sediment concentrations, but there is considerable scatter in the data which is typical for suspended sediment sampling. Photo AQ 5-56 shows the Powerhouse Tailrace at the suspended sediment sampling site on June 15, 2023. Flow is 106 cfs and sediment concentration was 56.8 milligrams per liter, notably the water is quite clear with the bottom of the channel visible.

Based on the results of the suspended sediment sampling, Rush Creek, the Powerhouse Tailrace, Reversed Creek, South Rush Creek and the unnamed tributaries all contribute sand sized sediment loads to the valley floor. Considering that the suspended sediment sampling sites on Rush Creek, South Rush Creek, and the Powerhouse Tailrace were located upstream from SR-158 and much of the channel upstream of the highway to Agnew Lake is bedrock (low sediment production), it is possible that some portion of the sediments transported through the upper watershed pass through Gem and Agnew lakes. It is possible that Agnew Lake in particular, may not have a high sediment-trap efficiency. Sediment carried into Agnew Lake from the upper watershed or surface soil inundated by the reservoir and redistributed through shoreline erosion may not be entirely retained and stored during high flows but could make it to the outflow of the reservoir and into the Rush Creek channel. Similarly, a portion of suspended sediment reaching Silver Lake may also be passing through the lake and downstream during high inflows.

6.4.6 Silver Lake Sediment Deposition

The USGS performed bathymetric surveys of Gull and Silver Lakes in 1994 to determine their respective capacities at that time (Blodget 1997). The average annual capacity of Silver Lake was approximately 3,000 acre-feet in 1994. Additionally, the USGS monitored sediment deposition at the inlet to Silver Lake starting in 1951 using aerial photography. The size of the deltaic deposit at the inlet of Rush Creek to Silver Lake was last updated by the USGS in 1994.

The USGS report used historical aerial photography beginning in 1951 to investigate sediment deposition at the inlet to Silver Lake along the eastern shoreline. Deposition first was observable in 1963. From 1963 to 1994, the area of sediment deposition increased from 0.32 to 2.4 acres. The USGS data shows that the rate of deposition was lower during 1951–1972 period, compared to the rate from 1973–1994. From 1963–1994, the center of the deltaic deposit migrated north about 95 feet and west about 29 feet (Blodgett 1997) indicating that the sediment deposit had increased in area and was growing in a northwesterly direction.

In 2004, the East Shore Silver Lake Improvement Association (ESSLIA) received a permit to dredge portions of Rush Creek at the Silver Lake inlet (Mark Shoemaker, ESSLIA President). A 33.5-foot Mud Cat maneuverable dredge operated by a dredging contractor was used in the Rush Creek channel. Approximately 5,800 cubic yards of dredge material within a 1,300-foot reach of the channel at the Silver Lake inlet was removed and disposed offsite.

SCE used imagery from Google Earth[10] to recreate the USGS (Blodgett 1996) report delineation of the deltaic deposit in 1993 and update their analysis. The original USGS mapping for the 1993 delta is shown in Figure AQ 5-1. A slightly larger area was calculated in this current analysis for the 1993 delta, by 0.13 acre, compared with the USGS study. This is reasonably close to the USGS calculation given the inaccuracies associated with delineation using the older, black and white aerial imagery.

The recently available aerial photography where the delta was fully visible for delineation was 2005 and 2019. The delta areas delineated for 1993, 2005 and 2019 are shown in Figures AQ 5-2 and AQ 5-3. The calculated areas of the previous delta deposits from the USGS, and the recent 1993, 2005 and 2019 deltas are shown in Table AQ 5-22. The delta decreased after the 2004 dredging by ESSLIA but has continued to expand. The delta increased from 2.35 acres in 1993 to 3.1 acres in 2019 (Figure AQ 5-4). This is an increase of 0.75 acre (32%) over 26 years. The delta area quantified by aerial imagery has not continuously increased in size in all time periods, there have been periods of decreased size, either due to the quantification method or actual decreases, interspersed with periods of increase (see Table AQ 5-22 and Figure AQ 5-4) (e.g., 5,800 cubic yards was removed by ESSLIA in 2004).

[10] A September 1994 aerial photo was not available in Google Earth to analyze delta area in 1994.

The largest increase in the delta area from 1972–1983 might be linked to development in the watershed associated with roads, housing, and ski area, or other factors. According to the USGS report, there were recreational summer home developments around June Lake, Gull Lake, and Silver Lake, with a permanent population of about 650 in the June Lake community by 1985. The June Mountain ski area was constructed in the early 1970s. Most of the ski runs are now revegetated and have sediment trap basins constructed. An erosion-prevention plan for the ski area was implemented by the Forest Service in 1982. Groeneveld and Thompson (1997) identified straightening of the SR-158 highway (1962), the June Mountain ski area, and floods from Yost and Fern creeks (January 1996) as the most significant sources of sediment. The USGS report did not identify if a particular period of construction was the cause of the higher rate of sediment deposition. In part, this is because linking sedimentation in the lake to a particular time period of construction is difficult because there are varying runoff and sediment transport rates from year to year and there is a time lag for bedload sediment to move from upstream to downstream. As such, sediment generated by development in one year may take many years before it reaches the lake due to the varying sediment transport rates. Also, sediments are naturally occurring products of weathering in the watershed, which over geologic timescales are continually transported to downstream reaches of the watershed.

6.5 Evaluation of Potential Rush Creek Channel Restoration in the Former Lakebed of Waugh Lake

Potential restoration of the Rush Creek channel within Waugh Lake is reported in the AQ 1 TSR.

6.6 Evaluation of Potential Enhancement of Rush Creek and South Rush Creek Channels Near SR-158

LWD accumulations in Rush Creek and South Rush Creek channels near SR-158 are shown in Map AQ 5-6 and photographs are provided in Appendix H. Characterizations of each site is provided in Table AQ 5-23.

The majority of the LWD in South Rush Creek was located east of SR-158 (downstream of SR-158) near the confluence with Reversed Creek. Five smaller LWD accumulations (SRWD_1 – SRWD_5; Map AQ 5-6) were located upstream of SR-158, while four larger accumulations (SRWD_6 – SRWD_9; Map AQ 5-6) were located downstream of SR-158. Woody debris accumulations in Rush Creek were located downstream of the highway both upstream (RCWD_1 and RCWD_2; Map AQ 5-6) and downstream (RCDSR_1 – RCDSR_4; Map AQ 5-6) of the confluence with Reversed Creek. The vast majority of the LWD was located in-channel below bankfull stage. Exceptions to this trend were located at SRWD_2 and SRWD_4 where the majority of the LWD was located in-channel above bankfull stage (see Appendix H, photos of SRWD_2 and SRWD_4). The LWD results will be used qualitatively in conjunction with hydraulic modeling in the AQ 1 TSR to evaluate the potential effect of LWD on channel conveyance (flow capability) in the Silver Lake Meadow area near SR-158.

An evaluation of potential enhancement of Rush Creek and South Rush Creek channels near SR-158, including an assessment of the flow conveyance capacity of culverts crossing SR-158, is discussed in the AQ 1 TSR.

6.7 Evaluation of Sediment Deposition/Transport in Rush Creek Near the Silver Lake Inlet

Results associated with this study element are provided in the AQ 1 TSR.

7 SUMMARY / KEY FINDINGS

7.1 Stream Segment Classification and Mesohabitat Typing

The length of Rush Creek generally consists of A, B, or C stream types. Below Silver Lake the reach is nearly evenly split between B4 (1.38 mile) and C4 (1.26) gravel bed dominated channel types. Upstream of Silver Lake to the Reversed Creek confluence, this reach is predominantly a sand-bed C5 channel type. Below Agnew Dam the channel is nearly all a very steep, bedrock A1 channel type, and similarly in the reach Below Gem Dam. Below Rush Meadows Dam the channel is nearly evenly split between A1 (0.47 mile), B3 (0.49 mile) and C3-C4 channel types (0.42 mile) that occur in alternating sections of this reach. Mesohabitat typing results are presented in AQ 1 TSR.

7.2 Sediment Conditions in Project-Affected Stream Segments

Fine sediment in pools were generally limited to a small proportion of the residual pool volume. In 21 of the 25 sampled pools, V* values were less than 0.10, indicating very little fine sediment storage. Reach-weighted average V*w values were equal to or less than 0.15 for all sampled reaches, indicating minor fine sediment storage in the Project-affected streams. The Rush Creek Above Silver Lake (Downstream of Reversed Creek Confluence) reach is a low gradient meadow/wetland dominated by fine and sediment and did not contain pools that meet the Hilton and Lisle (1993) pool selection criteria, therefore V* surveys were not performed in this reach.

The D_{50} of the 25 bulk samples collected in spawning riffles were within the typical size range of spawning material used by trout, 8–64 mm (Kondolf et al. 1993). Fine sediment was generally within the size criteria to support high reproductive success. Fine sediment <1 mm was relatively low in the gravel samples, none of the gravel samples exceeded the 14% criteria. Fine sediment content for 21 of the 25 gravel samples were within the <30% criteria for the <6.4 mm particle size, with four samples exceeding the criteria (samples exceeding the criteria were in Rush Creek above Silver Lake reach and in the Rush Creek below Silver Lake reach). After accounting for fine sediment reduction due to winnowing during spawning, all 25 samples were within the <30% criteria.

Seven sediment core samples were collected along Rush Creek from the Silver Lake delta inlet and upstream 0.67 mile along the channel. The D_{50} for all samples was consistently very coarse sand, averaging 1.3 mm and ranging from 0.8–1.5 mm with no apparent decreasing gradation in size from upstream to downstream.

7.3 Initiation of Sediment Transport

The discharge calculated for the field estimated bankfull elevations varies considerably on the four different mainstem Rush Creek reaches evaluated. The Rush Creek bankfull discharge at the far upstream reach (below Rush Meadows Dam) and downstream reach (below Silver Lake) is 263 and 281 cfs, respectively. For in-between bypass reaches that are dominated by bedrock channels (Gem Dam to upstream of Reversed Creek) the estimated bankfull discharge varied from 39 cfs (below Agnew Dam) to 49 cfs (upstream of Reversed Creek). The results suggest that flow regulation at Gem Dam has altered flows and the Rush Creek channel morphology/vegetation has adjusted to the modified flow regime at the adjustable sections of channel (15% of the reach). Generally, the reach below Gem Dam and Agnew Dam is steep bedrock, non-adjustable channel. The location of the transects for the bankfull flow and initiation of motion analyses were applicable only to the much lower gradient adjustable channel sections representing 15% of the channel.

The flows required to mobilize 32 mm spawning gravel and the bed surface D_{50} particle varied depending on reach variability in channel slope and morphology. At the selected transects analyzed, a discharge of 132 cfs or less was capable of transporting 32 mm size gravel (spawning gravel size). Similarly, in some reaches the D_{50} is mobilized at or near the bankfull flow but at other transects it can require a higher flow to mobilize the D_{50}.

7.4 Historical and Existing Sources of Sediment, Including Project-Related Erosion

All sources of sediment considered (mass-wasting, bank erosion, roads, trails, Project-related infrastructure), cumulatively contribute to sediment loads. Field observations indicate that sediments, particularly finer sand sized (<2 mm) materials that are readily transported, are present throughout the watershed, but there is little evidence of sand deposition along most channel segments which are high-gradient transport reaches. At the location of the Reversed Creek-Rush Creek confluence (RM 17.5), downstream to Silver Lake (RM 16.5), the channel bed is completely sand dominated. The gradient here is quite low and during high runoff periods the channel and entire meadow area upstream of Silver Lake is inundated, so that sand transported from all other parts of the watershed deposit in this area.

On a watershed scale, mass wasting is the greatest relative source of sediments, particularly those mass-wasting sites that are in direct contact with drainage pathways, which accounts for 2,574 acres (4.0 sq. mi.) of contributing area (see section 6.4.1). Of the total mass-wasting sites in direct contact with waterways, there are 1,116 mass-wasting acres (1.7 sq. mi.) situated downstream of all Project reservoirs and downstream of any large natural lakes, that contribute to direct routing of sediments to Silver Lake. As such, the 1,116 acres of mass-wasting area in the lower watershed are the most direct and largest contributors of sediment to Silver Lake. Yost and Fern Creeks are two streams that drain mass-wasting sites and transport their sediments to Reversed Creek, routing sediments into Rush Creek just upstream of Silver Lake.

All other sediment sources investigated, including roads, trails, streambank erosion, and erosion associated with Project facilities contribute relatively smaller amounts of sediment to the watershed and specifically to Silver Lake. There was no significant erosion identified at any of these types of features. Streambanks are well armored by bedrock and boulders throughout most of the watershed above the valley floor, so that they are subject to very little erosion. On the valley floor the finer grained streambanks have a greater potential for erosion, but of the streams observed (Yost, Fern, Rush, and Reversed Creeks), the streambanks are stable, well-vegetated, with relatively small areas of erosion. Groeneveld and Thompson (1997) identified the June Mountain Ski area and floods from Yost and Fern creeks (January 1996) significant historical sources of sediment.

Roads were determined to be minor sources of sediment. Most roads are located on the valley floor, which tend to generate less erosion than roads located on the steeper canyon side slopes, of which there are few in the watershed. No significant areas of erosion related to roads were identified in close proximity to Silver Lake. Groeneveld and Thompson (1997), however, reported historical straightening of the SR-158 highway (1962) as a source of sediment.

Trail erosion was minor, focused around site-specific stream crossings. The Rush Creek Trail (non-Project trail) crosses unstable areas of mass wasting, but erosion around the trail is associated with the mass-wasting itself, with no significant erosion caused by the trails.

There may have been Project infrastructure related erosion in the past, including an emergency cut in the penstock below Agnew Dam that contributed an estimated 185 cubic yards of sediment to Rush Creek in 2017. None of the Project infrastructure sites inspected are currently active, significant sources of erosion and sediment production.

7.5 SUSPENDED SEDIMENT SAMPLING

Suspended sediment samples were collected at five sampling locations and concentrations analyzed. Sediment concentrations generally increased with magnitude of flow, but there is considerable scatter in the data which is typical for sampling suspended sediments. All sampling sites contributed predominantly sand-sized sediments to Rush Creek on the valley floor above Silver Lake. Silt makes up a smaller proportion of the sediments transported and there is only a nominal amount of clay in the suspended load.

7.6 SILVER LAKE USGS SEDIMENT DEPOSITION UPDATE

The USGS calculated changes in the Silver Lake delta area from 1951–1994 using time series historical aerial photography (Blodgett 1996). Based on the imagery reviewed, the delta growth in 1963 was 0.32 acre. By 1993, the delta area had grown to 2.35 acres. This current study updated the USGS analysis using recent aerial photography from 2004 and 2019. The delta area has grown to 3.1 acres, an increase of 0.75 acre over the 26-year period since 1993. The delta area growth has not always been consistent, with periods of delta area loss in-between delta area increases. In 2004, ESSLIA dredged 5,800 cubic yards delta material. The findings show that overall, the delta continues to increase in size, but the rate of increase is slower than it was in the 1970s and early 1980s (period with a high rate of growth).

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TABLES

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Table AQ 5-1. Geomorphology Study Sites

Stream Segment Name	Segment Length (miles) / River Miles (RM)	Sampling Location River Site ID	Sampling Method
Rush Creek			
Waugh Lake	1.51 (RM 22.24–23.75)	RC23.0	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev., sediment deposition, restoration analysis, and Project facility sediment sources
Rush Creek Below Rush Meadows Dam	1.83 (RM 20.41–22.24)	RC21.65	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev.
Gem Lake	0.93 (RM 19.48–20.41)	—	Sediment deposition / Project facility sediment sources
Rush Creek Below Gem Dam	0.30 (RM 19.18–19.48)	—	—
Agnew Lake	0.58 (RM 18.60–19.18)	—	Sediment deposition / Project facility sediment sources
Rush Creek Below Agnew Dam	0.40 (RM 18.2–18.60)	RC18.55	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev.
Rush Creek Horsetail Falls	0.54 (RM 17.66–18.2)	—	—
Rush Creek Above Silver Lake	1.1 (RM 16.5–17.66)	RM 17.05 / RC17.05 RM 17.55 / RC17.55	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev.
		RM 17.50–17.60 / RC17.50–17.60	Map downed trees / riparian vegetation within channel
Silver Lake	0.83 (RM 15.89–16.72)	—	—
Rush Creek Below Silver Lake	2.69 (RM 13.20–15.89)	RM 15.2 / RC15.2	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev.
South Rush Creek			
South Rush Creek	0.46 (RM 0.0–0.46)	SRC0.15	V*, Spawning Gravel, Initiation of Motion, Bankfull Elev., suspended sediment
		SRC0.0–0.46	Map downed trees / riparian vegetation within channel

Table AQ 5-2. Rush Creek Project Facilities

Rush Meadows Dam Area
Dams
Rush Meadows Dam
Reservoirs
Waugh Lake
Valve House
Rush Meadows Dam Valve House
Stream Gages
Rush Creek below Rush Meadows (Waugh Lake) (USGS No. 10287262; SCE No. 359r)
Reservoir Gages
Waugh Lake (USGS No. 10287260; SCE No. 359)
Trails
Rush Meadows Dam Access Trail
Rush Meadows Dam/Waugh Lake Ancillary and Support Facilities
Rush Meadows Dam Equipment Shed
Rush Meadows Dam Gage House
Rush Meadows Dam Solar Facility
Gem Dam Area
Dams
Gem Dam
Reservoirs
Gem Lake
Flowline
Gem Dam to Agnew Junction Flowline
Valve House
Gem Valve House and Cabin
Gem Dam Arch 8 Valve House
Gem Flowline Valve House
Stream Gages
Rush Creek below Gem Lake (USGS No. 10287281; SCE No. 352r)
Reservoir Gages
Gem Lake (USGS No. 10287280; SCE No. 352)

Gem Dam Area (continued)
Communication Lines
Communication Line from Rush Creek Powerhouse to Gem Lake Dam
Communication Line from Gem Valve House to Arch 8 Valve House
Communication Line from Gem Tram Hoist House to Gem Valve House
Trams and Hoist Houses
Gem Tram
Gem Tram Hoist House
Gem Tram Lower/Upper Landing
Trails
Lower Gem Dam Access Trail
Gem Dam Arch 8 Access Trail
Upper Gem Dam Access Trail
Gem Dam/Lake Ancillary and Support Facilities
Gem Lake Dock
Gem Lake Motor Barge
Gem Bunkhouse
Gem Outhouse
Gem Cookhouse
Gem Dam Compressor Shed
Gem Dam Storage Shed
Gem Dam Overhead Hoist House for Dam Length
Gem Dam Overhead Hoist House
Gem Fish Release Footbridge
Gem Tram Landing Footbridge
Gem Tram Bridge
Gem Weather Station
Gem Satellite Dish
Gem Solar Facility
Gem Valve House Tunnel

Agnew Dam Area
Dams
Agnew Dam
Reservoirs
Agnew Lake
Flowline
Agnew Dam to Agnew Junction Flowline
Valve House
Agnew Junction (Valve House and Stand Pipe)
Agnew Dam Valve House
Stream Gages
Rush Creek below Agnew Lake (USGS No. 10287289; SCE No. 357)
Reservoir Gages
Agnew Lake (USGS No. 10287285; SCE No. 351)
Power Lines
4 kV Rush Creek Powerhouse to Agnew Dam Power Line
4 kV Agnew Lake Dam Power Line
4 kV Upper Agnew Boat Dock Power Line (non-operational)
Communication Lines
Communication Line from Agnew Hoist House to Agnew Boathouse
Trams and Hoist Houses
Agnew Tram
Agnew Tram Hoist House
Agnew Tram Landing
Trails
Agnew Stream Gage Access Trail
Agnew Dam/Lake Ancillary and Support Facilities
Lower Agnew Lake Boathouse/Dock
Upper Agnew Lake Boathouse/Dock
Agnew Lake Motor Barge
Agnew Cabin
Agnew Weather Station
Agnew Flume (downstream of Agnew Dam)

Rush Creek Powerhouse Area
Penstocks
Agnew Junction to Rush Creek Powerhouse Penstock (No. 1)
Agnew Junction to Rush Creek Powerhouse Penstock (No. 2)
Powerhouse
Rush Creek Powerhouse
Gages
Rush Creek Powerhouse (USGS No. 10287300; SCE No. 367)
Transmission Lines
2.4 kV Switchyard to Powerhouse Transmission Line
Powerhouse Ancillary and Support Facilities
Rush Creek Powerhouse Complex Access Road
Cottages (2)
Garages (4)
Warehouse and Dock
Machine Shop
Pump House
Woodshed (2)
Helicopter Landing Site
Tank (propane)
Bridge over Powerhouse Tailrace
Bridge over Rush Creek

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Table AQ 5-3. Geomorphic Assessment for Rush Creek Reaches Based on Montgomery and Buffington (1997)

Stream Reach	Gradient	Channel Type	Sediment Supply Sources	Sediment Transport	Response Type	External Influences	Discussion
Rush Creek Waugh Lake[1]	0.26%	pool-riffle	historical meadow deposits and currently some fine sediment from the presence of the reservoir	transport limited	adjustable, transport limited	currently inundated by Waugh Lake seasonally	Evaluation of sediment deposition within the reservoir footprint will be performed in summer 2024 and reported in the TSR filed with the Final License Application. Since 2012 Waugh Lake levels have been maintained at lower levels due to seismic restrictions and some natural revegetation of the reservoir footprint has started. In the future this stream reach may be suitable for restoration if the dam is removed, or water levels are maintained at a low level.
Rush Creek Below Rush Meadow Dam	3.47% (some lower and some steeper sections)	pool-riffle, plane bed, step-pool, cascade, bedrock	some of the lower gradient sections of stream have streambank sediment storage	mixed – transport limited in the low gradient sections and supply limited in the steeper gradient sections	mixed – adjustable in and lower gradient sections and non-adjustable in the steeper gradient sections	riparian vegetation and large woody debris in the low gradient sections and valley confinement / bedrock in the steeper gradient sections	This stream reach is a mix of low gradient pool-riffle and steep gradient step-pool sections. The lower gradient stream sections could adjust depending on future operational changes to Project hydrology or changes in sediment supply due to changes in the dam operations (e.g., removal).
Rush Creek Below Gem Dam	29.60%	bedrock, cascade, pool-riffle, plane bed	bedrock, limited sediment availability	supply limited	non-adjustable transport reach,	valley confinement / bedrock	Very steep, confined bedrock reach. No changes in geomorphology anticipated with changes in Project hydrology or sediment supply.
Rush Creek Below Agnew Dam	11.65%	bedrock, plane bed, cascade	bedrock, limited sediment availability	supply limited	non-adjustable transport reach	bedrock / valley confinement	Steep, confined bedrock reach. No changes in geomorphology anticipated with changes in Project hydrology or sediment supply.
Rush Creek Horsetail Falls	31.82%	bedrock, cascade	bedrock, limited sediment availability	supply limited	non-adjustable transport reach	bedrock	Very steep bedrock reach. No changes in geomorphology anticipated with changes in Project hydrology or sediment supply.
Rush Creek Above Silver Lake	1.83%	pool-riffle, dune ripple	streambank sediment storage	transport limited	adjustable depending on the hydrology and sediment regime	riparian vegetation and large woody debris	Lower gradient partially wooded and wetland stream reach flowing into Silver Lake.
Rush Creek Below Silver Lake	0.59%	pool-riffle, plane bed	streambank sediment storage	transport limited	adjustable depending on the hydrology and sediment regime	riparian vegetation and large woody debris	Lower gradient stream reach flowing between Silver Lake and Grant Lake.
Rush Creek Below Grant Lake	1.44%	pool-riffle	streambank sediment storage	transport limited	adjustable depending on the hydrology and sediment regime	riparian vegetation and historic incision	This reach was historically dewatered, and incision and loss of riparian vegetation occurred. Currently, the channel Los Angeles Department of Water and Power (LADWP) provides flows in the reach and the channel is in a state of recovery.
South Rush Creek	13.62%	bedrock, cascade, pool-riffle	bedrock, limited sediment availability except in the lower portion of the reach near the Rush Creek Powerhouse where there is streambank storage of sediment	mixed – supply limited in the steeper gradient section and transport limited in the low gradient section near the Rush Creek Powerhouse	mostly non-adjustable transport reach except in the low gradient section near the Rush Creek Powerhouse, which is adjustable	bedrock in most of the reach, but riparian vegetation and large woody debris in the section near the Rush Creek Powerhouse	This is mostly a steep, bedrock stream that splits off of Rush Creek and rejoins Reversed Creek / Rush Creek near the Rush Creek Powerhouse. The low gradient section is in places filled / clogged with large woody debris.

[1] This river reach is seasonally inundated by Waugh Lake.

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Table AQ 5-4. Stream Types Classified by River Mile Within Project Defined Stream Segments

Stream Segment Name	Rosgen Level I Stream Characterization		Rosgen Level II Stream Classification	
	Stream Type	River Mile	Stream Type	River Mile
Below Silver Lake	C	13.02 - 13.19	C4	13.02 - 13.19
	B	13.19 - 14.59	B4	13.19 - 13.49
			B3	13.49 - 13.57
			B4	13.57 - 13.6
			B1/2a	13.6 - 13.67
			B4c	13.67 - 14.57
			B3c	14.57 - 14.59
	C	14.59 - 15.89	C3	14.59 - 14.65
			C4	14.65 - 15.19
			B4c	15.19 - 15.34
			C4	15.34 - 15.89
Silver Lake	Lake	15.89 - 16.52	Lake	15.89 - 16.52
Upstream Silver Lake (Downstream of Reversed Confluence)	C	16.52 - 17.65	C5c	16.52 - 17.14
			C5	17.14 - 17.5
			C4	17.5 - 17.6
			B2/3	17.6 - 17.65
Below Agnew Dam	Aa+	17.65 - 18.47	A1	17.65 - 17.67
			A1a+	17.67 - 18.47
	B	18.47 - 18.61	B3c	18.47 - 18.58
			A1a+	18.58 - 18.61
Agnew Lake	Reservoir	18.61 - 19.1	Reservoir	18.61 - 19.1
Below Gem Dam	D	19.1 - 19.2	D4	19.1 - 19.18
			C4	19.18 - 19.2
	Aa+	19.2 - 19.5	A1a+	19.2 - 19.5
Gem Lake	Reservoir	19.5 - 20.43	Reservoir	19.5 - 20.43

Stream Segment Name	Rosgen Level I Stream Characterization		Rosgen Level II Stream Classification	
	Stream Type	River Mile	Stream Type	River Mile
Below Rush Meadows Dam	B	20.43 - 21.22	A1a+	20.43 - 20.47
			B2a	20.47 - 20.74
			C4	20.74 - 20.94
			B3	20.94 - 20.99
			A1	20.99 - 21.01
			B4	21.01 - 21.12
			C4	21.12 - 21.15
			B2	21.15 - 21.22
	A	21.22 - 21.51	A1	21.22 - 21.51
	B	21.51 - 21.93	B3a	21.51 - 21.59
			B3c	21.59 - 21.84
			A1	21.84 - 21.93
	C	21.93 - 22.14	B4	21.93 - 21.95
			C4/5	21.95 - 22.04
			C3b	22.04 - 22.14
	B	22.14 - 22.27	A1	22.14 - 22.17
			B3	22.17 - 22.27
South Rush Creek	C	0 - 0.17	C5	0 - 0.09
			C4/5	0.09 - 0.14
			C4	0.14 - 0.17
	B	0.17 - 0.22	B3	0.17 - 0.22
	Aa+	0.22 - 0.46	A1a+	0.22 - 0.46
Rush Creek Tailrace	C	N/A	C5	N/A
			C4	N/A
	B	N/A	B4	N/A

Table AQ 5-5. Pebble Count Summary Statistics

Reach	Transect	Size (mm)		
		D_{16}	D_{50}	D_{84}
Rush Creek Above Waugh Lake	1	13	90	230
Rush Creek Below Rush Meadows Dam	1	20	120	310
	2	6	94	180
	3	28	120	260
Rush Creek Below Agnew Dam	1	6.4	94	180
	2	47	110	180
	3	66	100	200
Rush Creek Above Silver Lake (Upstream of Reversed Confluence)	1	1.7	14	25
	2	29	56	98
	3	3.1	43	150
Rush Creek Upstream of Silver Lake (Downstream of Reversed Confluence)	1	No samples collected due to relatively uniform fine sediment, sand, at the site. Core samples were taken.		
	2	No samples collected due to relatively uniform fine sediment, sand, at the site. Core samples were taken.		
	3	1.2	1.6	3.4
Rush Creek Below Silver Lake	1	8	59	180
	2	9.2	39	93
	3	6	39	98
South Rush Creek	1	1.2	1.7	6
	2	17	69	140
	3	19	86	270

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Table AQ 5-6. Morphological Parameters Used to Classify the Stream Type at Each Transect and Comparison to the Stream Type for the Accompanying Reach Segment

Stream Segment Name	Transect ID	River Mile	Entrenchment Ratio[1]	Bankfull Width-Depth Ratio[2]	Channel Sinuosity[1,3]	Channel Slope (%)	Median Particle Size, D_{50} (mm)	Dominate Substrate (%)	Stream Type at Transect[4]	Reach Stream Type[4]
Rush Creek										
Below Silver Lake	G1	13.75	3.7	27.4	1.1	0.6	Gravel (59)	Gravel (45)	C4	B4c
	G2	14.24	2.7	24.6	1.1	0.15	Gravel (39)	Gravel (58)	C4	B4c
	G3	14.95	1.4	37.3	1.1	0.19	Gravel (39)	Gravel (58)	B4c	C4
Upstream Silver Lake (Downstream of Reversed Confluence)	G1	16.77	>2.2	13.3	1.9	0.016	Sand (<2)	Sand (<2)	C5c	C5c
	G2	16.80	>2.2	13.0	1.9	0.016	Sand (<2)	Sand (<2)	C5c	C5c
	G3	16.97	>2.2	25.8	1.9	0.016	Sand (1.6)	Clay/Silt/ Sand (71)	C5c	C5c
Upstream Silver Lake (Upstream of Reversed Confluence)	G1	17.54	2.1	18.9	1.2	0.3	Gravel (14)	Gravel (79)	B4c	C4
	G2	17.58	2.5	24.6	1.2	2.3	Gravel (56)	Gravel (58)	C4b	C4
	G3	17.59	5.2	21.2	1.2	0.6	Gravel (43)	Gravel (44)	C4	C4
Below Agnew Dam	G1	18.48	1.6	31.7	1.1	3.9	Cobble (94)	Bedrock (60)	B1/3	B3c
	G2	18.52	2.5	32.3	1.1	1.9	Cobble (110)	Cobble (69)	C3	B3c
	G3	18.56	1.6	28.0	1.1	0.7	Cobble (100)	Cobble (77)	B3c	B3c
Below Rush Meadows Dam	G1	20.94	2.0	35.5	1.2	2.8	Cobble (120)	Cobble (38)	B3	B3
	G2	21.67	1.5	37.3	1.3	0.8	Cobble (94)	Cobble (56)	B3c	B3c
	G3	22.09	4.2	32.9	1.1	2.9	Cobble (120)	Cobble (57)	C3b	C3b
Waugh Lake	G1	22.64	To be completed as part of 2024 field implementation and included in the TSR filed with the Final License Application							
	G2	23.07								
	G3	23.35								
South Rush Creek										
South Rush Creek	G1	0.14	8.1	11.4	1.2	0.4	Sand (1.7)	Sand (66)	C5	C4/5
	G2	0.20	1.6	9.2	1.0	2.0	Cobble (69)	Cobble (48)	B3	B3
	G3	0.21	2.1	25.0	1.0	5.9	Cobble (86)	Cobble (44)	B3a	B3

[1] Entrenchment ratio and sinuosity can vary +/- 0.2 units from that specified for a given stream type.
[2] Width/depth ratio can vary +/- 2.0 units from that specified for a given stream type.
[3] Calculated as stream length/valley length.
[4] Due to intra-reach geomorphic variability over relatively short distances, the stream type at a transect may vary from the stream type of the accompanying reach.

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Table AQ 5-7. V* Measurement Results

Reach	Pool	Length of Unit (ft)	Width of Unit (ft)	Number of Transects	Maximum Residual Pool Depth (ft)	Riffle Crest Depth (ft)	Ratio of Max Pool Depth to Riffle Crest Depth	Total Volume of Residual Pool (ft^3)	Total Volume of Residual Fines (ft^3)	V*
Rush Creek Above Waugh Lake	1	33	11	3	1.50	0.90	1.67	252	7	0.03
	2	80	27	4	4.65	1.05	4.43	2,522	8	0.00
	3(1)	110	46	5	6.89	1.41	4.89	9,124(1)	13,853(1)	0.60(1)
Rush Creek Below Rush Meadows Dam	1	216	38	7	4.47	1.13	3.94	10,910	1,209	0.10
	2	56	45	3	3.23	1.07	3.01	1,873	11	0.01
	3	56	30	4	2.73	1.07	2.56	1,138	47	0.04
	4	63	29	4	1.70	1.50	1.13	1,314	19	0.01
	5	48	40	3	2.43	1.07	2.28	920.1	62.4	0.06
	Reach Weighted Average V*w							16,155	1,350	**0.08**
Rush Creek Downstream Agnew Dam	1	51	21	3	3.69	0.91	4.05	993	9	0.01
	2	99	25	6	2.21	0.54	4.08	698	0	0.00
	3(2)	81	55	4	1.65	0.15	11.00	2,838(2)	1,070(2)	0.27(2)
	4	102	17	4	5.10	1.50	3.40	2,477	147	0.06
	5	22.5	14	3	1.56	0.74	2.1	76.6	0	0
	Reach Weighted Average V*w							4,224	156	**0.02**
Rush Creek Above Silver Lake (Upstream of Reversed Confluence)	1	20	18	3	1	0	11	175	18	0
	2	18	14	3	1	0	4	69	0	0
	3	16	12	3	1	1	1	31	0	0
	4	29	16	3	2	2	1	178	0	0
	5	64	19	4	1	1	2	268	71	0
	Reach Weighted Average V*w							721	88.4	**0.11**

Reach	Pool	Length of Unit (ft)	Width of Unit (ft)	Number of Transects	Maximum Residual Pool Depth (ft)	Riffle Crest Depth (ft)	Ratio of Max Pool Depth to Riffle Crest Depth	Total Volume of Residual Pool (ft^3)	Total Volume of Residual Fines (ft^3)	V*
Rush Creek Upstream of Silver Lake (Downstream of Reversed Confluence)	Lisle-Hilton criteria for pool selection are not met in this reach, refer to results section 6.1.2.1									
Rush Creek Below Silver Lake	1	131	68	5	7.74	0.56	13.82	10,411	2,566	0.20
	2	200	32	6	2.32	0.58	4.00	3,858	555	0.13
	3	97	41	4	3.25	1.45	2.24	3,643	141	0.04
	4	85	56	4	2.50	1.50	1.67	4,991	1,284	0.20
	5	115	38	5	4.29	0.71	6.04	5,912	452	0.07
	Reach Weighted Average V*w							28,815	4,996	**0.15**
South Rush Creek[3]	1	14	9	3	2.41	0.19	12.68	88	2	0.00
	2	8.5	3	3	0.69	0.01	69.00	6	0	0.02
	3	13	3	3	0.79	0.01	79.00	12	0	0.02
	4	28	12	3	0.32	0.01	32.00	60	0	0.00
	5	33	7	3	0.72	0.28	2.57	39	12	0.24
	Reach Weighted Average V*w							206	14	**0.05**

[1] Rush Creek Pool 3 above Waugh Lake dam is an outlier and should be discounted because it did not meet the V* selection criteria lacking a detectable armored boundary layer at depth beneath the fine sediment. A reach weighted V*w was not calculated since there were only 2 valid pools in the sampled population.
[2] This pool is upstream of the gaging weir, is not natural, and should be discounted in the sampling results. It was not included in the reach weighted V*W calculation.
[3] SRC pool volumes were surveyed at 0 flow conditions, a nominal riffle crest value of 0.01 was entered in place of 0 for the calculation.

Table AQ 5-8. Sediment Statistics of Potential Spawning Gravel Samples

Location	Sample ID	Habitat Type	Rush Creek River Mile	Geometric Mean (mm)	D_{16} (mm)	D_{50} (mm)	D_{84} (mm)
Rush Creek Above Waugh Lake	SG1	LGR	23.0	13.1	2.8	20	61
	SG2	LGR	23.0	10.2	2.8	13	37
	SG2 – R	LGR	23.0	6.7	0.91	17	49
	SG3	LGR	23.0	6.3	1.1	10	36
Rush Creek Meadow Below Waugh	SG1a	MCP	21.65	9.3	2.1	18	41
	SG1b – R	MCP	21.65	15.1	6.3	27	36
	SG2a	MCP	21.65	23.2	11	31	49
	SG2b – R	MCP	21.65	10.3	2.4	20	44
Rush Creek Below Agnew Dam	SG1a	MCP	18.55	14.0	6.1	18	32
	SG1b – R	MCP	18.55	21.3	9.9	28	46
	SG2	RUN	18.55	11.9	3.7	14	38
	SG3	RUN	18.55	16.8	7.4	20	38
Rush Creek Above Silver Lake (Upstream of Reversed Confluence)	SG1a	LGR	17.55	10.3	2.4	14	44
	SG1b – R	LGR	17.55	5.2	1.1	9.5	25
	SG2	LGR	17.55	9.7	3.6	10	26
	SG3	MCP	17.55	18.4	8.5	26	40
Rush Creek Below Silver Lake	SG1a	RUN	15.2	18.3	4	9	84
	SG1b – R	RUN	15.2	7.0	3.3	8.4	15
	SG2	LGR	15.2	16.9	8.2	25	35
	SG3	LGR	15.2	6.2	1.3	11	30
South Rush Creek	SG1a	LGR	0.15	17.5	6	18	51
	SG1b – R	LGR	0.15	12.9	7.2	14	23
	SG2	MCP	0.15	19.0	4.8	39	75
	SG3	LGR	0.15	25.6	9.1	33	72

Key:
HGR = high gradient riffle
LGR = low gradient riffle
LSP = lateral scour pool
MCP = mid channel pool
NSH = not suitable habitat
POW = pocket water
R = Replicate side-by-side sample
RUN = run
SRN = step run
STP = step pool

Table AQ 5-9. Fine Sediment Content of Potential Spawning Gravel Samples

Location	Habitat Type	River Mile	Spawning Gravel (SG)	Gravel Prior to Spawning		Gravel Following Spawning	
				Cumulative % Finer than 1 mm	Cumulative % Finer than 6.4 mm	Cumulative % Finer than 1 mm	Cumulative % Finer than 6.4 mm
Rush Creek Above Waugh Lake	LGR	23.0	SG1	7	29	4.7	16.8
	LGR	23.0	SG2	5	36	3.4	20.9
	LGR	23.0	SG2 – R	15	40	10.1	23.2
	LGR	23.0	SG3	14	43	9.4	24.9
Rush Creek Meadow Below Waugh	MCP	21.65	SG1a	7	29	4.7	16.8
	MCP	21.65	SG1b – R	3	16	2.0	9.3
	MCP	21.65	SG2a	5	10	3.4	5.8
	MCP	21.65	SG2b – R	11	27	7.4	15.7
Rush Creek Below Agnew Dam	MCP	18.55	SG1a	0	17	0.0	9.9
	MCP	18.55	SG1b – R	0	10	0.0	5.8
	RUN	18.55	SG2	3	25	2.0	14.5
	RUN	18.55	SG3	3	12	2.0	7.0
Rush Creek Above Silver Lake (Upstream of Reversed Confluence)	LGR	17.55	SG1a	9	26	6.0	15.1
	LGR	17.55	SG1b – R	13	**35**	8.7	20.3
	LGR	17.55	SG2	5	**30**	3.4	17.4
	MCP	17.55	SG3	3	12	2.0	7.0
Rush Creek Below Silver Lake	RUN	15.2	SG1a	5	24	3.4	13.9
	RUN	15.2	SG1b – R	3	**33**	2.0	19.1
	LGR	15.2	SG2	2	13	1.3	7.5
	LGR	15.2	SG3	11	**36**	7.4	20.9
South Rush Creek	LGR	0.15	SG1a	2	17	1.3	9.9
	LGR	0.15	SG1b – R	1	10	0.7	5.8
	MCP	0.15	SG2	6	19	4.0	11.0
	LGR	0.15	SG3	0	3	0.0	1.7

Note: **Bold indicates fine sediment threshold exceeded = >30%**

Key: HGR = high gradient riffle
LGR = low gradient riffle
LSP = lateral scour pool
MCP = mid channel pool
NSH = not suitable habitat
POW = pocket water
R = Replicate side-by-side sample
RUN = run
SRN = step run
STP = step pool

Table AQ 5-10. Particle Size Summary for Sediment Cores Sampled in Rush Creek above Silver Lake

Sample Location[1]		River Mile	Size (mm)			Percent			Dominate Substrate (%)	Stratification
			D_{16}	D_{50}	D_{84}	Silt/Clay	Sand	Gravel		
Stream Channel	SLCS-1	17.16	1.0	1.5	3.1	0%	73%	27%	Very coarse sand (58)	None
Stream Channel	SLCS-1R	17.15	0.4	1.5	3.5	2%	58%	39%	Very fine gravel (35)	None
Stream Channel	SLCS-12	17.03	0.3	0.8	4.7	3%	78%	19%	Coarse sand (26)	None
Stream Channel	SLCS-11	16.89	1.0	1.4	2.1	2%	81%	17%	Very coarse sand (67)	0 – 0.2 foot below surface: coarse sand, 0.2 - 0.56 foot+ very coarse sand, 0.56 - 0.8 foot silty-clay, 0.8 - 1.0 foot coarse sand
Stream Channel	SLCS-10	16.8	0.8	1.4	2.0	1%	85%	14%	Very coarse sand (67)	0 - 0.65 foot below surface: very coarse sand, 0.65 - 1.0 foot+ medium sand with compacted glacial till material above 1.0 foot
Stream Channel	SLCS-9	16.69	1.0	1.4	1.9	0.3%	89%	10%	Very coarse sand (73)	None
Stream Channel	SLCS-8	16.61	0.5	1.1	1.8	1%	91%	8%	Very coarse sand (52)	None
Stream Channel	SLCS-7	16.55	1.0	1.4	1.8	0.2%	93%	7%	Very coarse sand (79)	None
Delta	SLCS-4	16.52	1.0	1.4	1.9	0.05%	92%	8%	Very coarse sand (78)	None
Delta	SLCS-5	16.51	1.0	1.5	2.5	0.2%	80%	20%	Very coarse sand (68)	None
Delta	SLCS-3	16.49	0.7	1.3	1.9	0.4%	91%	9%	Very coarse sand (66)	None
		Average	0.8	1.3	2.5	1%	83%	16%		

[1] Sample locations are ordered from upstream to downstream.

Table AQ 5-11. SCE Maintenance Activities

Reservoir/Facility	Sediment Management	Woody Debris Maintenance
Waugh Reservoir	None	Historically removed LWD from spillway and low-level outlet about every three years. Wood was flushed through prior to notching the dam, but water surface is no longer high enough relative to the notch to flush. Last removal from outlet was about 3 years ago. Hand removal of LWD using chain saws since dam has been notched or by helicopter or boat. Removed wood was historically burned in the late fall.
Gem Reservoir	None	LWD last removed 2012, maintenance is needed less frequently than at Rush Meadows Dam. LWD is cut and placed downstream of the arched dam structures. If LWD was placed in channel it might get hung up where tramway crosses channel. SCE would like to burn the LWD in the future
Agnew Reservoir	None	Pulled LWD out this year via helicopter and by hand. There is a log boom which facilitates pulling out LWD with grappling hooks. LWD is only occasionally removed. The weir never needs maintenance.
Powerhouse Tailrace	None	None

Table AQ 5-12. Average Number of Days per Year the Rush Creek 1.5-year Flood Equaled or Exceeded for Unimpaired and Impaired Hydrologic Regimes

Location	1.5-yr Recurrence Interval Q (cfs)[a]	Average Number Days per Year the 1.5-year Flood Equaled or Exceeded[a]			
		Unimpaired	Historical	Proposed	Existing
Rush Creek Below Rush Meadows Dam	217	9.3	7.0	9.3	6.2
Percent Change from Unimpaired Condition		NA	-25%	0%	-34%
Rush Creek Below Agnew Dam	334	22.0	3.7	7.8	7.1
Percent Change from Unimpaired Condition		NA	-83%	-65%	-68%
Rush Creek Upstream of Reversed Creek Confluence	249[b]	11.2	1.5	3.3	2.9
Percent Change from Unimpaired Condition		NA	-87%	-71%	-74%
Rush Creek Below Silver Lake	396	16.5	6.4	11.6	11.1
Percent Change from Unimpaired Condition		NA	-61%	-30%	-33%

[a] Based on modeled unimpaired hydrology over the 33-year period from water year 1990-2022.

[b] This value is lower than upstream below Gem Dam due to the South Rush Creek channel taking a portion of the flow.

Table AQ 5-13. Bankfull Flow Hydraulics, Bed Sediment Particle Sizes, and Initiation of Sediment Transport Results

Transect ID	Q Bankfull (cfs)	Slope (%)	Manning's (n)	U (Mean velocity) (ft/s)	W (feet)	τ (lb/ft^2)	R (feet)	H (feet)	Pebble Count Sizes (mm)			Critical Grain Size (mm)[1]	Particle Size
									D_{16}	D_{50}	D_{84}		
Rush Creek Below Rush Meadows Dam													
G1T1	257	2.36 %	0.085	3.3	55.0	1.99	1.4	1.4	20	121	311	126	Small Cobble
G2T2	286	0.80 %	0.054	3.3	56.8	0.75	1.5	1.5	6	94	180	48	Very Coarse Gravel
G3T3	247	2.94 %	0.060	5.1	36.4	2.37	1.3	1.3	28	122	265	151	Large Cobble
Rush Creek Below Agnew Dam													
G1T9	37	3.84 %	0.055	3.1	23.9	1.10	0.5	0.5	6	94	177	70	Small Cobble
G2T10	40	1.76 %	0.068	2.1	28.9	0.69	0.6	0.7	47	106	177	44	Very Coarse Gravel
G3T12	39	0.71 %	0.046	2.0	28.1	0.28	0.6	0.7	66	101	197	18	Coarse Gravel
Rush Creek Upstream of Reversed Creek Confluence													
G1T4	11	0.20 %	0.056	0.9	16.2	0.09	0.7	0.7	2	14	25	6	Fine Gravel
G2T6	75	3.42 %	0.074	2.7	41.8	1.36	0.6	0.7	29	56	98	86	Small Cobble
G3T8	61	0.39 %	0.040	1.9	41.6	0.18	0.7	0.8	3	43	150	11	Medium Gravel
Rush Creek Below Silver Lake													
G1T1	284	0.60 %	0.051	3.3	45.7	0.67	1.8	1.9	8	59	180	43	Very Coarse Gravel
G2T6	310	0.27 %	0.038	3.3	44.3	0.35	2.0	2.1	9	39	93	22	Coarse Gravel
G3T18	249	0.47 %	0.057	2.7	47.2	0.55	1.9	1.9	6	39	98	35	Very Coarse Gravel

[1] Largest particle size for which initiation of sediment transport is calculated to occur. Based on cross-sectionally averaged shear stress.

Key: % =%
τ = shear stress
cfs = cubic feet per second
ft/s = feet per second
H = bankfull depth
lb/ft^2 = pounds per square foot
mm = millimeter
n = Manning's roughness coefficient
R = hydraulic radius
W = wetted perimeter

Table AQ 5-14. Flow Required to Mobilize a 32 mm and D_{50} Particle Across 25% of the Active Channel Width for a Subset of Cross-Sections Judged to be Most Representative for Initiation of Motion of Gravel Substrates

	32 mm Q (cfs)	32 mm Average # Days Mobilization per Year[a]				D_{50} Q (cfs)	D_{50} mm Average # Days Mobilization per Year[a]				Pebble Count Sizes (mm)		
		Unimpaired	Historical	Proposed	Existing		Unimpaired	Historical	Proposed	Existing	D_{16}	D_{50}	D_{84}
Rush Creek above Rush Meadows Dam (Waugh Lake)													
G3	45	77.8	NA	NA	NA	761[b]	0.0	NA	NA	NA	13	90	230
Percent Change from Unimpaired Condition		NA	NA	NA	NA		NA	NA	NA	NA			
Rush Creek Below Rush Meadows Dam													
G2T2	67	60.1	71.1	60.1	67.2	650[b]	0.0	0.0	0.0	0.0	6	94	180
Percent Change from Unimpaired Condition		NA	+18%	0%	+12%		NA	NA	NA	NA			
Rush Creek Below Agnew Dam													
G2T10	8	236.5	29.9	53.7	58.4	105	59.3	11.5	18.0	17.8	47	106	177
Percent Change from Unimpaired Condition		NA	-87%	-77%	-75%		NA	-81%	-70%	-70%			
G3T12	32	118.0	21.2	30.3	32.3	675	0.5	0.0	0.2	0.2	66	101	197
Percent Change from Unimpaired Condition		NA	-82%	-74%	-73%		NA	-100%	-59%	-65%			
Rush Creek Upstream of Reversed Creek Confluence													
G3T8	132	45.5	8.9	14.4	14.5	-	-	-	-	-	3	43	150
Percent Change from Unimpaired Condition		NA	-80%	-68%	-68%		NA	NA	NA	NA			
Rush Creek Below Silver Lake													
G1T1	60	107.2	175.2	140.9	142.6	386	17.1	6.8	11.9	11.5	8	59	180
Percent Change from Unimpaired Condition		NA	+63%	+31%	+33%		NA	-60%	-30%	-33%			
G3T18	67	100.3	140.3	115.9	117.5	159	53.7	28.5	37.5	39.6	6	39	98
Percent Change from Unimpaired Condition		NA	+40%	+16%	+17%		NA	-47%	-30%	-26%			

[a] Based on modeled hydrology over the 33-year period from water year 1990-2022

[b] 761 cfs and 650 cfs is greater than the maximum modeled mean daily discharge for any of the four flow scenarios

Key: - = Flow required exceeds the capacity of the surveyed channel
NA = not applicable

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Table AQ 5-15. Variation in Annual Bedload Transport Rates for Unimpaired and Impaired Hydrologic Regimes at Select Cross-Sections

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	Historical	Proposed	Existing
Rush Creek Below Rush Meadows Dam G2T2							
Sand	0.4	11.3%	11.3%	7,002	6,354	7,002	6,628
Gravel	2.8	1.9%	13.2%	706	621	706	655
	4.9	2.8%	16.0%	923	803	923	850
	6.9	0.9%	17.0%	281	243	281	258
	9.4	0.9%	17.9%	259	223	259	236
	13.3	2.8%	20.8%	702	599	702	637
	18.8	0.0%	20.8%	0.0	0.0	0.0	0.0
	26.5	4.7%	25.5%	882	739	882	788
	37.9	4.7%	30.2%	683	563	683	600
	53.7	5.7%	35.8%	533	427	533	453
Cobble	75.9	12.3%	48.1%	527	408	527	420
	107.3	16.0%	64.2%	173	133	173	122
	151.8	19.8%	84.0%	28	22	28	18
	214.7	7.5%	91.5%	1.4	1.1	1.4	1.0
Boulder	304.4	7.5%	99.1%	0.2	0.2	0.2	0.2
	430.5	0.9%	100.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	100.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**12,702**	**11,137**	**12,702**	**11,666**
% Change from Unimpaired Condition				**NA**	**-12%**	**0%**	**-8%**

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	Historical	Proposed	Existing
Rush Creek Below Agnew Dam G2T10							
Sand	0.4	3.0%	3.0%	1,466	255	461	444
Gravel	2.8	1.0%	4.0%	250	43	80	76
	4.9	0.0%	4.0%	0.0	0.0	0.0	0.0
	6.9	0.0%	4.0%	0.0	0.0	0.0	0.0
	9.4	0.0%	4.0%	0.0	0.0	0.0	0.0
	13.3	1.0%	5.0%	142	24	46	43
	18.8	1.0%	5.9%	123	21	40	37
	26.5	2.0%	7.9%	214	35	70	65
	37.9	6.9%	14.9%	632	104	207	191
	53.7	10.9%	25.7%	816	133	268	246
Cobble	75.9	14.9%	40.6%	849	138	280	255
	107.3	19.8%	60.4%	734	118	244	218
	151.8	24.8%	85.1%	412	65	138	120
	214.7	9.9%	95.0%	34	5.4	11	10
Boulder	304.4	4.0%	99.0%	1.5	0.2	0.5	0.4
	430.5	1.0%	100.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	100.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**5,674**	**941**	**1,846**	**1,705**
% Change from Unimpaired Condition				**NA**	**-83%**	**-67%**	**-70%**

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	Historical	Proposed	Existing
Rush Creek Below Agnew Dam G3T12							
Sand	0.4	2.0%	2.0%	4.5	0.4	1.3	0.9
Gravel	2.8	0.0%	2.0%	0.0	0.0	0.0	0.0
	4.9	0.0%	2.0%	0.0	0.0	0.0	0.0
	6.9	0.0%	2.0%	0.0	0.0	0.0	0.0
	9.4	0.0%	2.0%	0.0	0.0	0.0	0.0
	13.3	0.0%	2.0%	0.0	0.0	0.0	0.0
	18.8	0.0%	2.0%	0.0	0.0	0.0	0.0
	26.5	2.0%	4.0%	0.2	0.0	0.0	0.0
	37.9	1.0%	5.0%	0.1	0.0	0.0	0.0
	53.7	8.0%	13.0%	0.4	0.0	0.1	0.1
Cobble	75.9	29.0%	42.0%	0.9	0.1	0.2	0.2
	107.3	24.0%	66.0%	0.5	0.0	0.1	0.1
	151.8	16.0%	82.0%	0.1	0.0	0.0	0.0
	214.7	8.0%	90.0%	0.0	0.0	0.0	0.0
Boulder	304.4	10.0%	100.0%	0.0	0.0	0.0	0.0
	430.5	0.0%	100.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	100.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**6.7**	**0.6**	**1.8**	**1.3**
% Change from Unimpaired Condition				**NA**	**-91%**	**-73%**	**-80%**

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	Historical	Proposed	Existing
Rush Creek Upstream of Reversed Creek Confluence G3T8							
Sand	0.4	10.9%	10.9%	945	184	296	304
Gravel	2.8	7.9%	18.8%	279	49	80	83
	4.9	2.0%	20.8%	53	9	15	15
	6.9	1.0%	21.8%	22	4	6	6
	9.4	2.0%	23.8%	36	6	10	10
	13.3	3.0%	26.7%	42	7	11	12
	18.8	6.9%	33.7%	66	11	18	19
	26.5	5.9%	39.6%	31	5.1	8.1	8.5
	37.9	11.9%	51.5%	19	3.3	5.2	5.4
	53.7	3.0%	54.5%	0.9	0.1	0.2	0.2
Cobble	75.9	9.9%	64.4%	0.3	0.1	0.1	0.1
	107.3	12.9%	77.2%	0.0	0.0	0.0	0.0
	151.8	14.9%	92.1%	0.0	0.0	0.0	0.0
	214.7	3.0%	95.0%	0.0	0.0	0.0	0.0
Boulder	304.4	5.0%	100.0%	0.0	0.0	0.0	0.0
	430.5	0.0%	100.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	100.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**1,494**	**280**	**449**	**464**
% Change from Unimpaired Condition				**NA**	**-81%**	**-70%**	**-69%**

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	Historical	Proposed	Existing
Rush Creek Below Silver Lake G1T1							
Sand	0.4	7.0%	7.0%	5,223	4,414	4,729	4,746
Gravel	2.8	1.0%	8.0%	428	316	362	362
	4.9	3.0%	11.0%	1,100	780	913	912
	6.9	5.0%	16.0%	1,659	1,145	1,361	1,358
	9.4	1.0%	17.0%	303	204	246	245
	13.3	5.0%	22.0%	1,357	887	1,089	1,084
	18.8	5.0%	27.0%	1,196	756	947	942
	26.5	6.0%	33.0%	1,224	742	954	947
	37.9	10.0%	43.0%	1,604	920	1,227	1,212
	53.7	9.0%	52.0%	976	520	730	717
Cobble	75.9	15.0%	67.0%	790	389	580	561
	107.3	12.0%	79.0%	159	72	115	108
	151.8	5.0%	84.0%	7.2	3.2	5.2	4.8
	214.7	11.0%	95.0%	1.9	0.8	1.4	1.3
Boulder	304.4	5.0%	100.0%	0.1	0.1	0.1	0.1
	430.5	0.0%	100.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	100.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**16,029**	**11,148**	**13,261**	**13,201**
% Change from Unimpaired Condition				**NA**	**-30%**	**-17%**	**-18%**

	Particle Size (mm)	Percent in Class	Percent Finer Than	Bedload Transport Average Tons per Year[a]			
				Unimpaired	**Historical**	**Proposed**	**Existing**
Rush Creek Below Silver Lake G3T18							
Sand	0.4	7.0%	9.0%	11,570	12,159	12,012	12,057
Gravel	2.8	1.0%	6.0%	4,882	4,879	4,890	4,903
	4.9	3.0%	1.0%	716	703	709	710
	6.9	5.0%	4.0%	2,629	2,550	2,581	2,586
	9.4	1.0%	3.0%	1,818	1,742	1,771	1,774
	13.3	5.0%	6.0%	3,263	3,074	3,145	3,148
	18.8	5.0%	9.0%	4,249	3,908	4,034	4,035
	26.5	6.0%	6.0%	2,291	2,026	2,125	2,122
	37.9	10.0%	11.0%	2,879	2,350	2,558	2,546
	53.7	9.0%	12.0%	1,606	1,110	1,326	1,307
Cobble	75.9	15.0%	13.0%	536	295	411	394
	107.3	12.0%	17.0%	120	57	91	82
	151.8	5.0%	2.0%	2.0	0.9	1.5	1.3
	214.7	11.0%	1.0%	0.2	0.1	0.1	0.1
Boulder	304.4	5.0%	0.0%	0.0	0.0	0.0	0.0
	430.5	0.0%	0.0%	0.0	0.0	0.0	0.0
	724.1	0.0%	0.0%	0.0	0.0	0.0	0.0
Total Average Annual Bedload (tons/year)				**36,560**	**34,855**	**35,654**	**35,665**
% Change from Unimpaired Condition				**NA**	**-5%**	**-2%**	**-2%**

[a] Based on modeled hydrology over the 33-year period from water year 1990–2022

Table AQ 5-16. Mass-Wasting Sites with Sediment Delivery Ratings

Upper Watershed					
Drainage Basin (acres)	**Subwatersheds**	**Total number of mass wasting sites**	**Total area of mass wasting sites (acres)**	**Number of mass wasting sites with direct sediment delivery to waterways**	**Total area of mass wasting sites with direct sediment delivery to waterways (acres)**
Waugh Lake (9,587)	Marie Lakes	17	401	14	338
	Rush Creek	3	70	2	64
	Rodgers Lakes	8	102	3	45
	Davis Lakes	5	229	4	226
	Waugh Lake	2	9	1	1
	Unnamed tributary/unnammed lake	11	609	3	261
	Waugh Lake basin totals	46	1420	27	934
Gem Lake (4.422)	Crest Creek	13	361	3	199
	Rush Creek	12	40	0	0
	Clark Lakes	4	15	2	4
	Unnamed tributaries	8	47	4	31
	Gem Lake	5	7	3	4
	Gem Lake basin totals	42	469	12	238
Agnew Lake (807)	Rush Creek	8	291	6	285
Upper watershed totals		**96**	**2181**	**45**	**1458**

Lower Watershed					
Drainage Basin (acres)	**Subwatersheds**	**Total number of mass wasting sites**	**Total area of mass wasting sites (acres)**	**Number of mass wasting sites with direct sediment delivery to waterways having unimpeded connection to Silver Lake**	**Total area of mass wasting sites with direct sediment delivery to waterways having unimpeded connection to Silver Lake (acres)**
Below Agnew Lake (873)	Rush Creek	5	44	2	25
	unnamed tributary	1	66	1	66
	Below Agnew Lake basin totals	6	110	3	91
Silver Lake (4,806)	Alger Lakes/Unnamed tributary	10	397	6	305
	Alger Creek	9	1000	8	258
	Silver Lake	8	152	0	0
	Silver Lake basin totals	27	1548	14	563
June Lake (9,639)	Yost Creek	7	247	6	241
	Fern Creek	7	229	3	206
	South Rush Creek	6	86	2	16
	June Lake basin totals	20	561	11	463
Lower watershed totals		**53**	**2219**	**28**	**1116**

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Table AQ 5-17. Perennial Stream Lengths and Drainage Density in the Rush Creek Watershed

Sub-Drainage Basin	Stream Length (feet)	Stream Length (mi.)	Drainage Area (sq. mi.)	Drainage Density (stream length/sq. mi.)
Waugh Lake	104,747	19.8	14.98	1.32
Gem	43,177	8.2	6.91	1.18
Agnew	9,379	1.8	1.26	1.41
Below Agnew	20,944	4.0	1.36	2.92
June Lake	93,706	17.7	15.1	1.18
Silver Lake	33,515	6.3	7.51	0.85

Table AQ 5-18. Trail- and Road-Related Erosion Observed below Gem Dam

Location ID	Active or Inactive Erosion	Erosional Process	Potential to Deliver Sediment to a Stream/Lake/Reservoir[1]	Notes	Photograph
TE-1	Active	Sheet	Unlikely	Concave incised trail bed due to surface wear and erosion along the south side of Waugh Lake.	Photo AQ 5-23
TE-2	Active	Sheet	Unlikely	Typical trail bed erosion and sediment accumulation at water bars where spacing between bars is greatest.	Photo AQ 5-24
TE-3	Active	Sheet	Unlikely	Trail bed erosion and runoff diversion at tram intersections where sediment accumulates downslope.	Photo AQ 5-25
TE-4	Active	Sheet	Likely	Trail surface runoff into Rush Creek at the Spooky Meadows Trail bridge crossing.	Photo AQ 5-26
TE-5	Active	Sheet/ravel	Unlikely	Trail surface erosion on steep loose material that easily dislodged downslope.	Photo AQ 5-27
RE-1	Active	Sheet/ streambank	Likely	Limited erosional surface area. Direct input of sediment associated with road runoff and maintenance (e.g., sanding, plowing), turnout, and public stream access.	Photo AQ 5-28
RE-2	Active	Sheet	Likely		Photo AQ 5-29
RE-3	Active	Sheet	Likely		N/A
RE-4	Active	Sheet/ streambank	Likely	Limited erosional surface area. Direct input of sediment associated with road runoff and maintenance (e.g., sanding, plowing), turnout, public stream access, and bank erosion around the outlet headwall.	Photo AQ 5-30
RE-5	Active	Sheet/ streambank	Likely	Limited erosional surface area. Sediment input associated with road maintenance (e.g., sanding, plowing), turnout, and public stream access. Very narrow vegetated buffer present in some locations around the headwall.	Photo AQ 5-31

Location ID	Active or Inactive Erosion	Erosional Process	Potential to Deliver Sediment to a Stream/Lake/Reservoir[1]	Notes	Photograph
RE-6	Active	Sheet/ streambank	Likely	Limited erosional surface area. Sediment input associated with road maintenance (e.g., sanding, plowing), turnout, and public stream access. Narrow vegetated buffer present.	Photo AQ 5-32
RE-7	Active	Sheet/ streambank	Likely	Limited erosional surface area. Sediment input associated with road maintenance (e.g., sanding, plowing), turnout. Narrow vegetated buffer present.	Photo AQ 5-33
RE-8	Active	Sheet/rill	Unlikely	Road surface erosion and sediment delivery to a large, vegetated buffer between Reversed Creek with no evidence of conveyance.	Photo AQ 5-34
RE-9	Active	Sheet/rill	Unlikely	Sediment fan deposition across road from apparently road runoff farther upslope. Large, vegetated ditch nearby but no evidence of sediment conveyance.	Photo AQ 5-35
RE-10	Active	Sheet/rill	Unlikely	Erosion and deposition from spur road. Large, vegetated meadow between road and creek.	N/A
RE-11	Active	Sheet/rill	Unlikely	Erosion from steep road section. Large, vegetated meadow between road and creek.	N/A
RE-12	Active	Sheet	Unlikely	Minor sediment runoff from gravel road to ditch relief culvert. Large, vegetated meadow between road and creek.	Photo AQ 5-36

[1] Likely or unlikely to deliver sediment particles larger than sand (>0.062mm) to a stream channel capable of transporting bed material to Silver Lake.

Table AQ 5-19. Total Mileage of Roads by Surface Type That Drain to Silver Lake

Road Surface	Total Length (mi)	Percent of Total Length
Aggregate	7.3	17%
Asphalt	26.1	62%
Concrete	0.1	0.4%
Native	8.8	21%
Total	42.3	100%

Table AQ 5-20. Project-Related Infrastructure Erosion Assessment

Location ID	Active or Inactive Erosion	Erosional Process	Potential to Deliver Sediment to a Stream/ Lake/ Reservoir	Notes	Photograph
PE-1	Active	Sheet (recent) Mass wasting (historical)	Unlikely (recent), Probable (historically)	More recent erosion of soil cover over the penstock/access trail. Historical spoils are visible on the hillslope below the penstock. No indication of recent transport of sediment to Agnew Lake.	Photo AQ 5-42
PE-2	Active	Slump/ failure (recent)	Likely (if larger failure occurs)	Slumping of soil around shack and small failures of the gunite/rock retaining wall around the penstock.	Photo AQ 5-43
PE-3	Inactive	Gully (historical)	Likely (recent) Likely (historically)	Gully erosion down to bedrock and large boulders most of the length is unlikely to contribute sediment. Potential recent reprocessing of sediment deposited when the tramway culverts were plugged in 2017 but no longer evident. Potential to carry any subsequent sediment delivered to the channel in the future from surrounding slopes/sources (e.g., location PE-2).	Photo AQ 5-44
PE-4	Active	Slump/ failure (recent) Surface (recent)	Likely	Failure of the slope/upper portion of retaining wall along the right bank - upstream portion of the tram bridge abutment. Continued minor surface erosion.	Photo AQ 5-45
PE-5	Active	Surface (historical/recent)	Likely	Erosion of soil between tramway rail ties and fill slope especially on steeper pitches below Gem Dam.	Photo AQ 5-46
PE-6	Active	Gully (historical) Surface (recent)	Likely	Plugged culvert in 2017 washed out or buried approximately 250 feet of the tramway depositing sediment in Rush Creek.	Photo AQ 5-47 & Photo AQ 5-48

Location ID	Active or Inactive Erosion	Erosional Process	Potential to Deliver Sediment to a Stream/ Lake/ Reservoir	Notes	Photograph
PE-7	Active	Gully (historical) Surface (recent)	Likely	Erosion of hillslope soil beneath the emergency penstock cut and gully erosion approximately 100 feet to Rush Creek. Some of the sediment has deposited behind the stream gage weir.	Photo AQ 5-49
PE-8	Active	Gully (historical) Surface (recent)	Likely	Prior use of overflow release valve eroded away soil and rock on the left bank and what existed in the bedrock crevice on the right bank into Rush Creek. The right bank may continue to contribute minor sediment input, but the right bank is unlikely to contribute additional sediment other than rock or fines that accumulate in the crevice from natural upslope colluvial processes.	Photo AQ 5-50
PE-9	Active	Gully (historical) Surface (recent)	Likely	Penstock drainage channel at Agnew Junction has eroded a channel leaving a coarse substrate that likely will not contribute much more sediment to Rush Creek.	Photo AQ 5-51
PE-10	Active	Potential Slump/ failure (historical) Surface (recent)	Likely	Rock retaining wall may have partially failed prior to being coated in gunite depositing sediment in Rush Creek. Surface erosion from the tram and colluvial rock /sediment from the mountainside enter the creek at his location.	Photo AQ 5-52
PE-11	Active	Surface (historical/recent)	Unlikely	Erosion of soil between tramway rail ties and fill soil especially on steeper pitches middle portions of the tracks below Agnew Dam.	Photo AQ 5-53

Location ID	Active or Inactive Erosion	Erosional Process	Potential to Deliver Sediment to a Stream/ Lake/ Reservoir	Notes	Photograph
PE-12	Active	Surface (historical/recent)	Likely	Minor tramway fill slope erosion in proximity to a tributary of Rush Creek.	Photo AQ 5-54
PE-13	Active	Surface/rill (historical/recent)	Unlikely	Erosion of soil between tramway rail ties and fill soil along the tracks in the lower portion of the tracks below Agnew Dam before reaching the powerhouse facilities.	Photo AQ 5-55

Table AQ 5-21. 2023 Suspended Sediment Concentrations and Particle Sizes

Date	Q (cfs)	Suspended Sediment Concentration (mg/L)	%Sand	%Silt	%Clay
SS1 Rush Creek Mainstem above SR-158					
5/31/2023	156.8	29.1	91.8	8.2	0.0
6/15/2023	243.5	58.4	58.4	39.7	1.9
7/21/2023	227.5	196.1	93.9	6.1	0.0
8/4/2023	9.6	42.4	35.4	52.8	11.8
8/14/2023	8.3	76.4	84.2	14.8	1.0
9/21/2023	2.0	80.5	83.3	16.0	0.7
10/12/2023	2	43.1	87.6	11.8	0.7
SS2 Reversed Creek					
5/31/2023	87.7	57.4	44.4	52.3	3.3
6/15/2023	114.7	104.6	82.4	17.2	0.4
7/21/2023	48.3	168.4	74.4	25.2	0.4
8/4/2023	25.4	50.6	74.8	24.6	0.6
8/14/2023	19.7	58.2	68.4	30.5	1.1
9/21/2023	6.5	87.3	73.7	25.6	0.7
10/12/2023	--	--	--	--	--
SS3 Powerhouse Tailrace					
5/31/2023	107	76.8	79.9	18.6	1.4
6/15/2023	106	56.8	73.7	25.3	1.0
7/21/2023	105	111.4	41.6	56.1	2.3
8/4/2023	105	18.1	94.5	5.1	0.5
8/14/2023	100	10.5	97.4	2.6	0.0
9/21/2023	25	188.9 *	100.0	0.0	0.0
10/12/2023	--	--	--	--	--
SS4 Unnamed Tributary to South Rush Creek					
5/31/2023	30.7	28.4	80.5	18.7	0.8
6/15/2023	31.4	53.3	75.9	23.4	0.7
7/21/2023	9	194.4	45.6	50.7	3.8
8/4/2023	3.59	22.3	67.1	31.0	1.8
8/14/2023	3.06	47.3	79.4	19.7	0.9
9/21/2023	2.33	14.8	38.3	57.6	4.1
10/12/2023	--	--	--	--	--
SS5 South Rush Creek					
5/31/2023	20.2	72.6	85.9	13.9	0.2
6/15/2023	28.9	35.5	83.0	17.0	0.0
7/21/2023	111.2	160.5	86.0	13.2	0.9
8/4/2023	--	--	--	--	--
8/14/2023	--	--	--	--	--
9/21/2023	--	--	--	--	--
10/12/2023	1.2	35.4	96.7	3.3	0.0

* Data point is suspect (considerable scatter possibly due to collection or lab error)

Table AQ 5-22. Silver Lake Delta Areas 1951-2019

Date of Aerial Photography	Area of Delta Deposit (acres)
08/10/1951	none
08/23/1963	0.32
08/14/1972	0.32
08/27/1983	2.05
08/11/1985	1.88
07/05/1987	3.12
10/04/1989	2.17
09/24/1993	2.22 (USGS) 2.35 (this study)
09/29/1994	2.42
06/11/2005	2.1 (this study)
09/2019	3.1 (this study)

Source: Blodgett 1997.

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Table AQ 5-23. Characterization of Large Woody Debris in Rush Creek and South Rush Creek Upstream of Silver Lake Meadow

Reach	Site name	Description	Number of pieces greater than 3" diameter at breast height	Significant amount of smaller debris in-channel (Y/N)	Number of pieces In-channel below bankfull stage	Number of pieces In-channel above bankfull stage	Significant debris on floodplain (Y/N)
Rush Creek upstream of Reversed Creek	RCWD_1	~70' section with several large fallen trees spanning channel and in-channel debris accumulation	~10	Y	~6	~4	Y
	RCWD_2	~100' section heavily obstructed by multiple fallen trees and debris	~20	Y	~16	~4	Y
Rush Creek downstream of Reversed Creek	RCDSR_1	One log and some small debris in channel	1	Y	1	0	N
	RCDSR_2	Several fallen trees spanning channel	5	N	4	1	Y
	RCDSR_3	~100' section with multiple fallen trees spanning channel and dense debris throughout floodplain	~20	Y	~17	~3	Y
	RCDSR_4	Several large fallen trees spanning channel. Many extend from the floodplain to below the WSEL	~24	y	~20	~4	y
South Rush Creek	SRWD_1	Two ~15' long logs and smaller debris in channel, smaller logs on banks	~4	N	3	1	N
	SRWD_2	Single large fallen tree spanning channel with a log around bankfull	2	N	0	2	N
	SRWD_3	~50' section of channel choked with attached dead riparian vegetation and small debris	1	Y	1	0	N
	SRWD_4	~80' section of channel spanned by several large fallen trees, and one large stump/rootwad embedded in right bank of channel	~7	N	1	6	Y
	SRWD_5	Large fallen double-trunk tree in channel parallel to flow on top of a fallen tree spanning channel	2	N	1	1	N
	SRWD_6	Large undercut live tree partially submerged and partially blocking channel (significant flow obstruction)	n/a	n/a	n/a	n/a	n/a
	SRWD_7	Large partially fallen live tree blocking most of channel and trapping debris	n/a	n/a	n/a	n/a	n/a
	SRWD_8	~140' stretch of channel and floodplain partially to mostly blocked with many large fallen trees and debris.	~26	Y	~17	~9	Y
	SRWD_9	~100' stretch of channel littered with fallen trees and debris	~30	Y	~19	~11	Y

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PHOTOS

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Photo AQ 5-1. Location of debris slide from unnamed tributary to Waugh Lake north shoreline

Photo AQ 5-2. Debris slide "levee: material deposits (blue arrows) on north shoreline of Waugh Lake

Photo AQ 5-3. Close up debris slide deposit on shoreline of Waugh Lake

Photo AQ 5-4. Example of a high sediment delivery potential mass-wasting site with colluvial material from Carson Peak being deposited into Agnew Lake

Photo AQ 5-5. Rush Creek Upstream from Silver Lake, RM 16.97 (XS G3)

Photo AQ 5-6. Rush Creek just downstream from the confluence with Reversed Creek and upstream from the Powerhouse tailrace, approximately RM 17.4. Note minor bank erosion with undercutting (arrows)

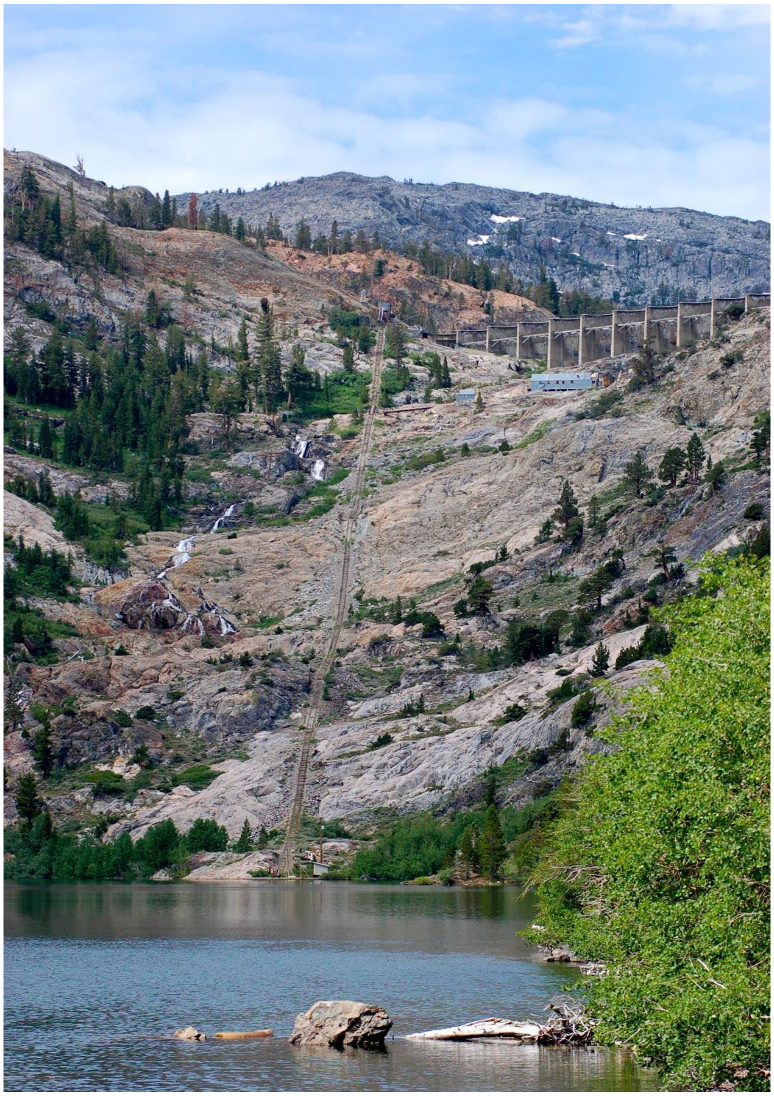

Photo AQ 5-7. Rush Creek A1a+ channel type with cascading bedform over bedrock between Gem Dam and Agnew Lake.

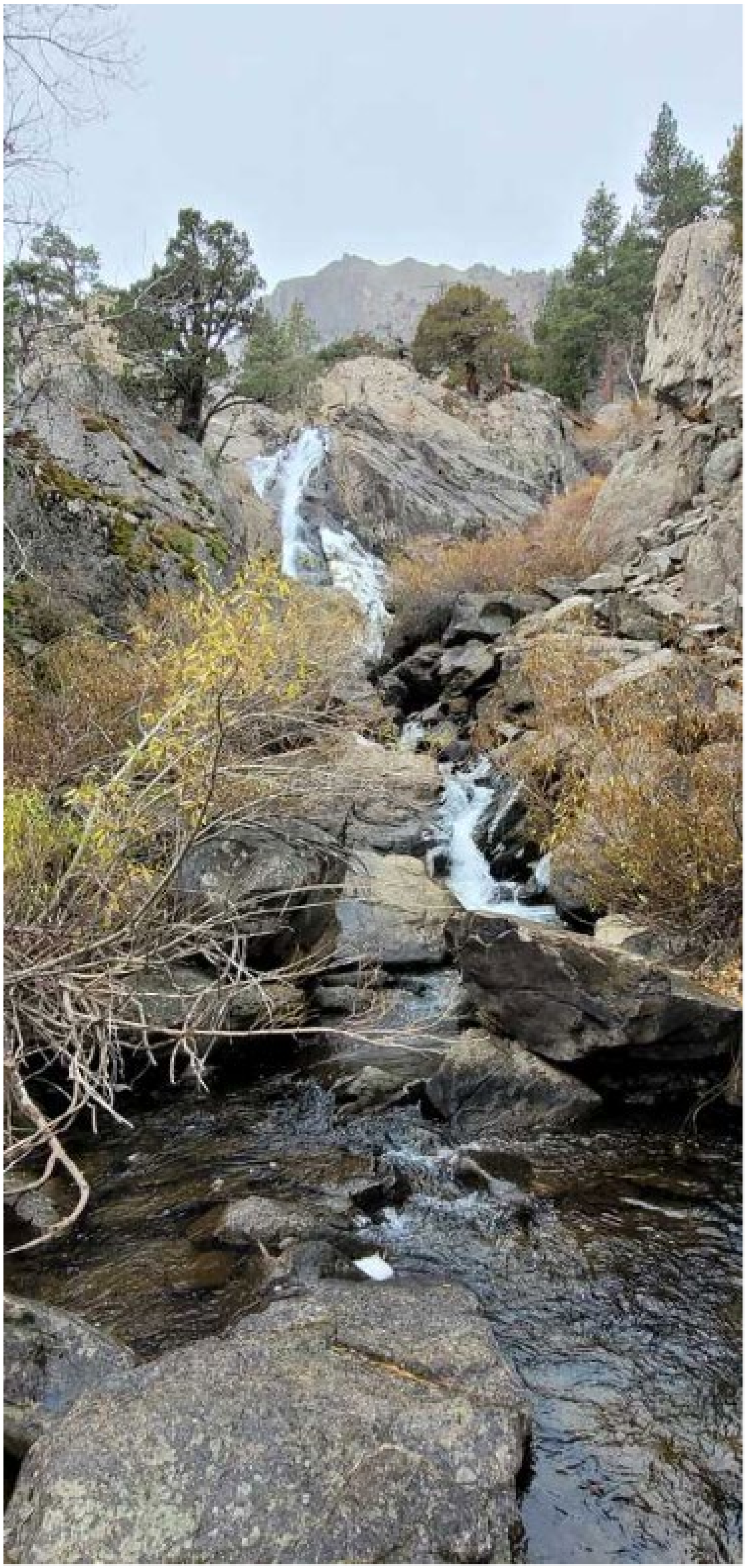

Photo AQ 5-8. Rush Creek reach downstream from Agnew Dam A1a+ channel type, which is bedrock controlled, non-adjustable channel type with very low potential for bank erosion.

Photo AQ 5-9. Rush Creek B3 channel type downstream from Gem Dam RM 18.5 (XS G2), with bedrock outcropping on right bank, cobble armor, well-vegetated left bank, no indications of erosion.

Photo AQ 5-10. Rush Creek below Rush Meadows Dam (approx. RM 21.8), B3 channel type. Stable moderate bank slopes, bedrock armor outcrops and well-vegetated.

Photo AQ 5-11. Rush Creek below Waugh, RM 20.9, B3 channel type with forested and brushy-vegetated stable moderately sloped banks (XS G1 view downstream)

Photo AQ 5-12. Section of Rush Ck below Rush Meadows Dam where it is non-adjustable, controlled by bedrock.

Photo AQ 5-13. Aerial image (Google Earth) showing two locations at RM's 20.9 and 21.1 (blue dots) in the reach below Rush Meadows Dam where Rush Creek channel had historically eroded and widened.

Photo AQ 5-14. Rush Creek approximately 0.1 mile upstream of inlet to Waugh Lake (approx. RM 27.6) showing stable forested channel banks with interspersed bedrock and boulder outcropping.

Photo AQ 5-15. Reversed Creek near Rainbow Dr. about 0.5 mile downstream from ski area.

Photo AQ 5-16. Reversed Creek downstream from Fern Ck confluence. Low grassy and forested banks, cobble-gravel bed material.

Photo AQ 5-17. Reversed Creek in Meadow downstream from Hwy.158, one of the few sites observed with erosion (left bank, view is downstream).

Photo AQ 5-18. Fern Creek near the Fern/Yost trailhead loop road off Boulder Road (Hwy 158). Low, cobble banks, forested. No erosion.

Photo AQ 5-19. Fern Creek located upstream of Double Eagle Resort. Note left bank erosion opposite large woody debris (view from left to right bank).

Photo AQ 5-20. Yost Creek just upstream of confluence with Reversed Creek, off Shadow Pines Rd crossing.

Photo AQ 5-21. South Rush Creek in B3-channel type segment RM 0.2 (XS G1). Note area of unvegetated bank where measuring tape crosses the channel on left side of photo.

Photo AQ 5-22. South Rush Creek in C5-channel type segment RM 0.04. Note minor bank erosion associated with fallen trees along the right bank.

Photo AQ 5-23. Prolonged surface wear and erosion of the trail bed coupled with diversion of surface flow from upslope has caused incision (location TE-1).

Photo AQ 5-24. Example of a trail runoff diversion structure with minor sediment accumulation due to trail bed surface erosion (location TE-2).

Photo AQ 5-25. Example of worn concave trail surface and erosion at the intersection of the tramway (location TE-3).

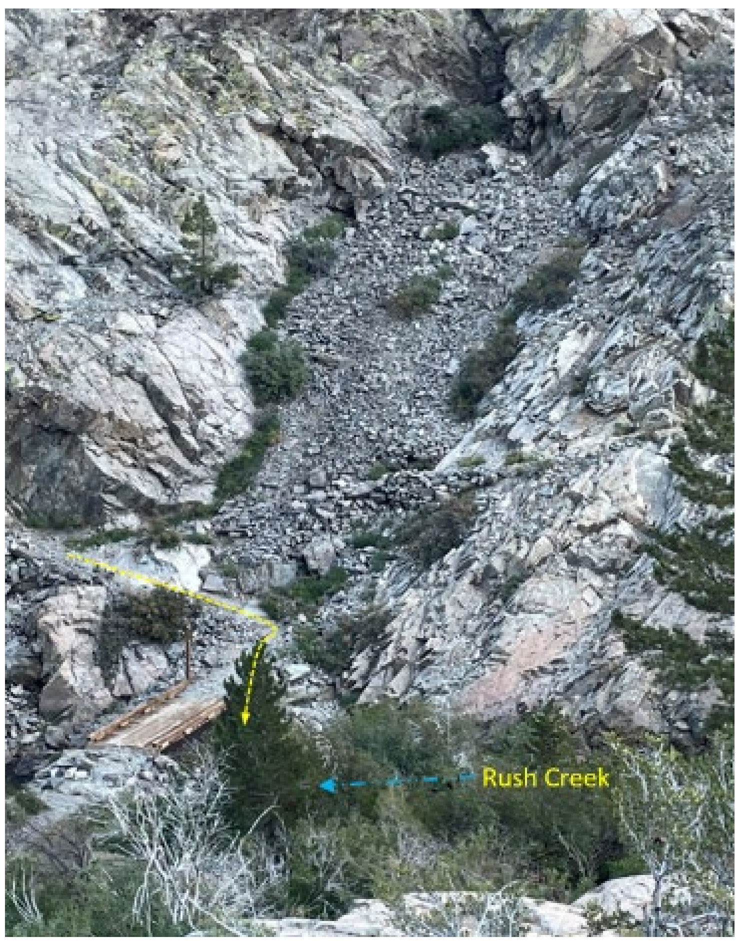

Photo AQ 5-26. Surface erosion and sediment deposition into Rush Creek from the Spooky Meadows Trail typical at stream crossings (location TE-4).

Photo AQ 5-27. Surface erosion from the Lower Gem Dam Trail (location TE-5).

Photo AQ 5-28. Sheet/bank erosion along SR-158 turnout and stream access (location RE-1).

Photo AQ 5-29. Sheet/bank erosion along SR-158 turnout and stream access (location RE-2).

Photo AQ 5-30. Surface and bank erosion at the outlet side of the tailrace SR-158 culvert (location RE-4).

Photo AQ 5-31. Minor surface erosion from the shoulder/turnout at the outlet side of the Rush Creek SR-158 culverts (location RE-5).

Photo AQ 5-32. Minor surface erosion from the shoulder/turnout at the outlet side of the South Rush Creek SR-158 culverts (location RE-6).

Photo AQ 5-33. Minor sheet and bank erosion associated with the SR-158 Reversed Creek culvert and turnout (location RE-7).

Photo AQ 5-34. Nevada Street surface and inboard ditch runoff diversion with a vegetated buffer between Reversed Creek and the road (location RE-8).

Photo AQ 5-35. Gravel and sand deposition across Nevada Street presumably from a road upslope. Deposition is near a vegetated ditch leading to Reversed Creek, but no indication sediment was transported to the creek (location RE-9).

Photo AQ 5-36. Very minor road surface erosion and runoff to a small culvert and large vegetated buffer between Rush Creek (location RE-12).

Photo AQ 5-37. Example location where erosion of Canyon Trail Road cut slope, road surface, as well as sediment from ski runs may be conveyed downslope to nearby stream channels or may be stored in low lying areas (hillslope benches or meadows) or in retention/detention basins (location RE-13).

Photo AQ 5-38. Example location (Los Angeles St and adjoining streets) where paved and unpaved surface street runoff may be a source of sediment to Reversed Creek.

Photo AQ 5-39. Microsoft Bing street view image of Los Angeles Street at Reversed Creek where road runoff enters the channel.

Photo AQ 5-40. Example location where overbank flows from Fern Creek (blue lines) are eroding the Fern/Yost trailhead parking area and re-entering the creek downstream of the bridge (yellow lines).

Photo AQ 5-41. Google street view photo showing an example of road runoff from SR-158 (and spur roads) entering directly into Reversed Creek carrying with it sediment from sanding the roadway.

Photo AQ 5-42. Surface erosion around the Gem to Agnew junction flowline and access trail. Spoils likely from historical construction of penstock is visible on the hillslope in the right photo (location PE-1).

Photo AQ 5-43. Rock and shotcrete/gunite retaining wall failures below the Gem to Agnew junction flowline and slumping/collapsing in around the shack (upper right photo). Location PE-2.

Photo AQ 5-44. Historical erosion of hillslope and drainage below the penstock outlet (location PE-3).

Photo AQ 5-45. Erosion of the right bank side of the tram bridge abutment retaining wall (location PE-4).

Photo AQ 5-46. Surface erosion from around the tramway rails and fill slope, particularly on steeper pitches (location PE-5).

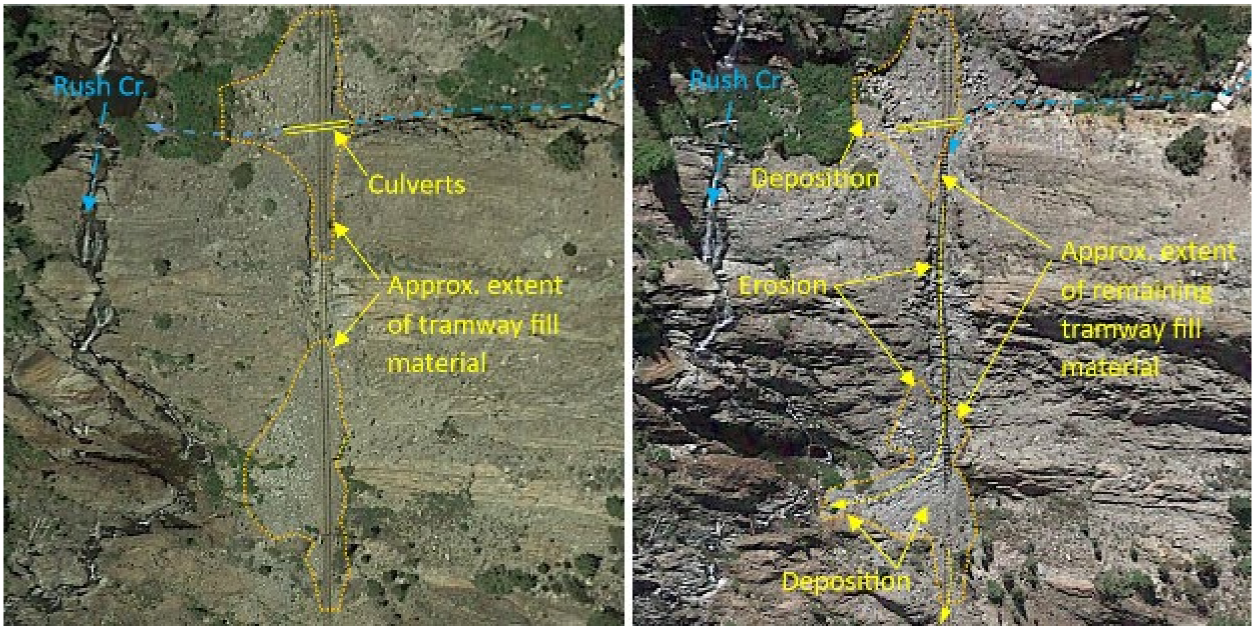

Photo AQ 5-47. Before (2016) and after (2019) images showing the erosion and of the tramway fill slope after the culverts became plugged in the 2017 runoff season (location PE-6).

Photo AQ 5-48. Various perspectives of the eroded tramway caused by runoff diversion from the culvert crossing that became plugged in the 2017 runoff season (location PE-6).

Photo AQ 5-49. Surface erosion and approximately 100 linear feet of gully/channel erosion to Rush Creek from the 2017 emergency cut in the Agnew penstock (location PE-7).

Photo AQ 5-50. Agnew junction valve house 18-inch standpipe outlet and the area eroded on the right and left bank of Rush Creek (location PE-8).

Photo AQ 5-51. **Erosion of a channel below the Agnew junction valve house to Rush Creek (location PE-9).**

Photo AQ 5-52. **Surface erosion from around the tramway (lower left) and hillslope erosion below the retaining wall (right) from a combination of prior tram/wall construction/repairs and mass wasting of the mountainside (top left). Location PE-10.**

Photo AQ 5-53. Typical surface erosion from around the rail ties in the middle portion of the tramway below Agnew (location PE-11).

Photo AQ 5-54. Minor surface erosion of the tramway fill slope into a tributary of Rush Creek (location PE-12).

Photo AQ 5-55. Typical surface erosion along steeper pitches of the lower Agnew tramway (note the gap beneath the rail and rotated tie). Rill erosion along the lower side of the tracks leading towards the powerhouse (location PE-13).

Photo AQ 5-56. Powerhouse tailrace on June 15, 2023. Flow was 106 cfs and sediment concentration was 56.8 mg/L. Channel bottom is visible through clear water.

FIGURES

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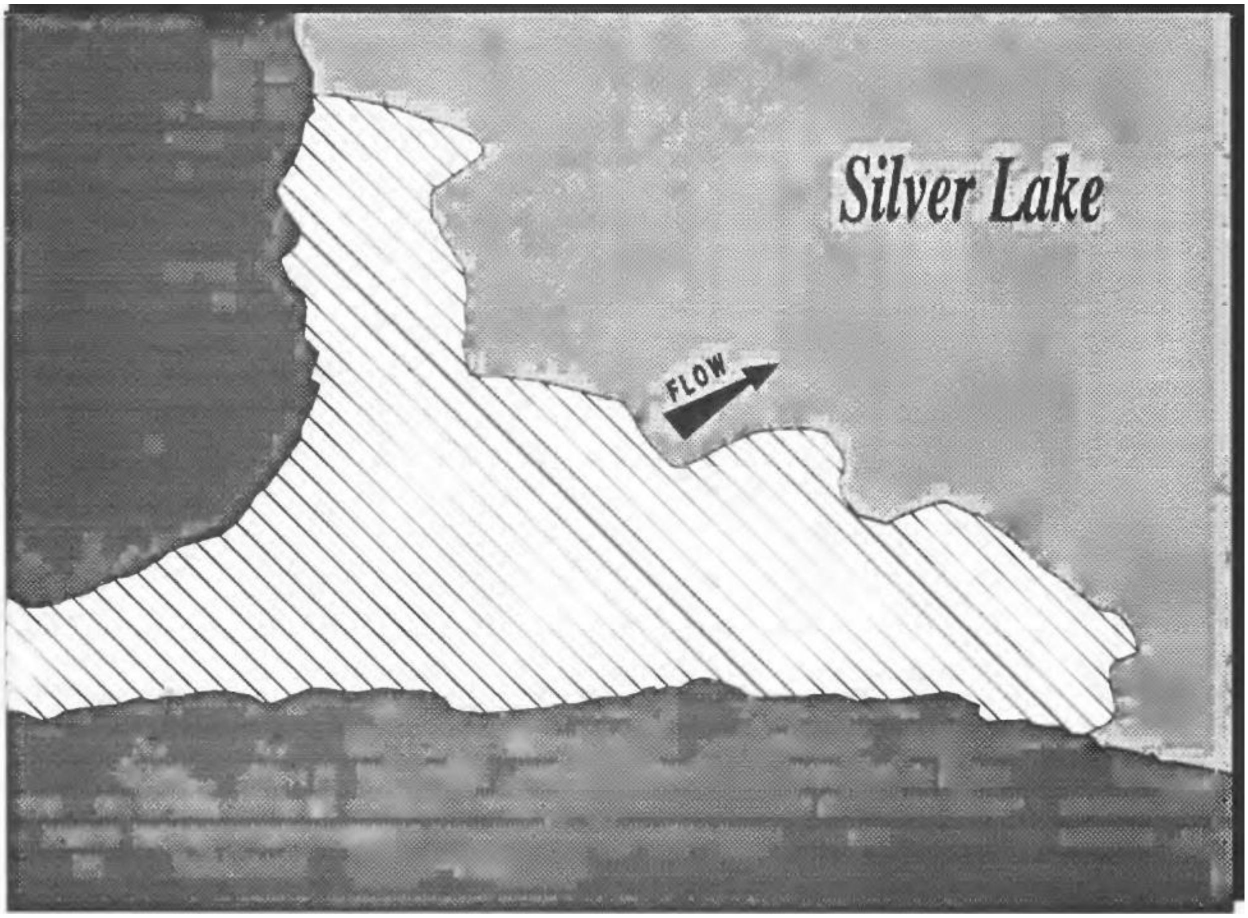

Source: Blodgett 1997

Figure AQ 5-1. USGS Figure Showing Area of Delta Deposition in Silver Lake as of September 1993

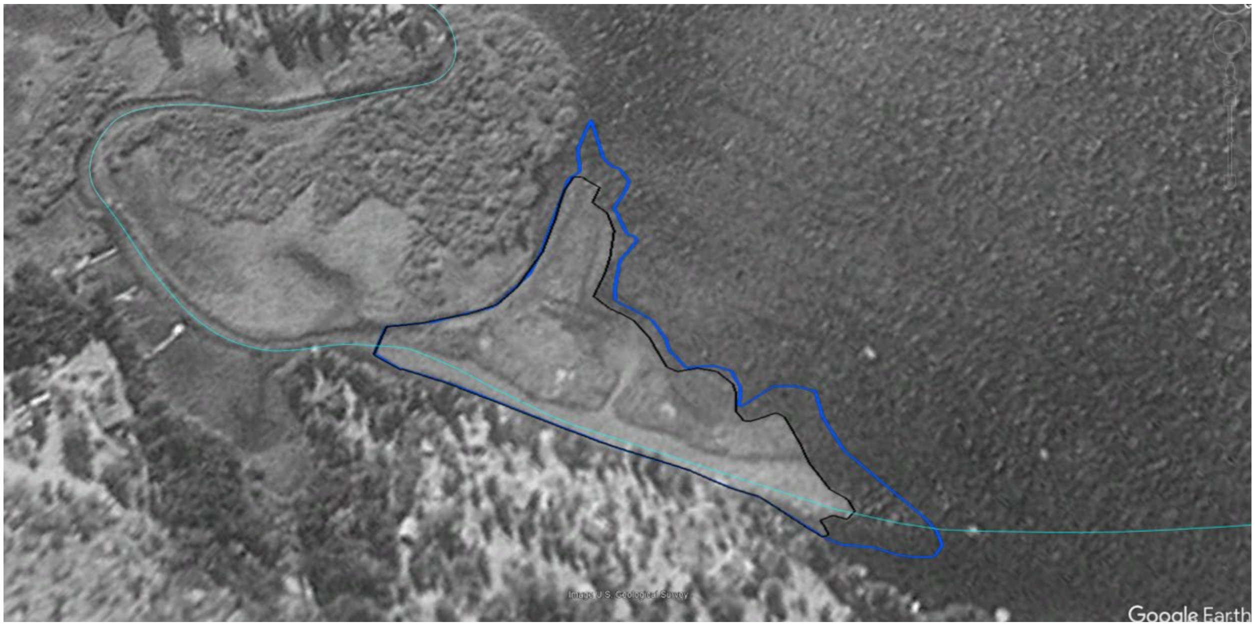

Figure AQ 5-2. Silver Lake Delta 1993 (Black Outline) and 2019 (Blue Outline) Shown on September 1993 Google Earth Aerial

Figure AQ 5-3. Silver Lake Delta 1993 (Black Outline), 2005 (Green Outline) and 2019 (Blue Outline) Shown on September 2019 Google Earth Aerial

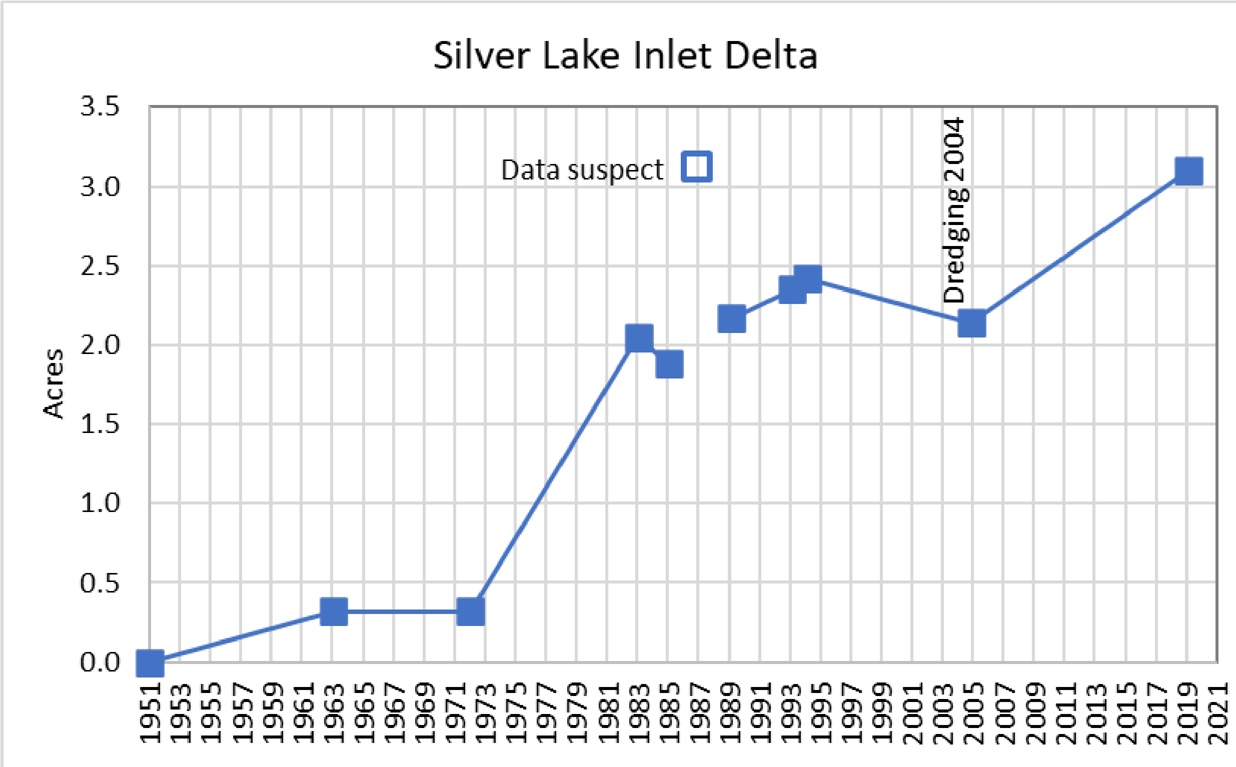

Figure AQ 5-4. Silver Lake Inlet Delta Area

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MAPS

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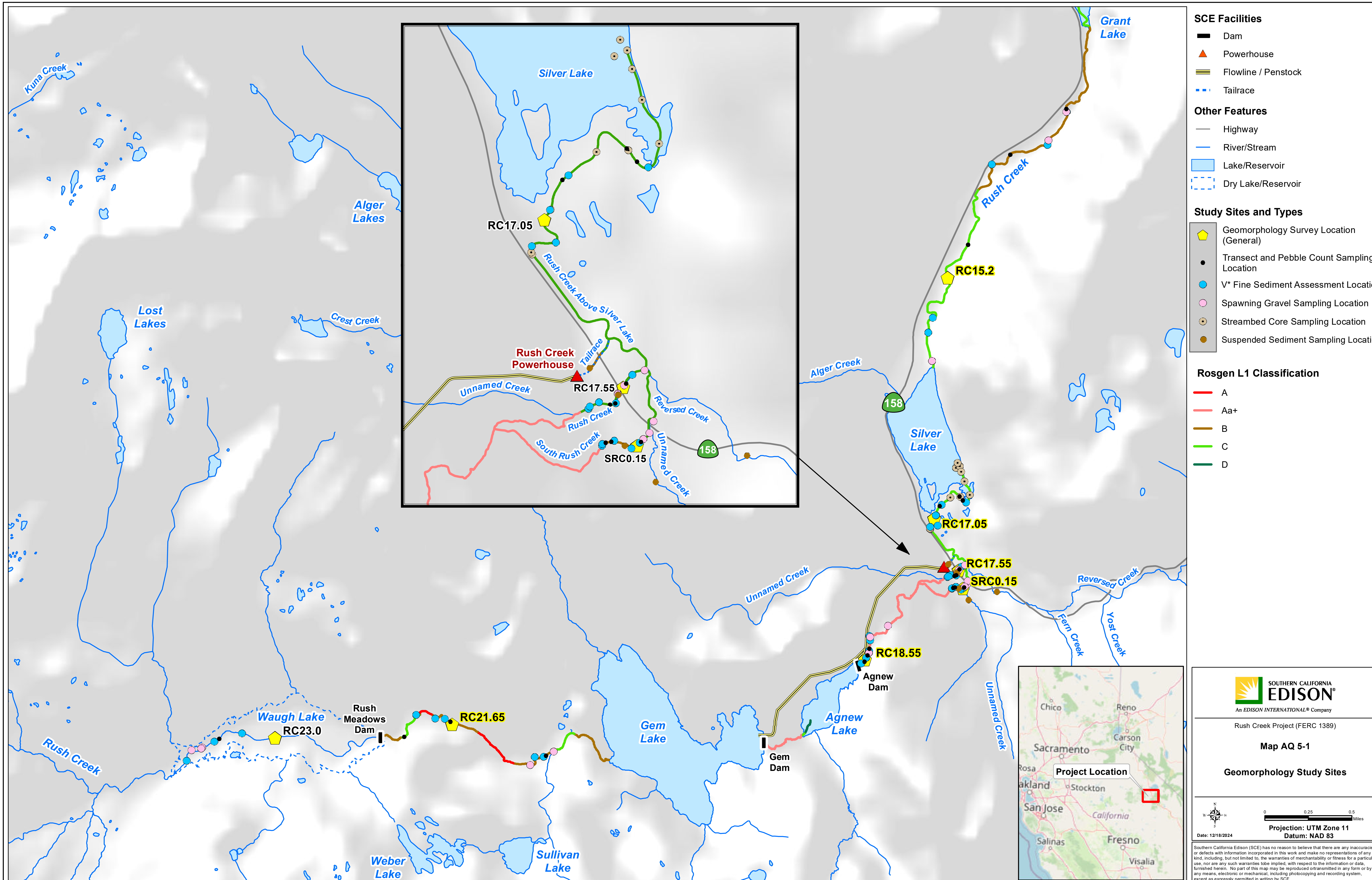

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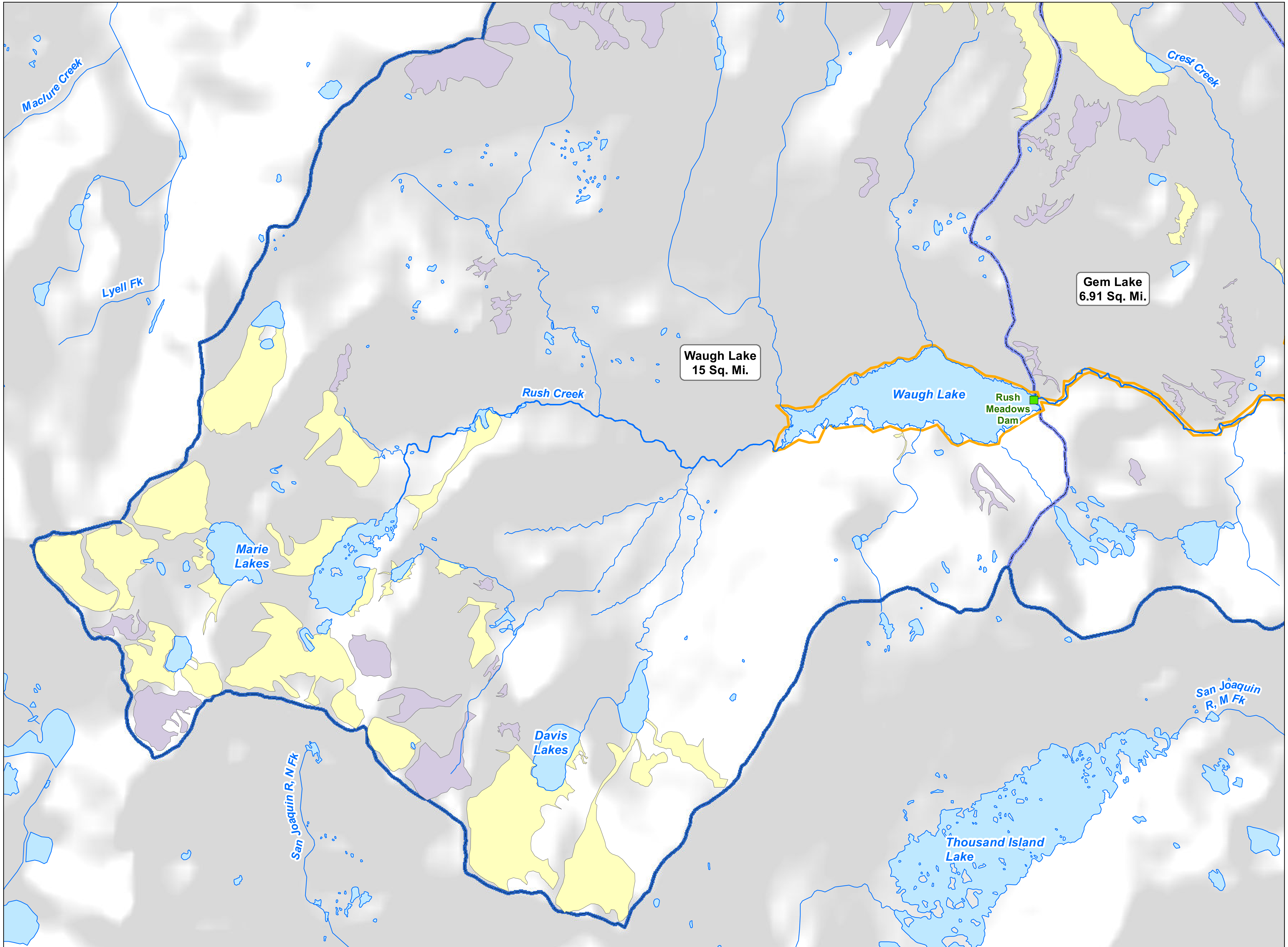


SCE Facilities

- Dam
- Powerhouse

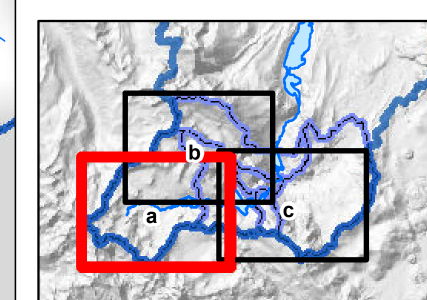
Other Features

- Highway
- FERC Boundary
- River/Stream
- Lake/Reservoir
- Drainage Basins
- Rush Creek Watershed Boundary

Mass Wasting Areas

Sediment Recruitment

- Hillslope Storage
- Direct Sediment Delivery to Waterways
- Direct Sediment Delivery to Waterways with Unimpeded Connection to Silver Lake



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Rush Creek Project (FERC 1389)

Map AQ 5-2a

Mass-Wasting Sites in the Western Portion of the Study Area

0 500 1,000 2,000 Feet

Date: 2/20/2024

Projection: UTM Zone 11
Datum: NAD 83

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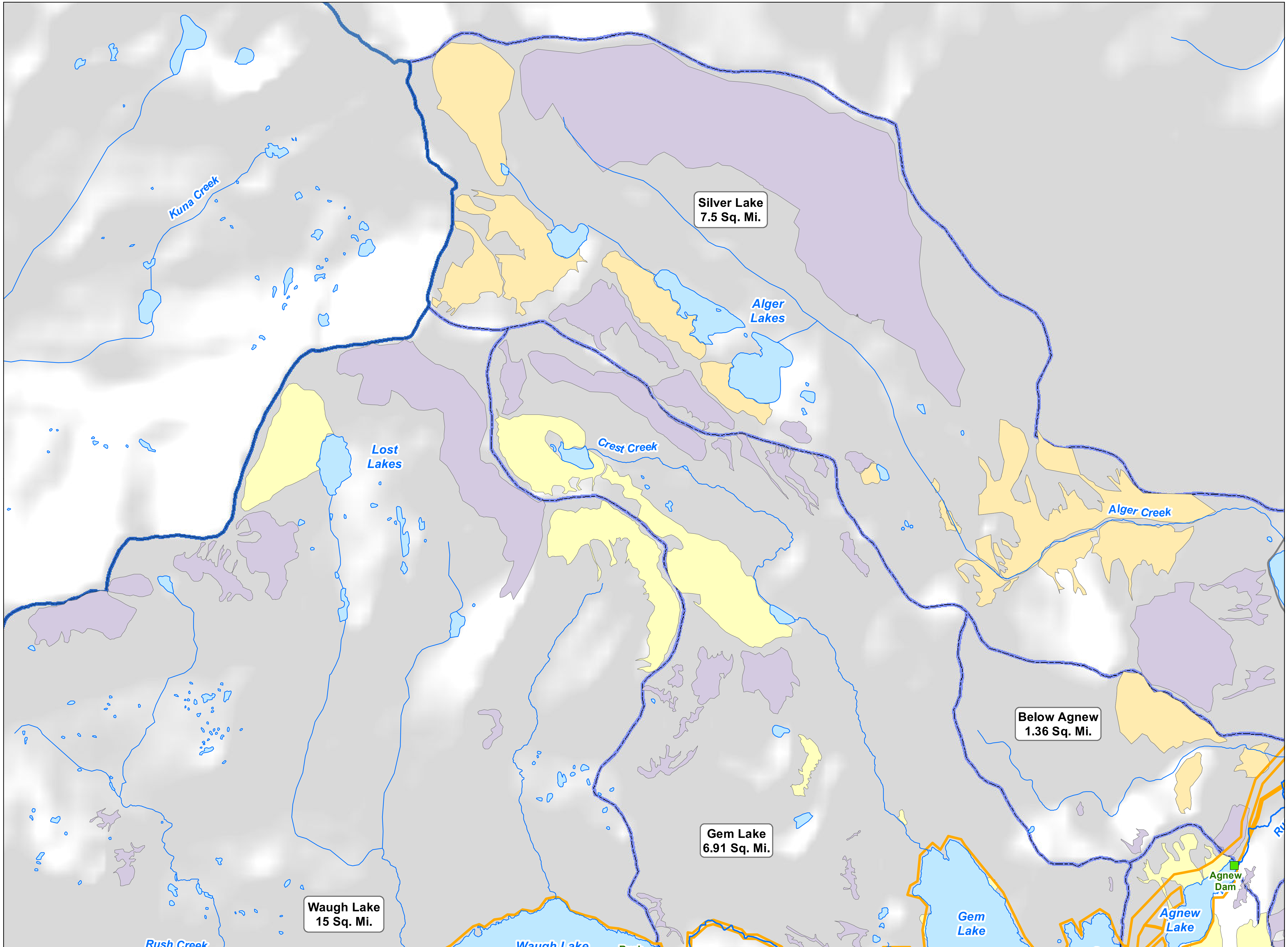

SCE Facilities

- Dam
- Powerhouse

Other Features

- Highway
- FERC Boundary
- River/Stream
- Lake/Reservoir
- Drainage Basins
- Rush Creek Watershed Boundary

Mass Wasting Areas

Sediment Recruitment

- Hillslope Storage
- Direct Sediment Delivery to Waterways
- Direct Sediment Delivery to Waterways with Unimpeded Connection to Silver Lake

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Rush Creek Project (FERC 1389)

Map AQ 5-2b

Mass-Wasting Sites in the Northern Portion of the Study Area

0 500 1,000 2,000 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 2/20/2024

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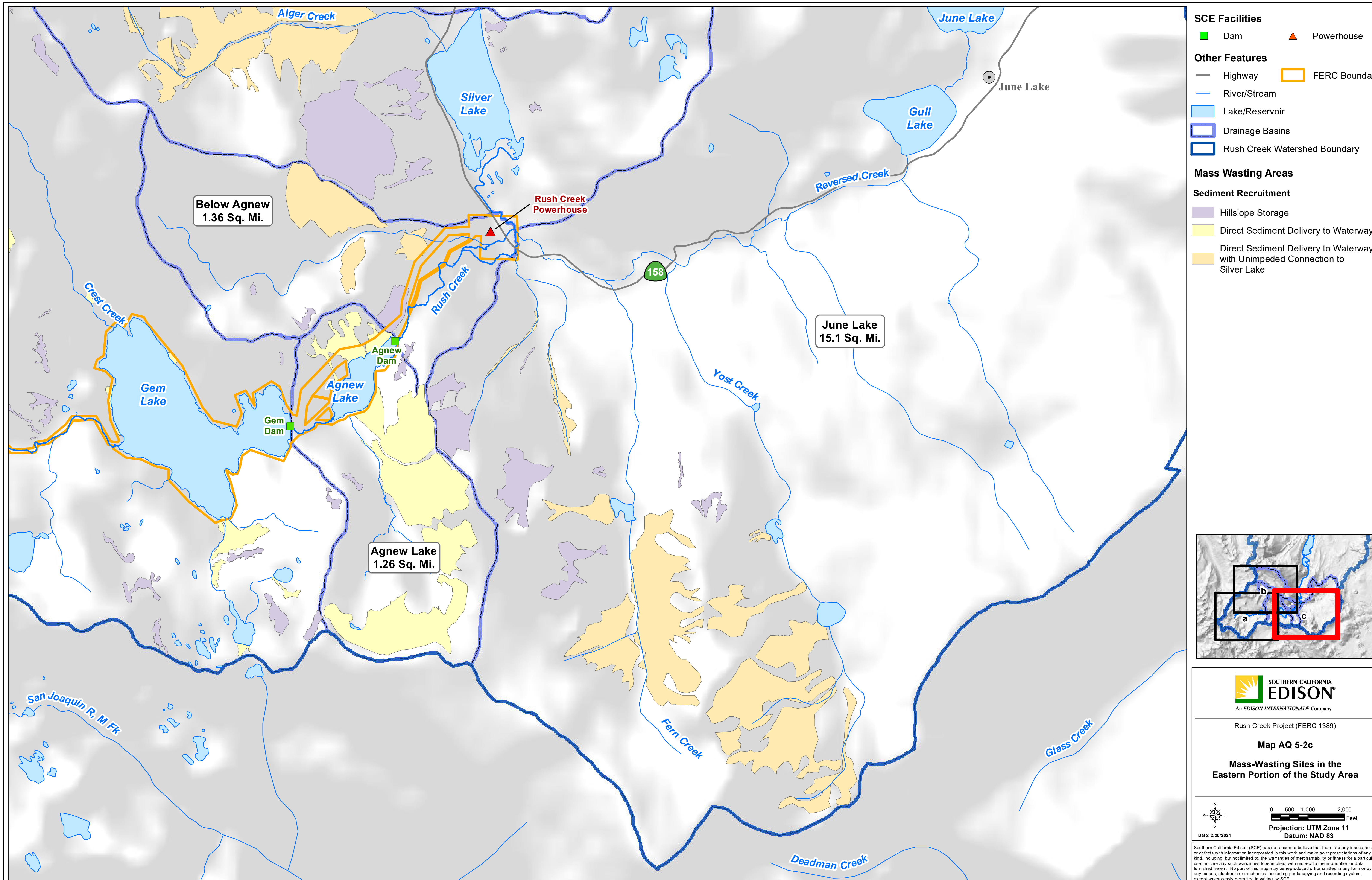

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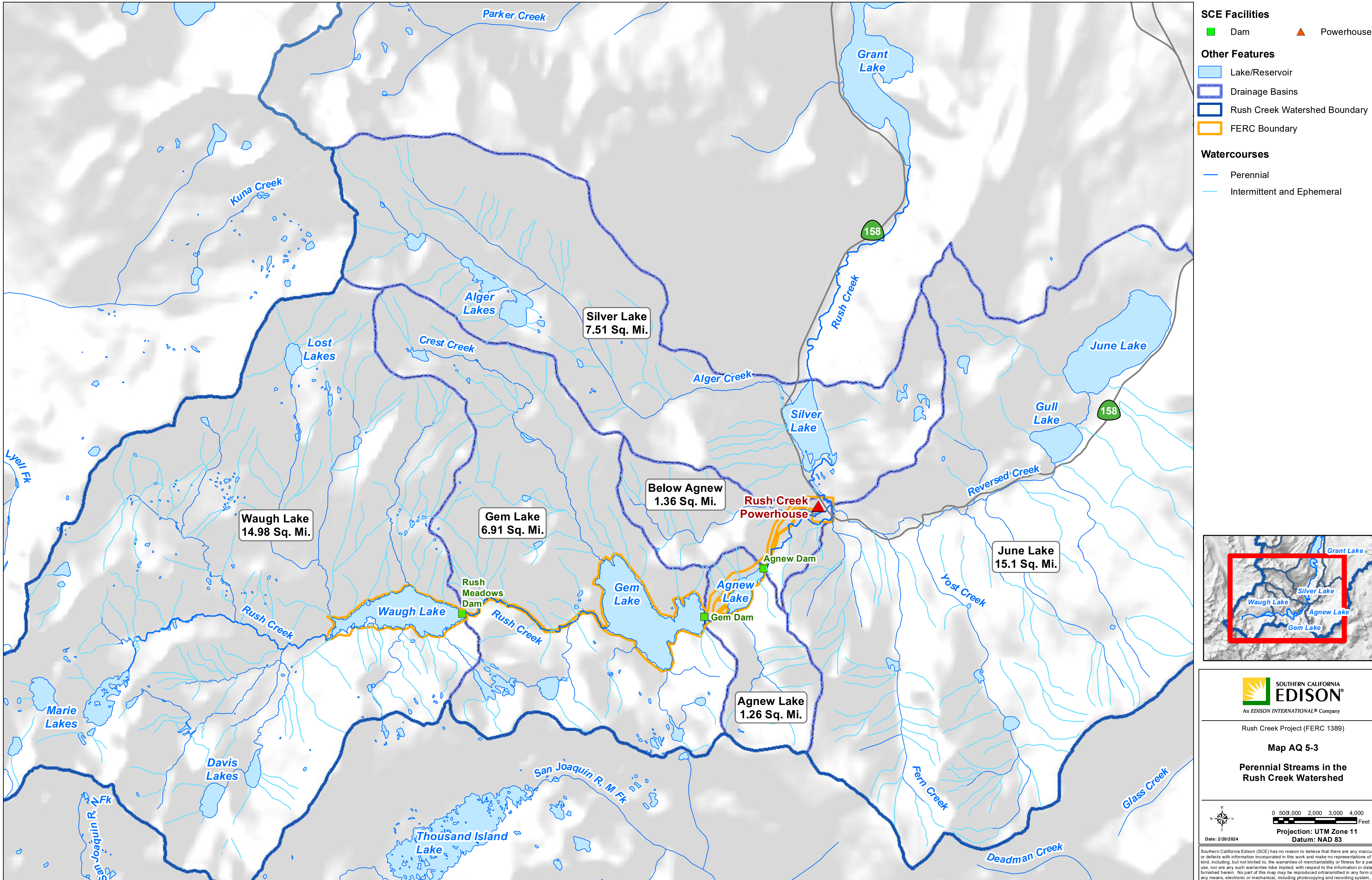

SCE Facilities

- Dam
- Powerhouse

Other Features

- Lake/Reservoir
- Drainage Basins
- Rush Creek Watershed Boundary
- FERC Boundary

Watercourses

- Perennial
- Intermittent and Ephemeral

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Rush Creek Project (FERC 1389)

Map AQ 5-3

Perennial Streams in the Rush Creek Watershed

0 500 1,000 2,000 3,000 4,000 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 2/20/2024

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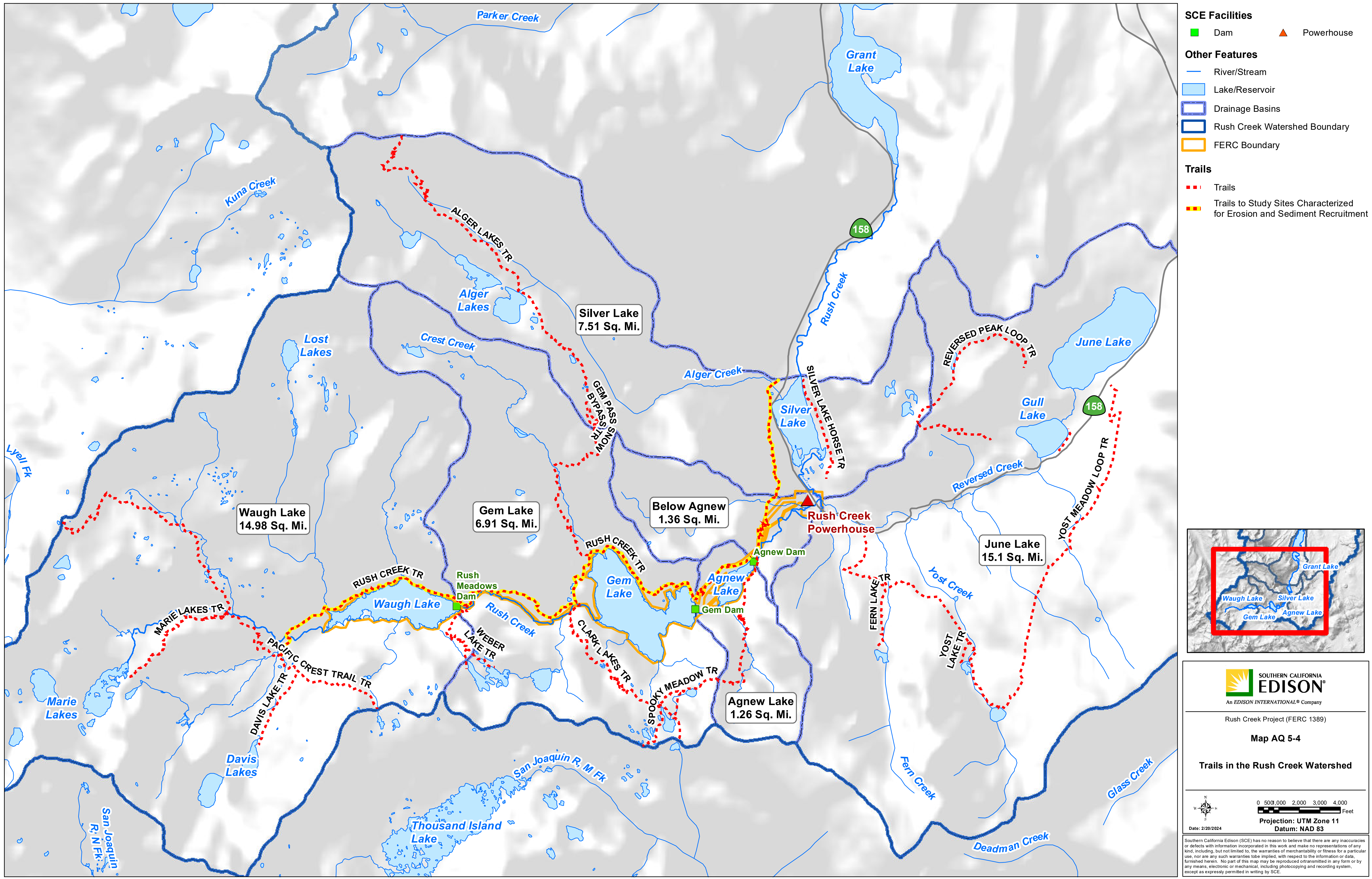

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Rush Creek Project (FERC 1389)

Map AQ 5-4

Trails in the Rush Creek Watershed

0 500 1,000 2,000 3,000 4,000 Feet

Date: 2/20/2024

Projection: UTM Zone 11
Datum: NAD 83

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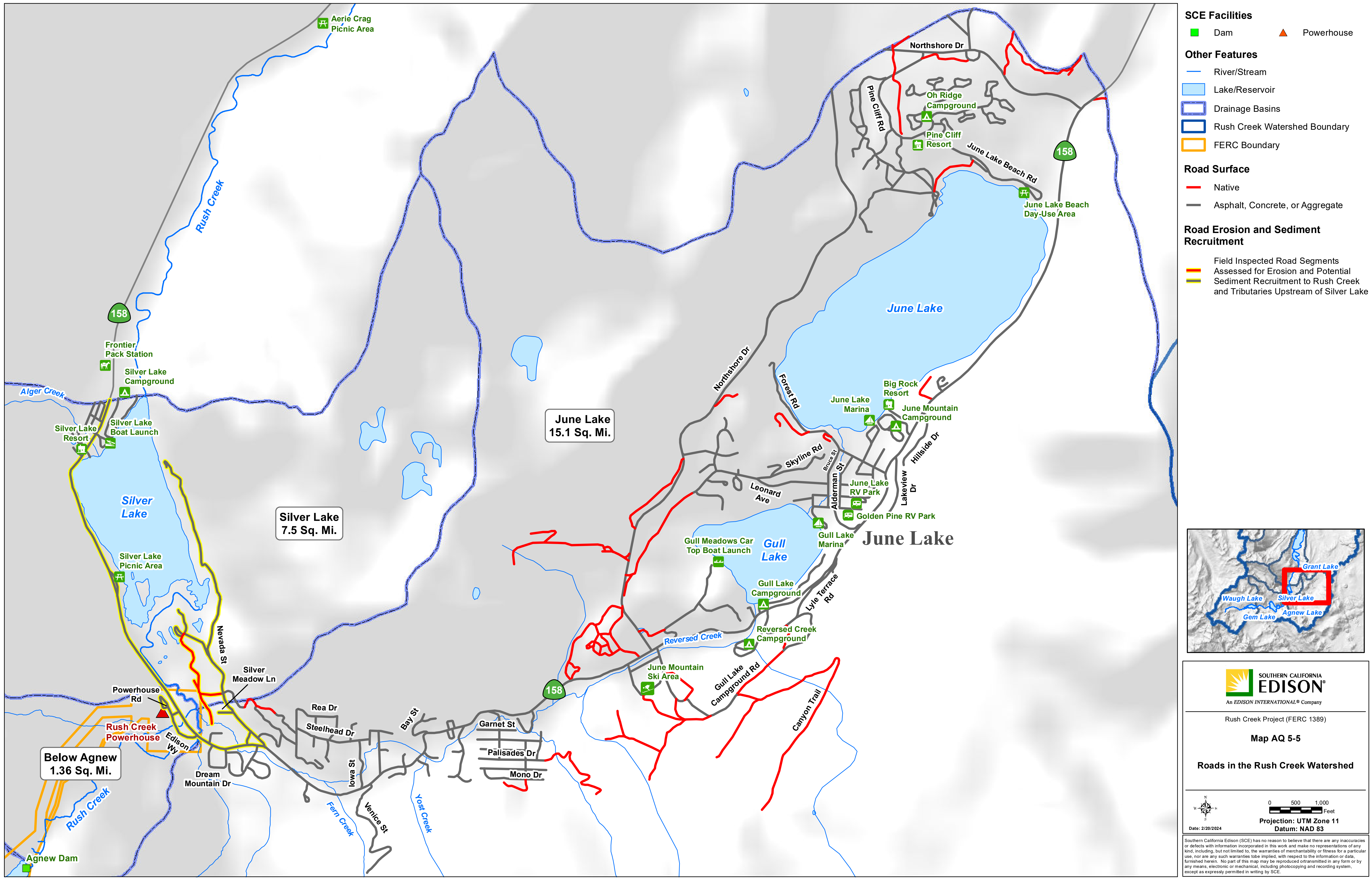

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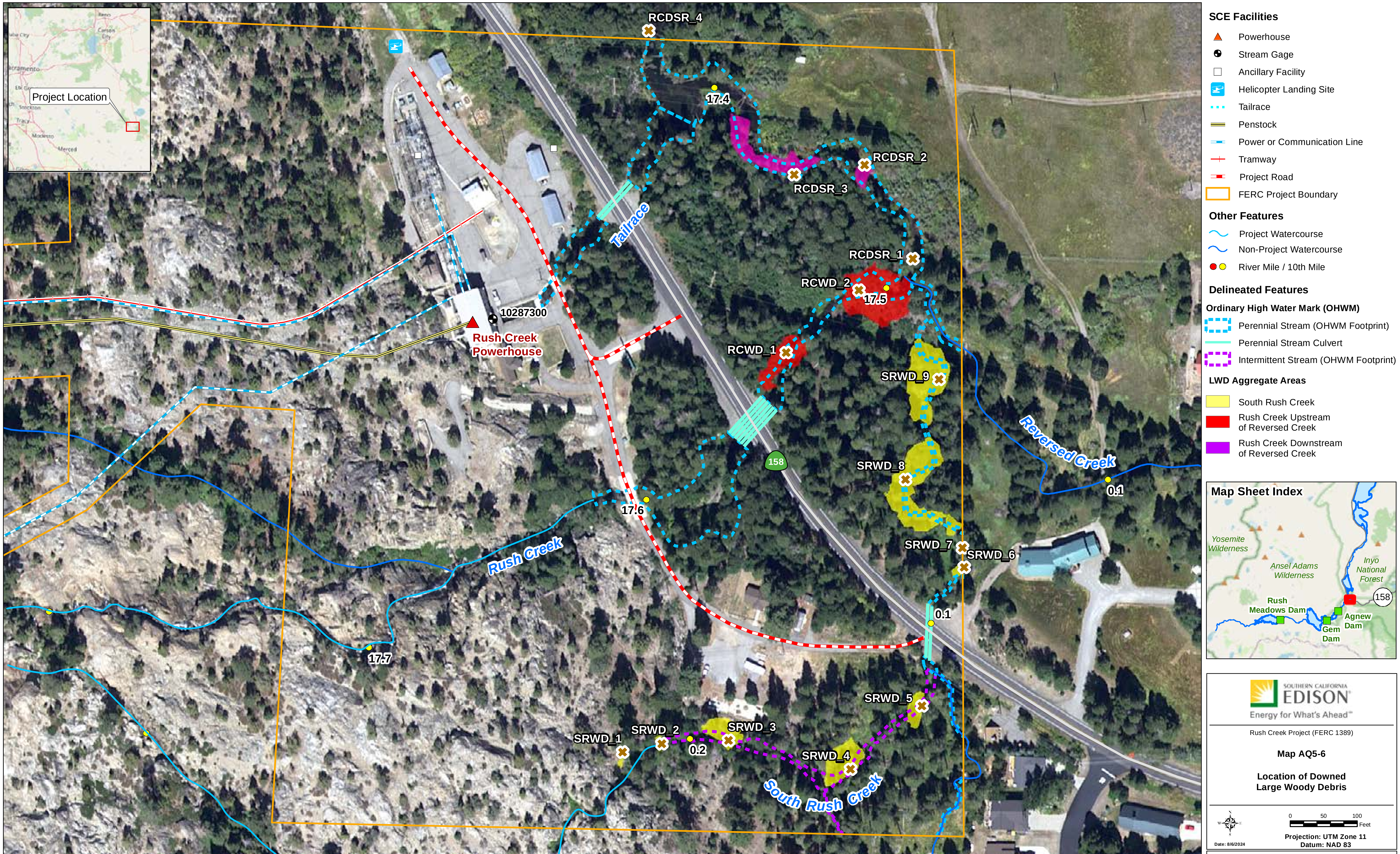

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APPENDIX A

Detailed Geomorphology Technical Studies Maps

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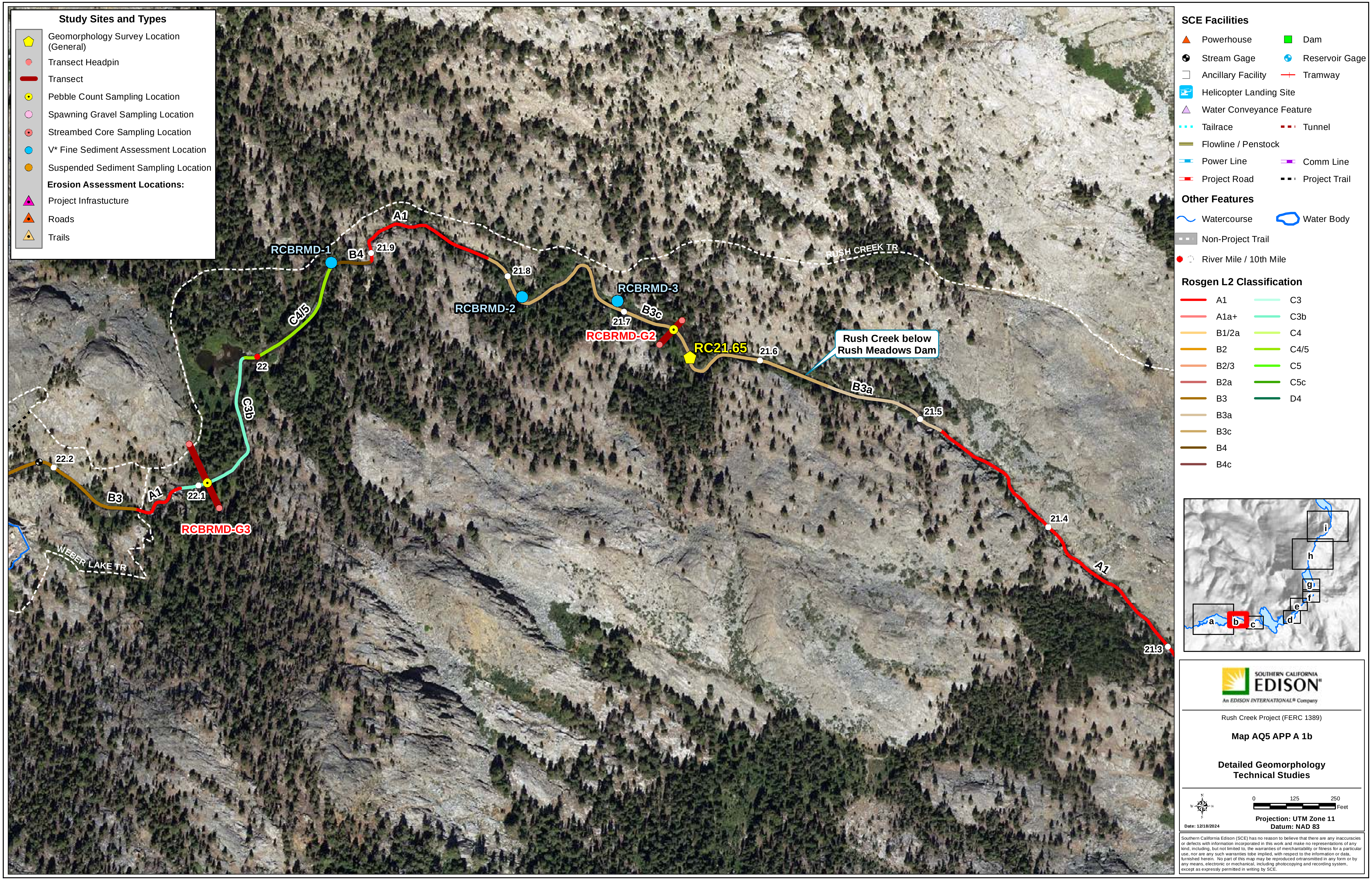

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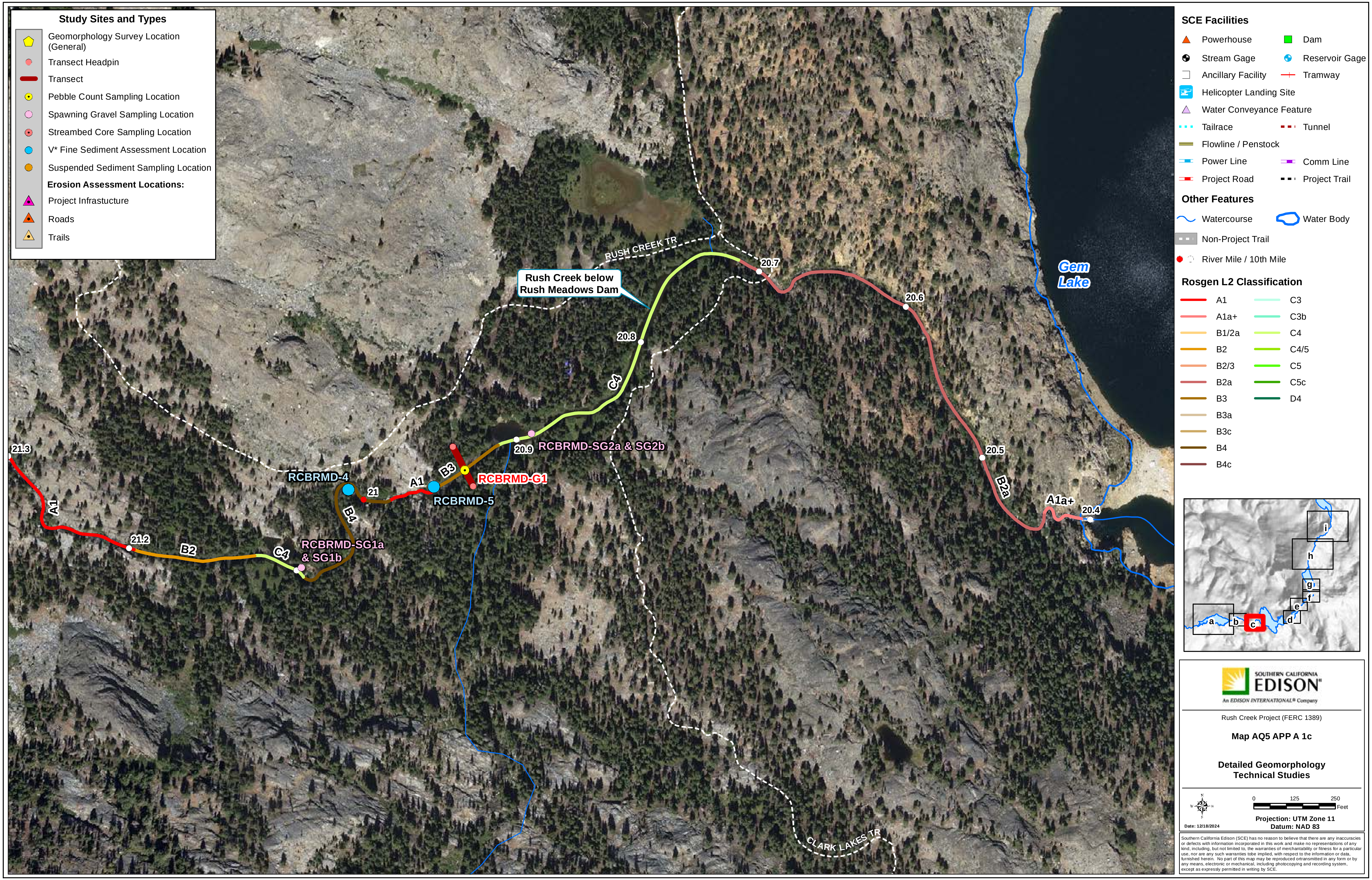

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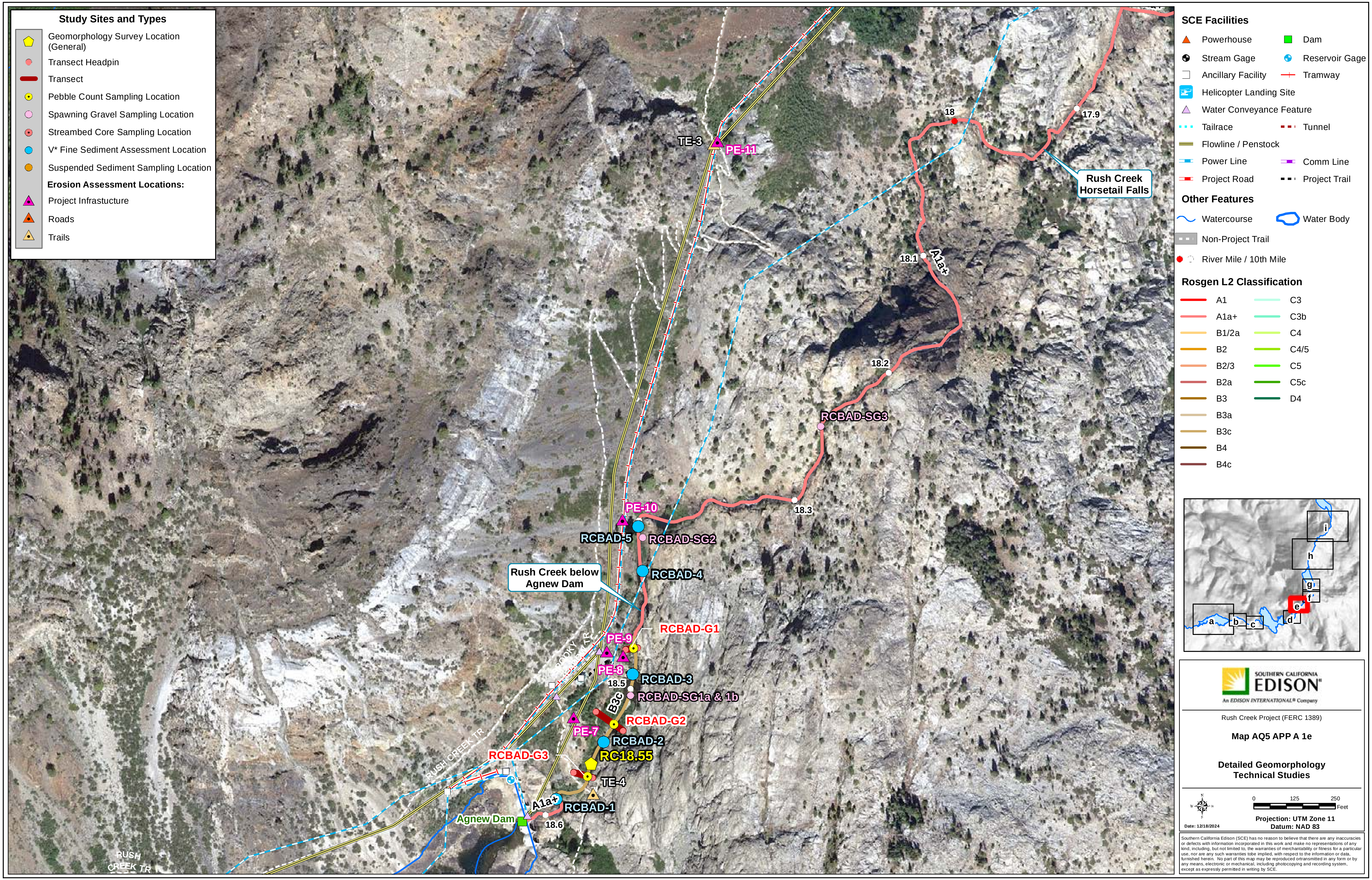

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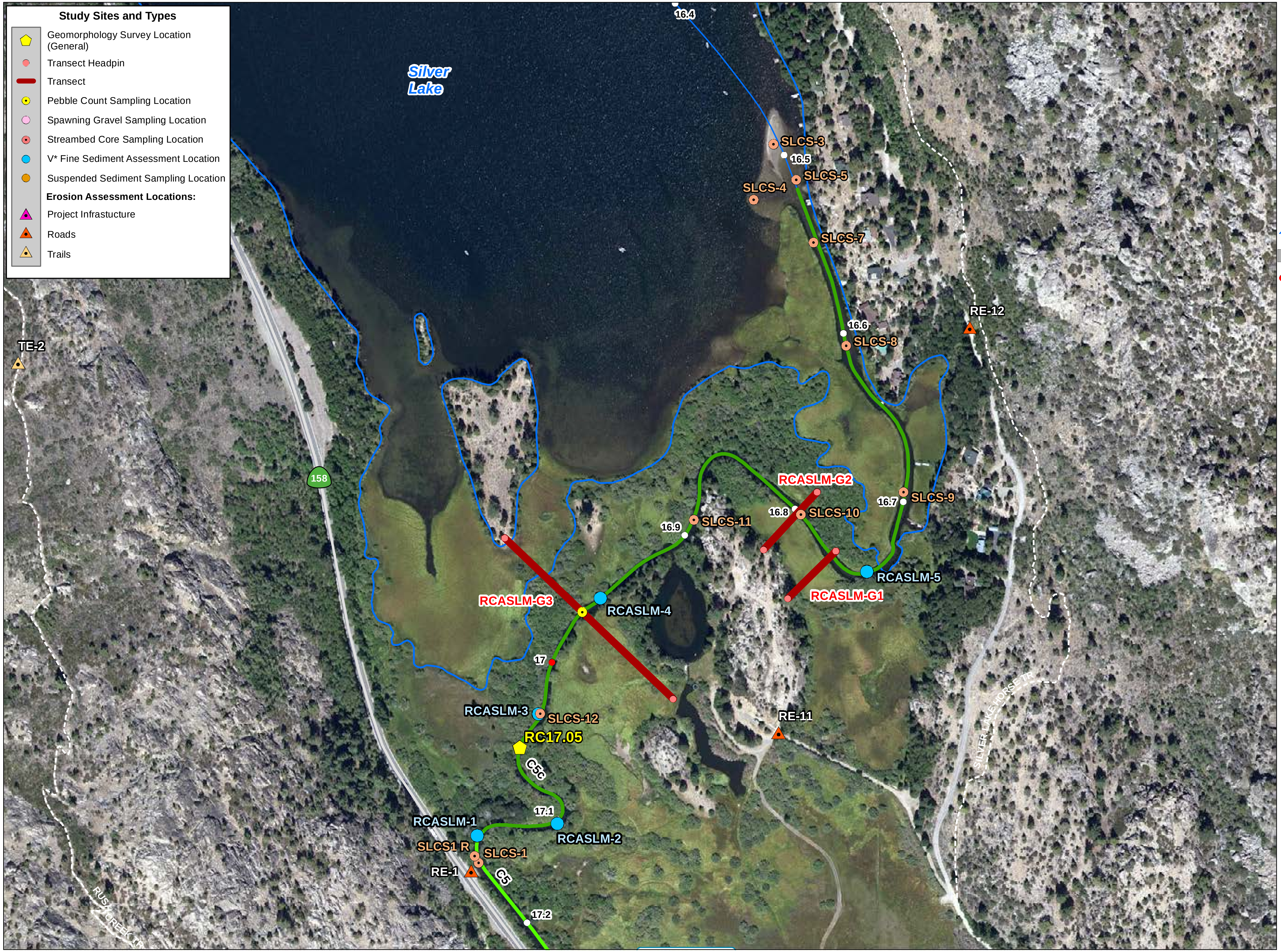


Study Sites and Types

- Geomorphology Survey Location (General)
- Transect Headpin
- Transect
- Pebble Count Sampling Location
- Spawning Gravel Sampling Location
- Streambed Core Sampling Location
- V* Fine Sediment Assessment Location
- Suspended Sediment Sampling Location

Erosion Assessment Locations:

- Project Infrastucture
- Roads
- Trails

SCE Facilities

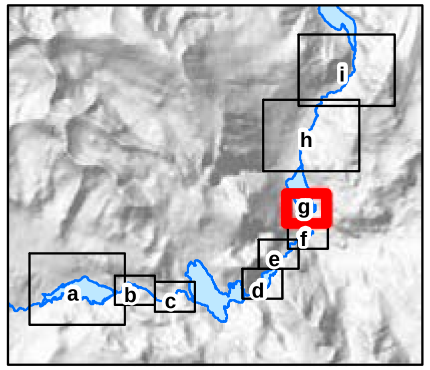
- Powerhouse
- Dam
- Stream Gage
- Reservoir Gage
- Ancillary Facility
- Tramway
- Helicopter Landing Site
- Water Conveyance Feature
- Tailrace
- Tunnel
- Flowline / Penstock
- Power Line
- Comm Line
- Project Road
- Project Trail

Other Features

- Watercourse
- Water Body
- Non-Project Trail
- River Mile / 10th Mile

Rosgen L2 Classification

- A1
- C3
- A1a+
- C3b
- B1/2a
- C4
- B2
- C4/5
- B2/3
- C5
- B2a
- C5c
- B3
- D4
- B3a
- B3c
- B4
- B4c



SOUTHERN CALIFORNIA EDISON
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Rush Creek Project (FERC 1389)

Map AQ5 APP A 1g

Detailed Geomorphology Technical Studies

0 125 250 Feet

Date: 12/18/2024

Projection: UTM Zone 11
Datum: NAD 83

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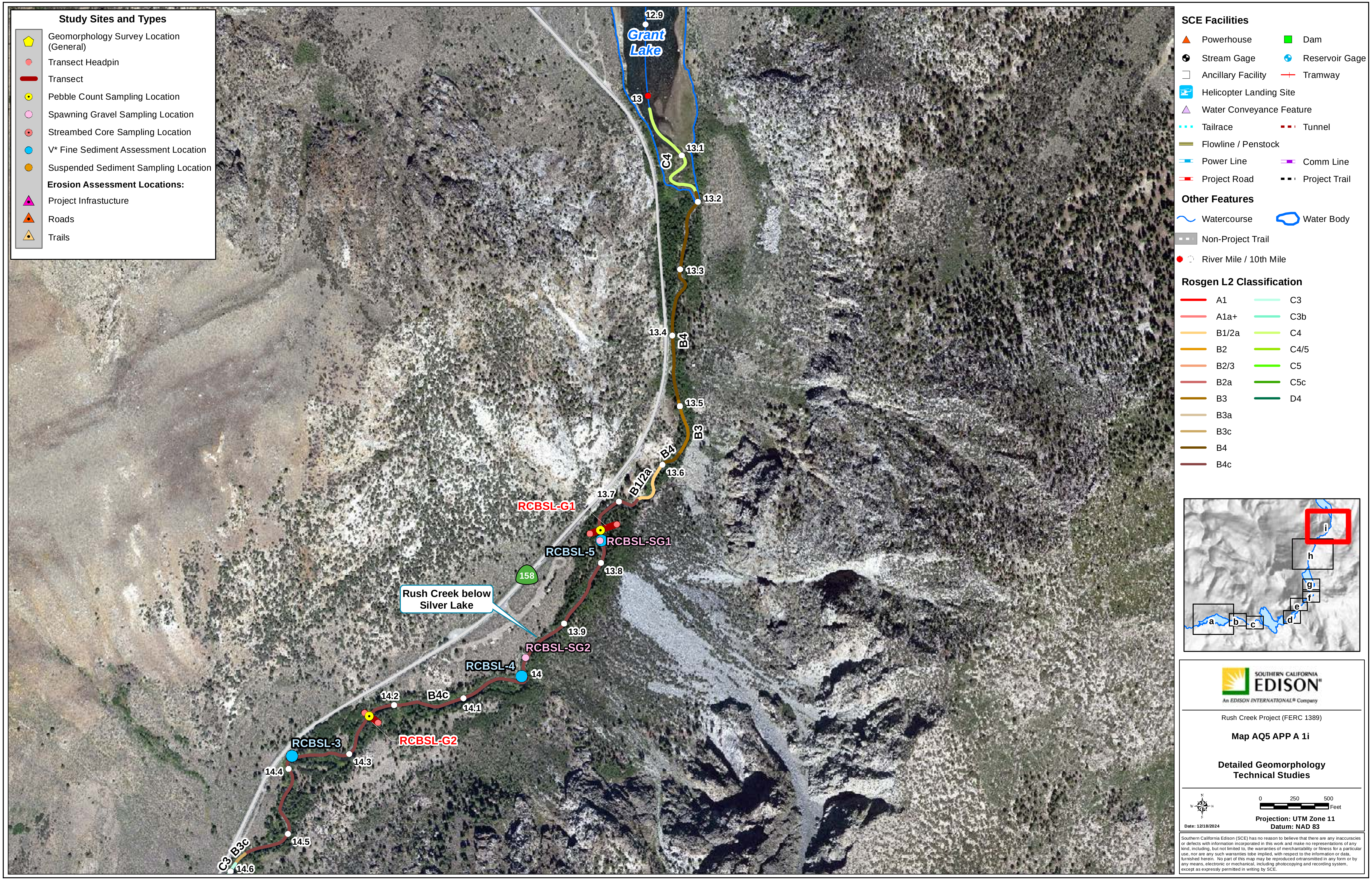

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APPENDIX B

Pebble Count Histogram and Cumulative Particle Size Distribution Curves

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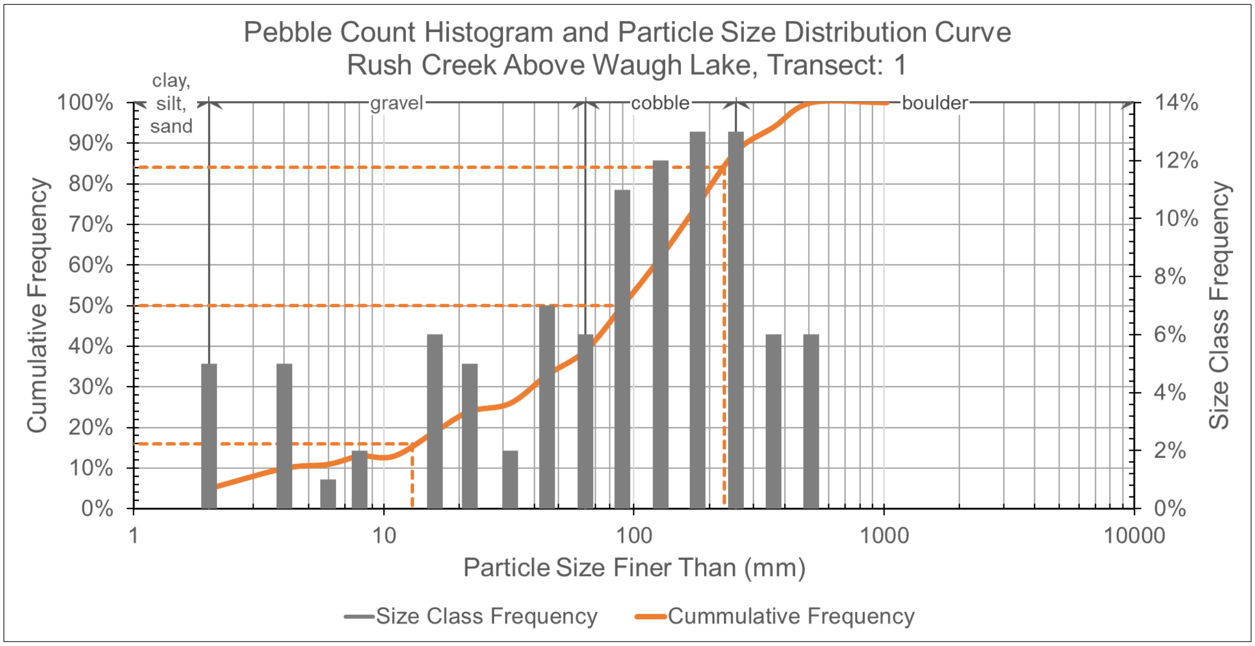

Figure B-1. Rush Creek Above Waugh Lake Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

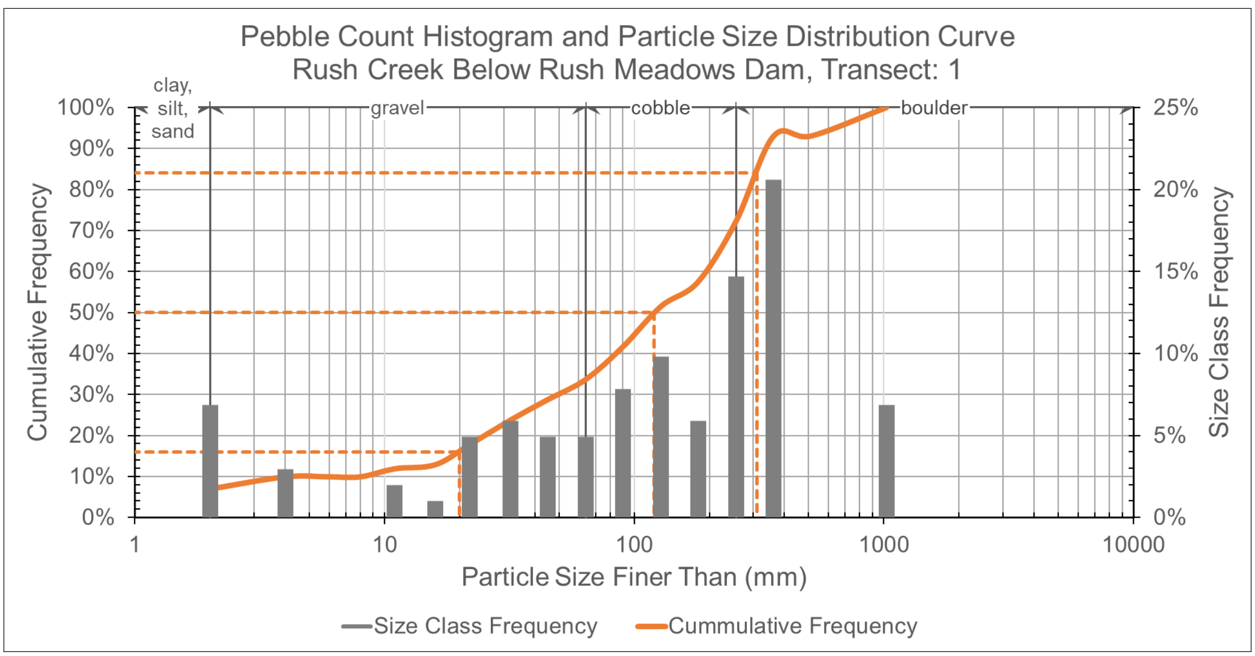

Figure B-2. Rush Creek Below Rush Meadows Dam Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

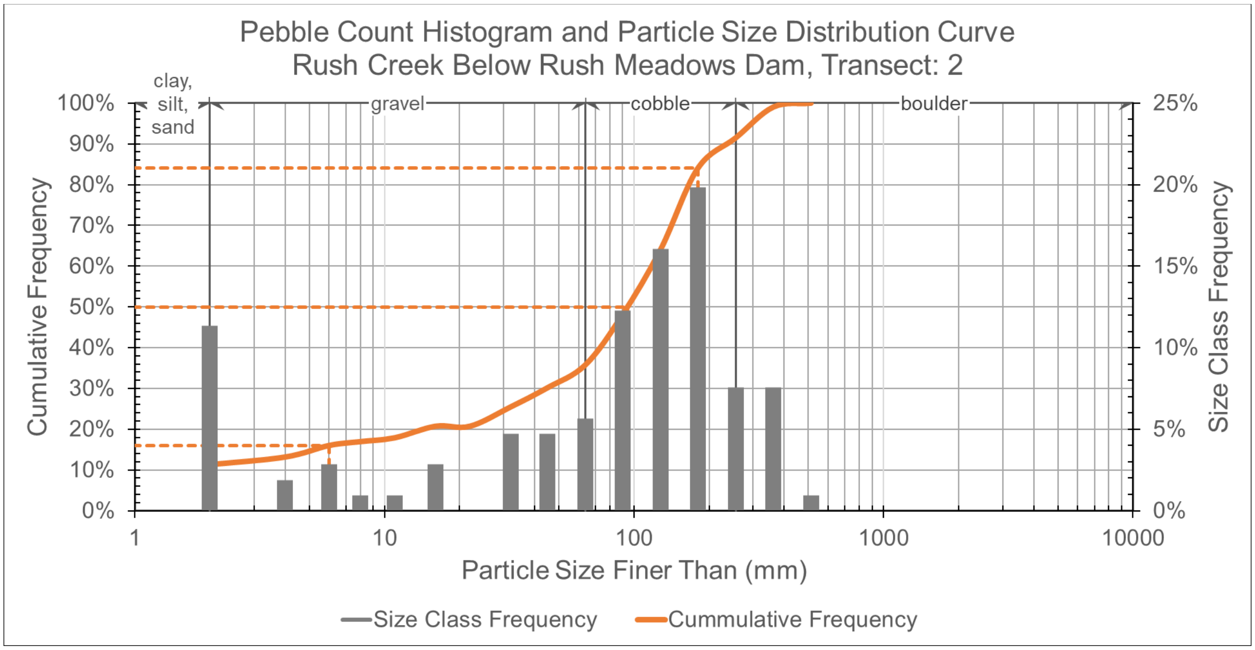

Figure B-3. Rush Creek Below Rush Meadows Dam Transect 2 Pebble Count: Histogram and Particle Size Distribution Curve

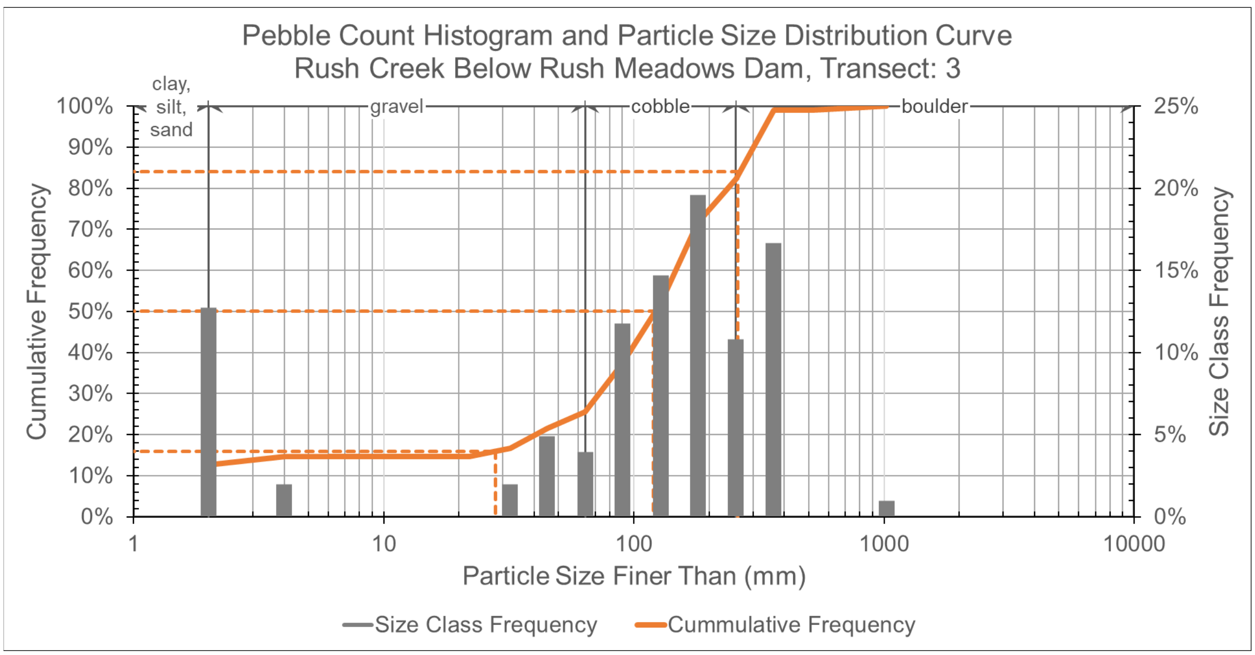

Figure B-4. Rush Creek Below Rush Meadows Dam Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

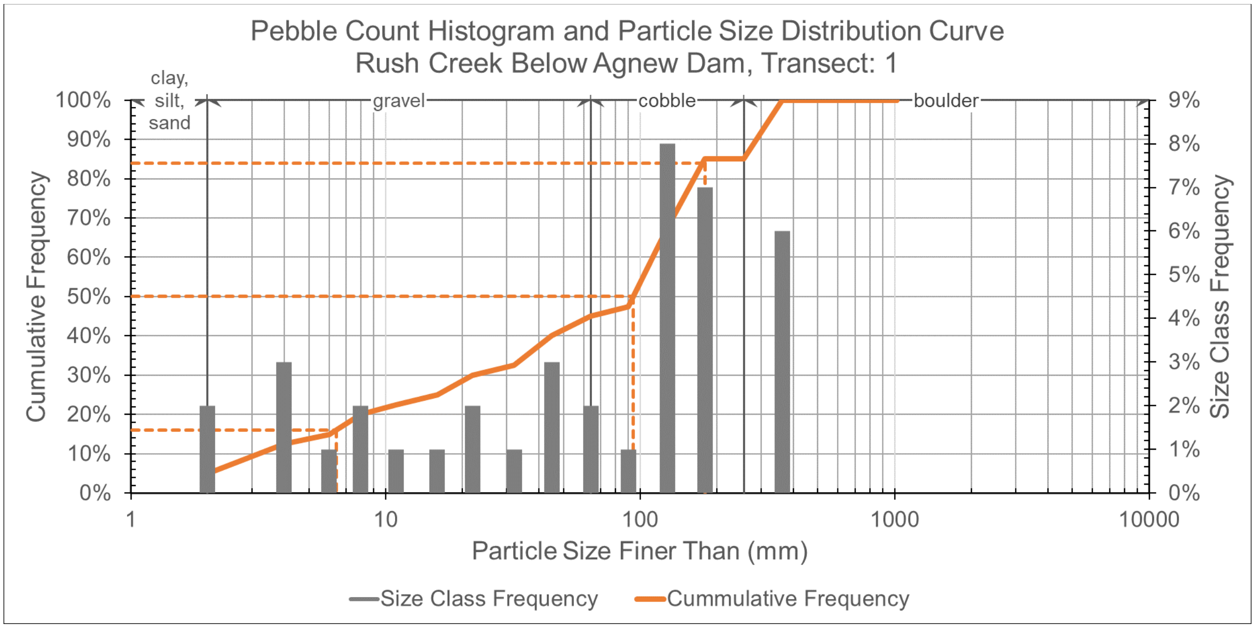

Figure B-5. Rush Creek Below Agnew Dam Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

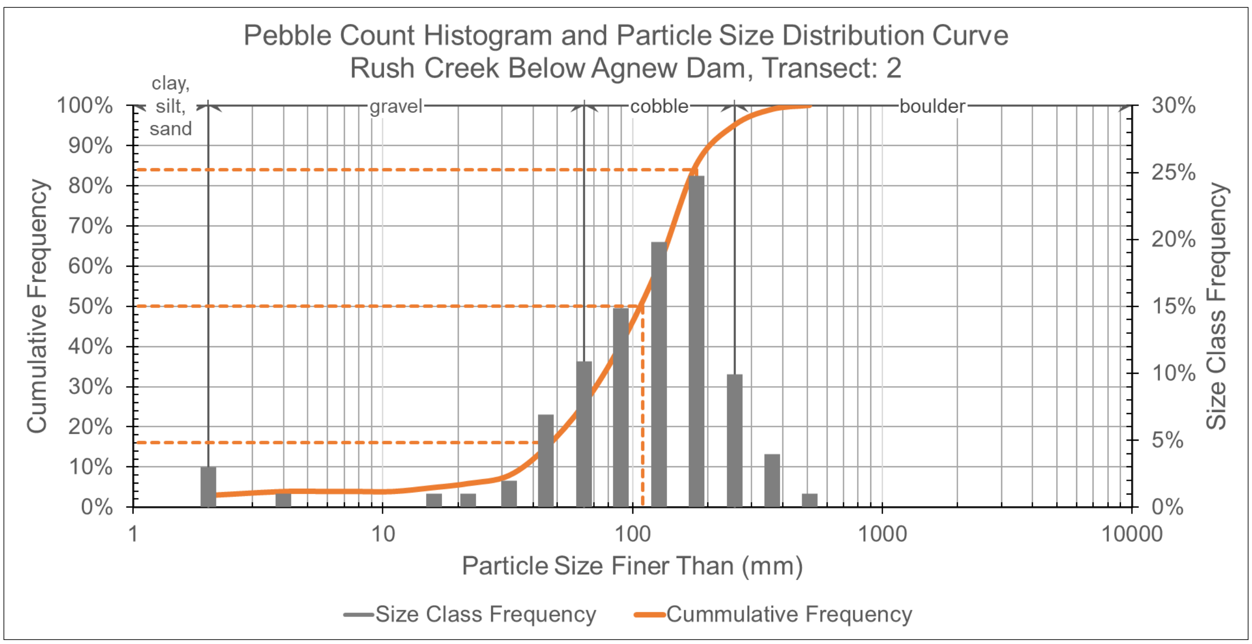

Figure B-6. Rush Creek Below Agnew Dam Transect 2 Pebble Count: Histogram and Particle Size Distribution Curve

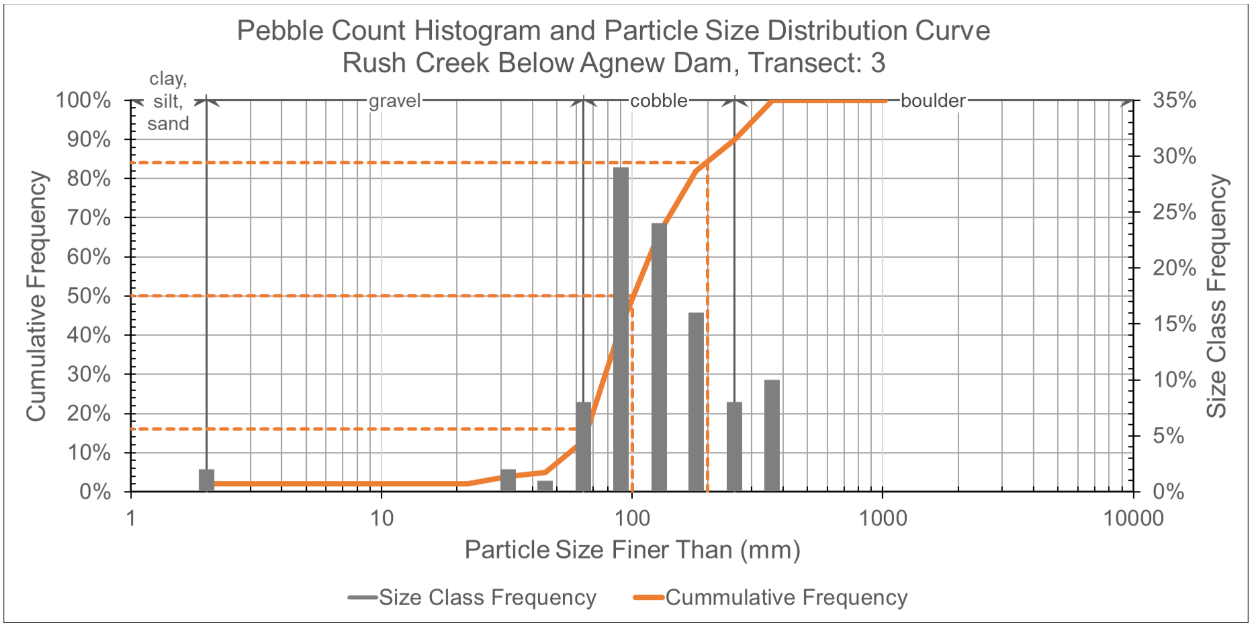

Figure B-7. Rush Creek Below Agnew Dam Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

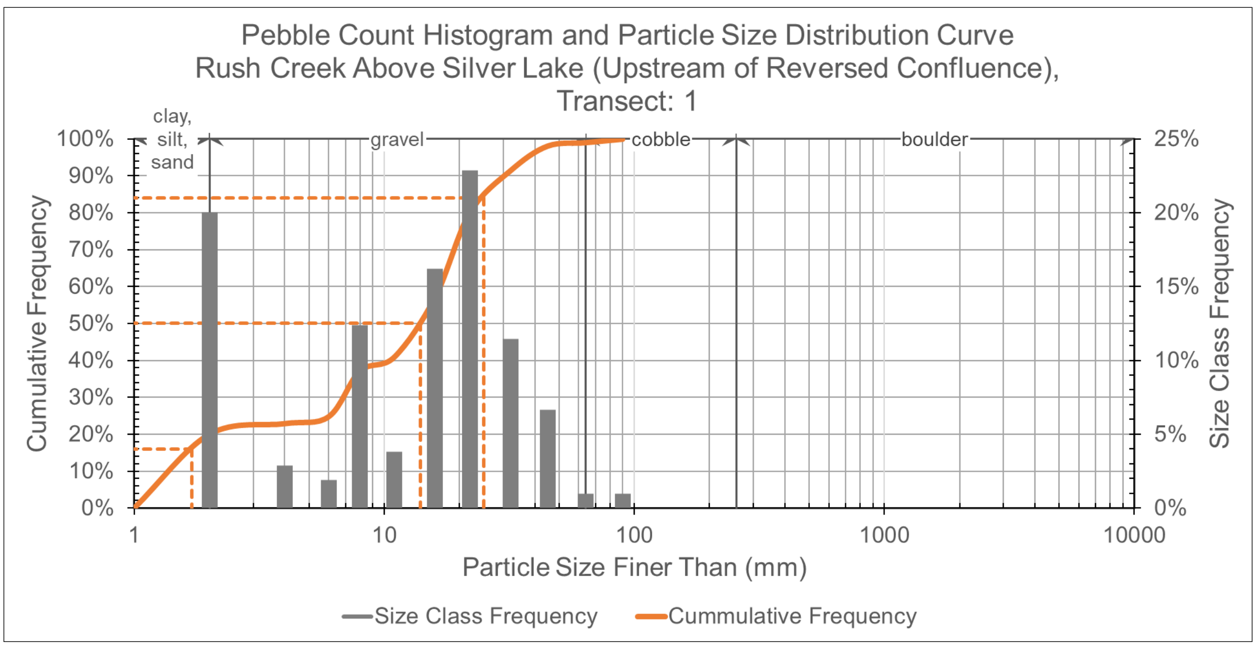

Figure B-8. Rush Creek Above Silver Lake (Upstream of Reversed Confluence Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

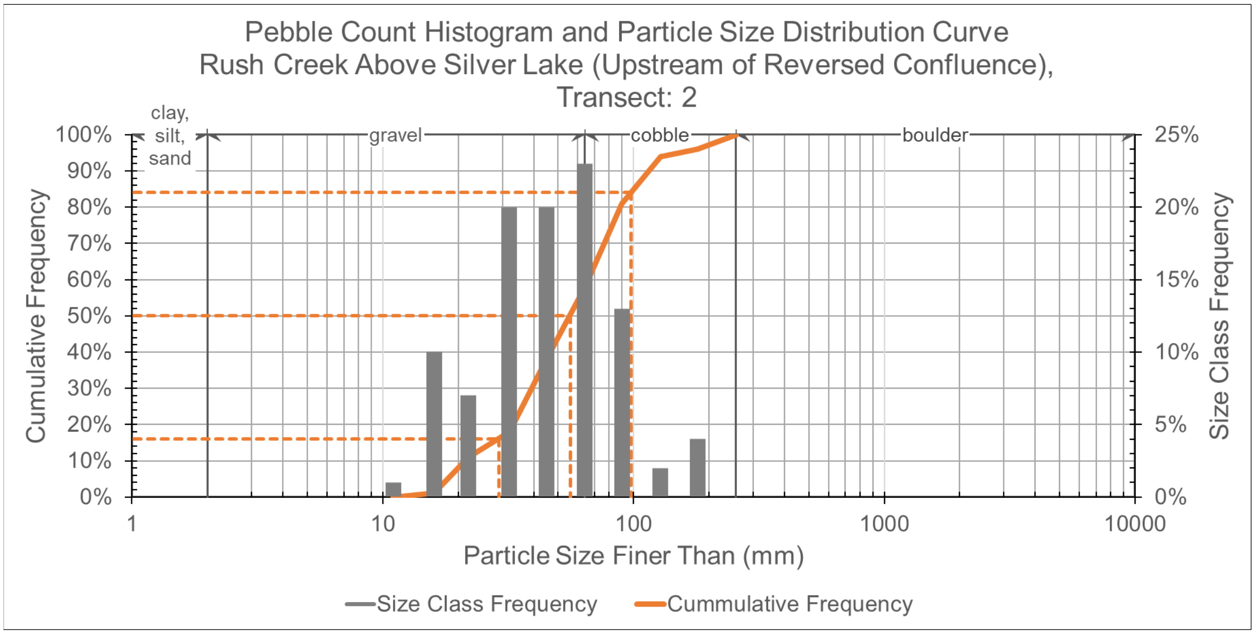

Figure B-9. Rush Creek Above Silver Lake (Upstream of Reversed Confluence Transect 2 Pebble Count: Histogram and Particle Size Distribution Curve

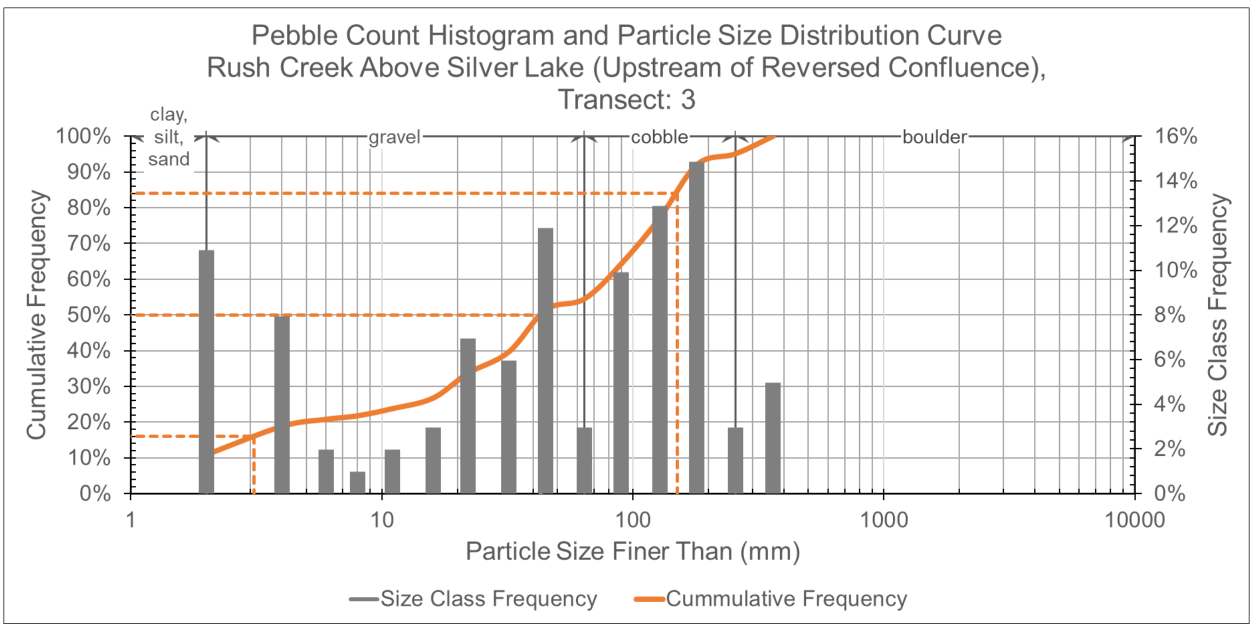

Figure B-10. Rush Creek Above Silver Lake (Upstream of Reversed Confluence Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

A pebble count was not conducted at these two study sites

Figure B-11. Rush Creek Upstream of Silver Lake (Downstream of Reversed Creek Confluence) Transect 1 & 2: No particle size distribution data collected

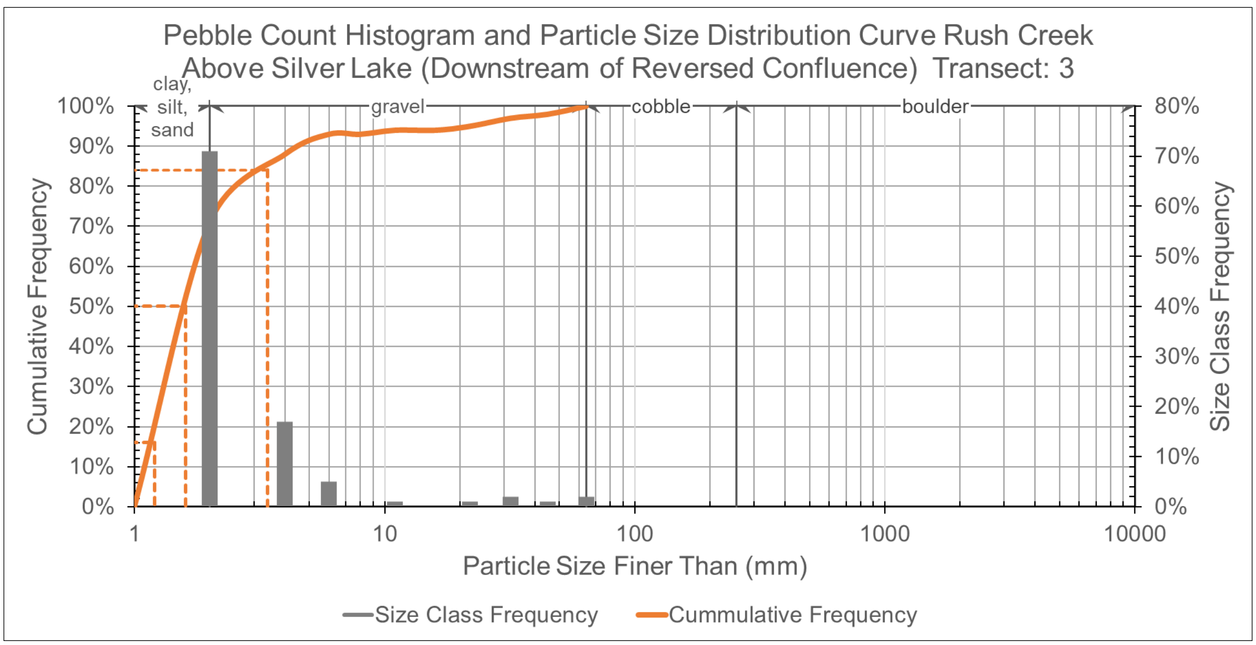

Figure B-12. Rush Creek Above Silver Lake (Downstream of Reversed Confluence Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

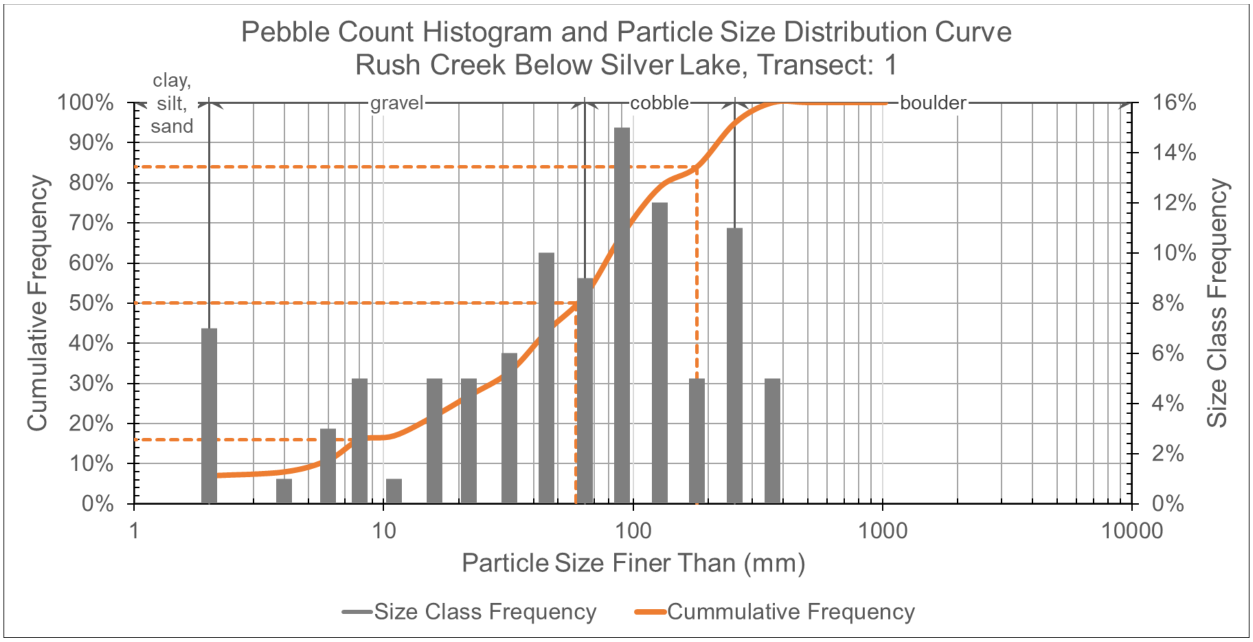

Figure B-13. Rush Creek Below Silver Lake Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

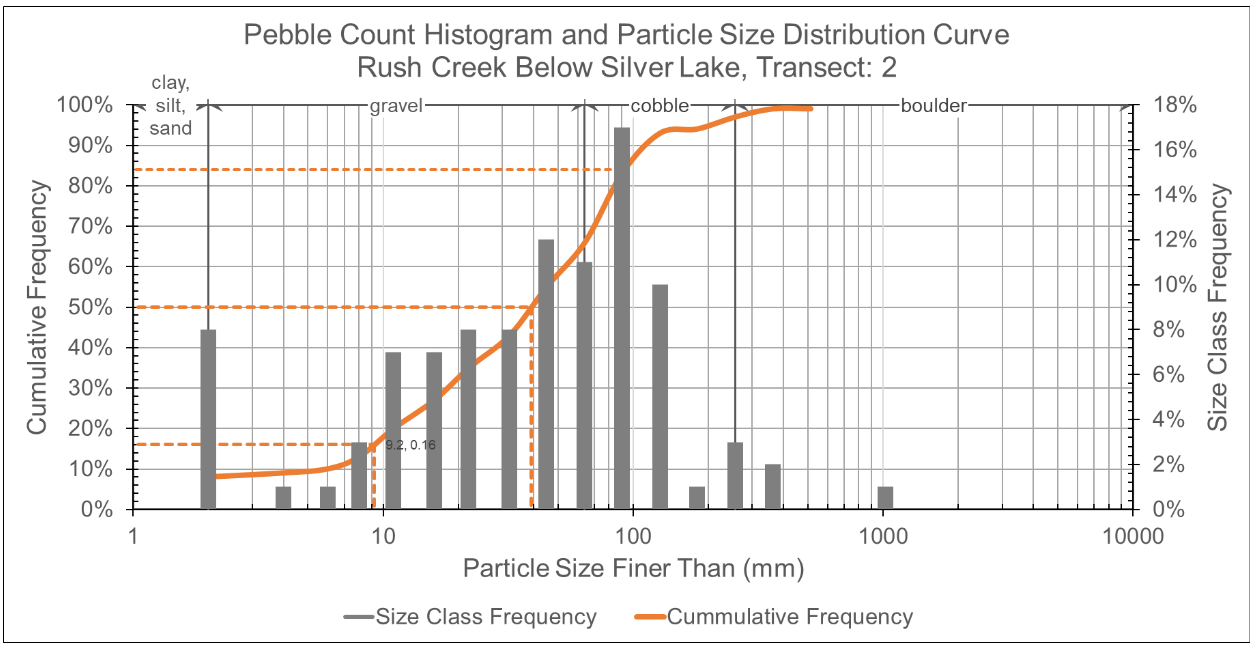

Figure B-14. Rush Creek Below Silver Lake Transect 2 Pebble Count: Histogram and Particle Size Distribution Curve

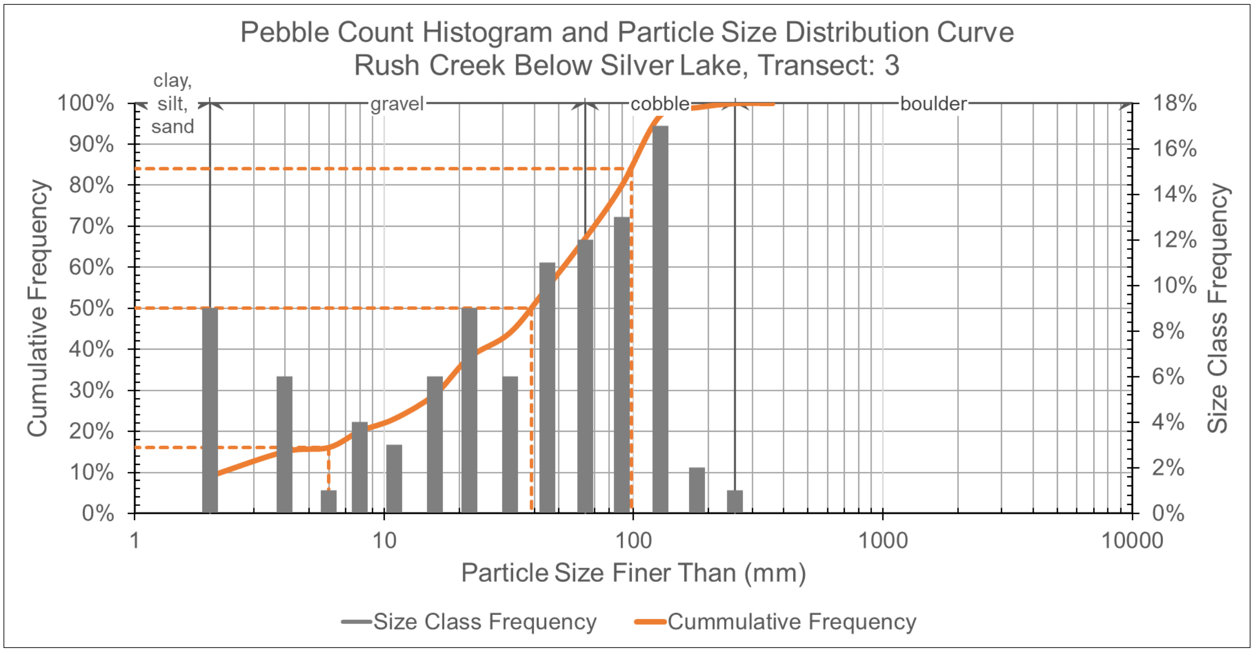

Figure B-15. Rush Creek Below Silver Lake Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

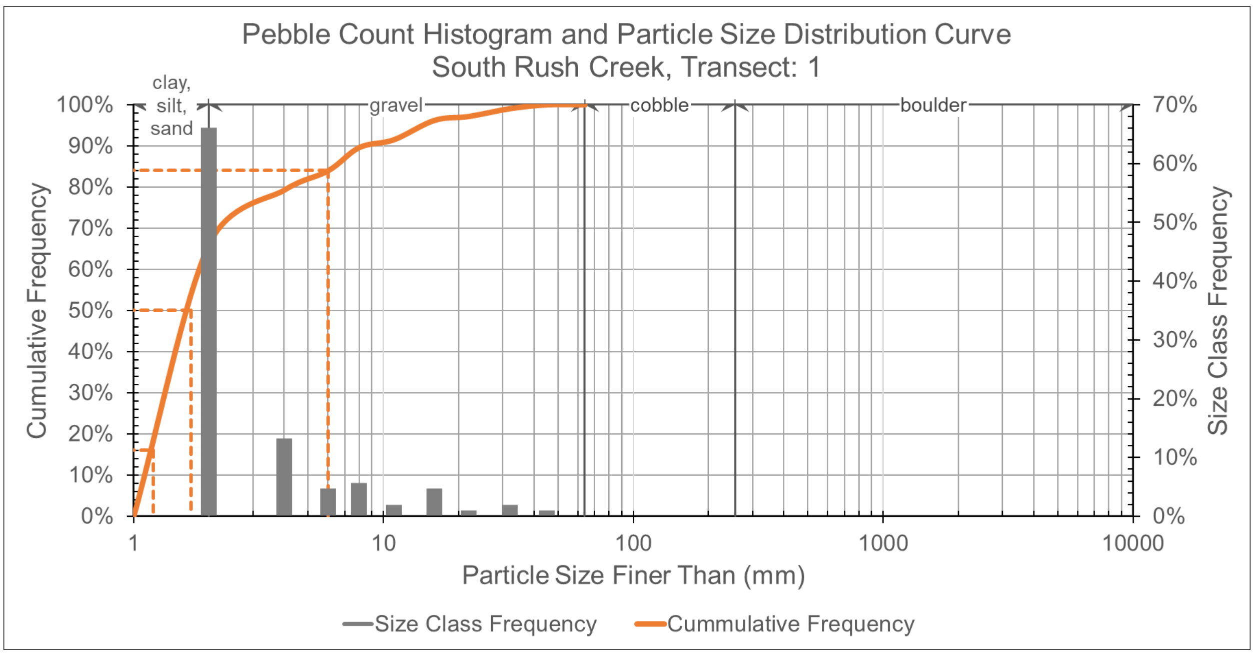

Figure B-16. South Rush Creek Transect 1 Pebble Count: Histogram and Particle Size Distribution Curve

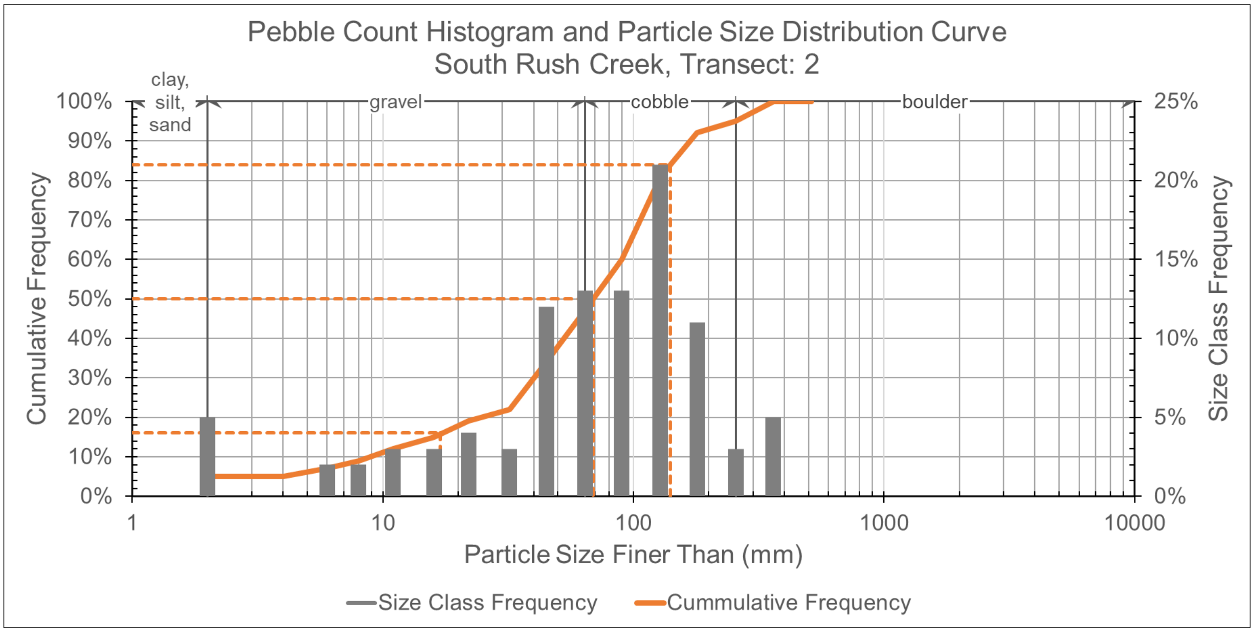

Figure B-17. South Rush Creek Transect 2 Pebble Count: Histogram and Particle Size Distribution Curve

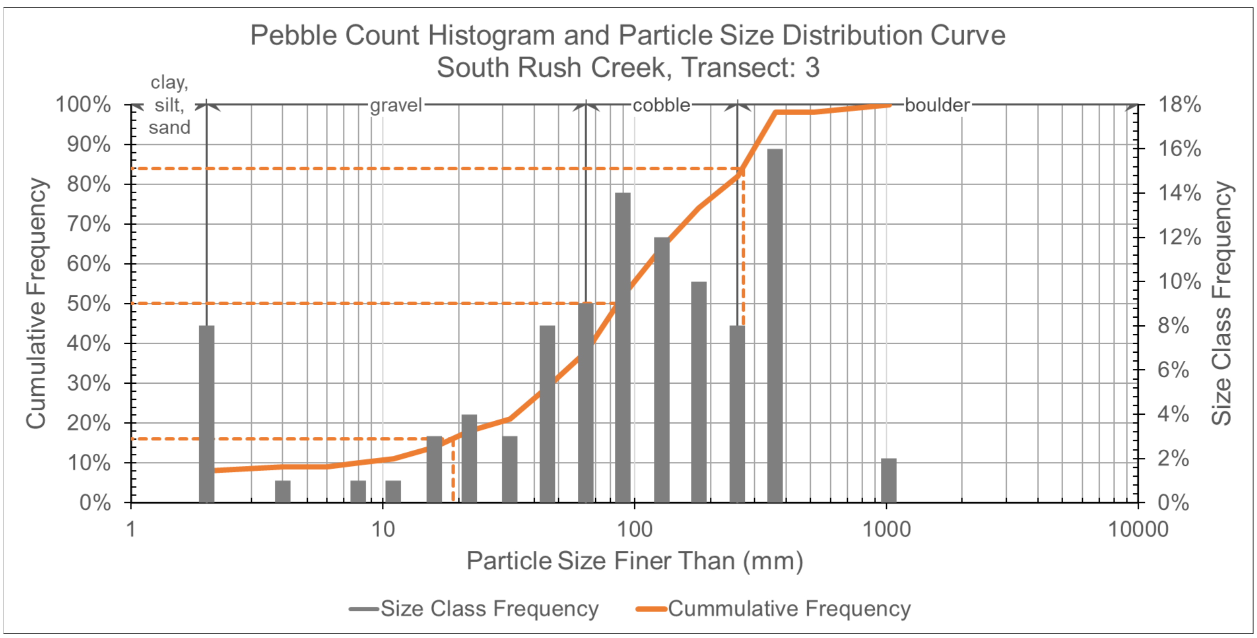

Figure B-18. South Rush Creek Transect 3 Pebble Count: Histogram and Particle Size Distribution Curve

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APPENDIX C

Transect Plots and Morphological Parameters for Rosgen Level II Stream Classification

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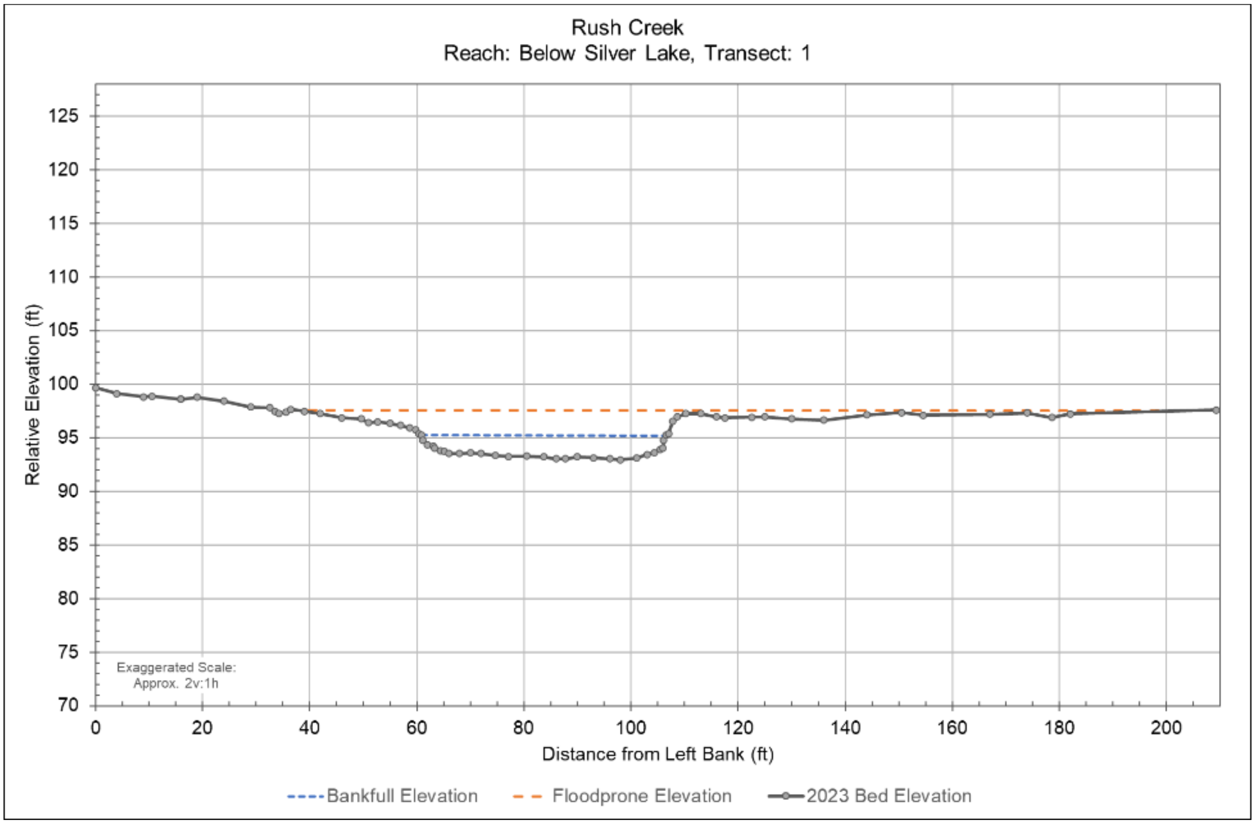

Figure C-1. Rush Creek Transect 1 Below Silver Lake

Table C-1. Morphological Parameters for Rosgen Level II Stream Classification at Transect 1 Below Silver Lake

Entrenchment Ratio	3.7
Bankfull Width-Depth Ratio	27.4
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	0.60
Median Particle Size, D_{50} (mm)	Gravel (59)
Dominate Substrate (%)	Gravel (45)
Stream Type	C4

Notes:

1 Sinuosity ratios can vary +/- 0.2 unit from the >1.2 ratio required to be a B or C-stream type.

2 Calculated as stream length/valley length.

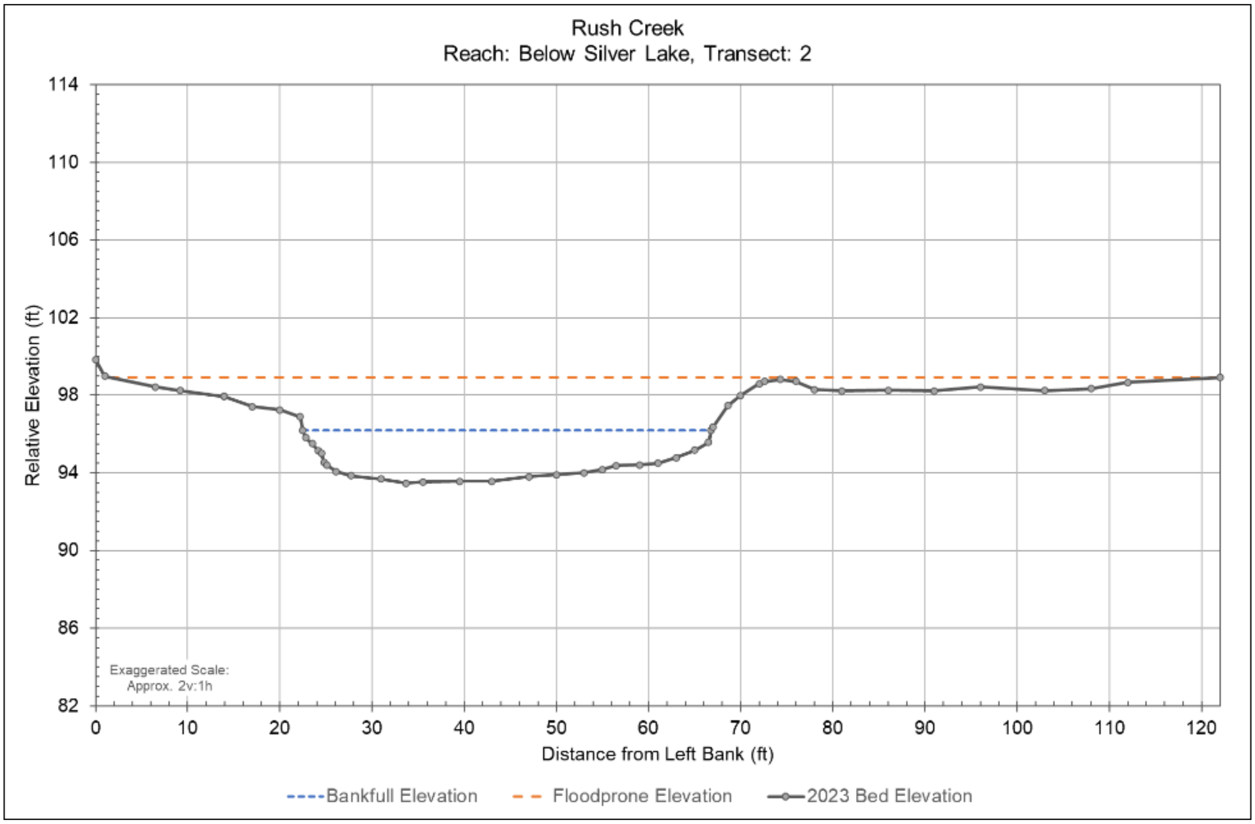

Figure C-2. Rush Creek Transect 2 Below Silver Lake

Table C-2. Morphological Parameters for Rosgen Level II Stream Classification at Transect 2 Below Silver Lake

Entrenchment Ratio	2.7
Bankfull Width-Depth Ratio	24.6
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	0.15
Median Particle Size, D_{50} (mm)	Gravel (39)
Dominate Substrate (%)	Gravel (58)
Stream Type	C4

Notes:

[1] Sinuosity ratios can vary +/- 0.2 unit from the >1.2 ratio required to be a B or C-stream type.

[2] Calculated as stream length/valley length

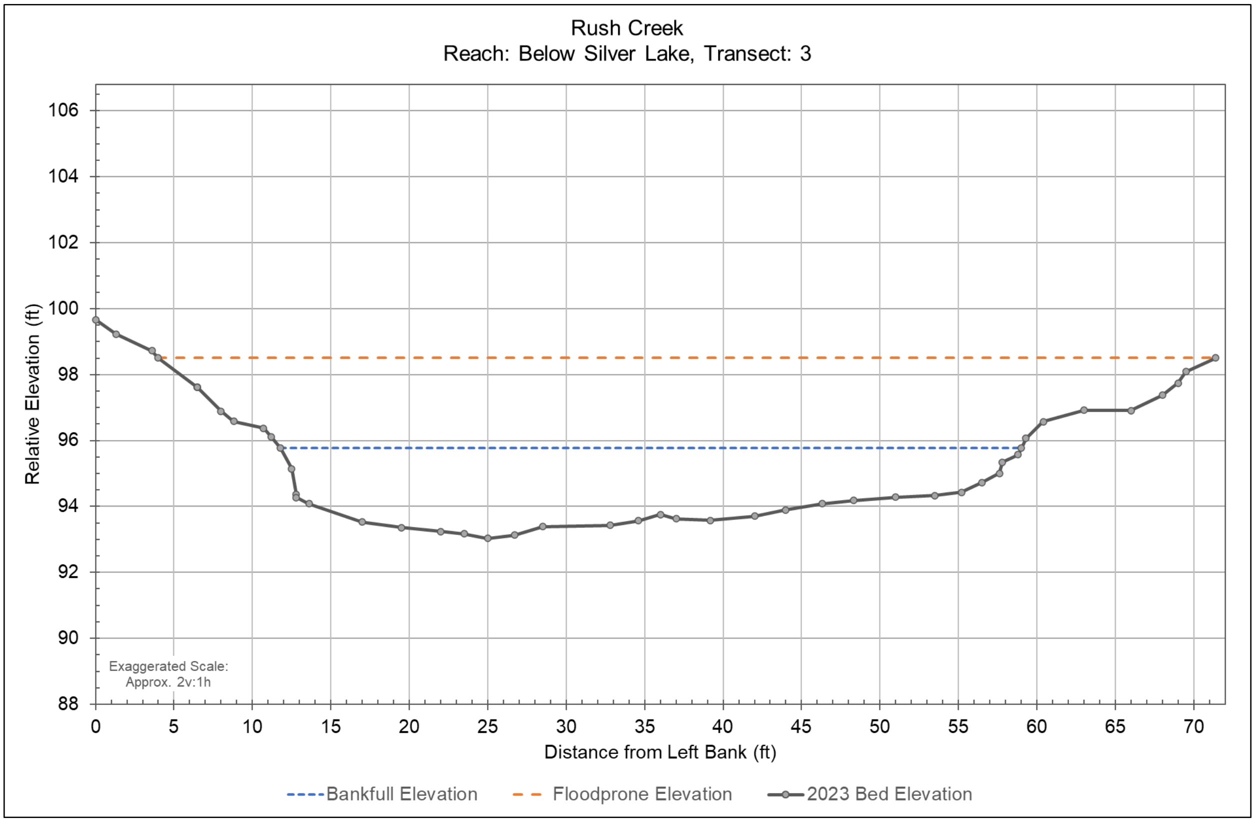

Figure C-3. Rush Creek Transect 3 Below Silver Lake

Table C-3. Morphological Parameters for Rosgen Level II Stream Classification at Transect 3 Below Silver Lake

Entrenchment Ratio	1.4
Bankfull Width-Depth Ratio	37.3
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	0.19
Median Particle Size, D_{50} (mm)	Gravel (39)
Dominate Substrate (%)	Gravel (58)
Stream Type	B4c

Notes:

1 Sinuosity ratios can vary +/- 0.2 unit from the >1.2 ratio required to be a B or C-stream type.

2 Calculated as stream length/valley length

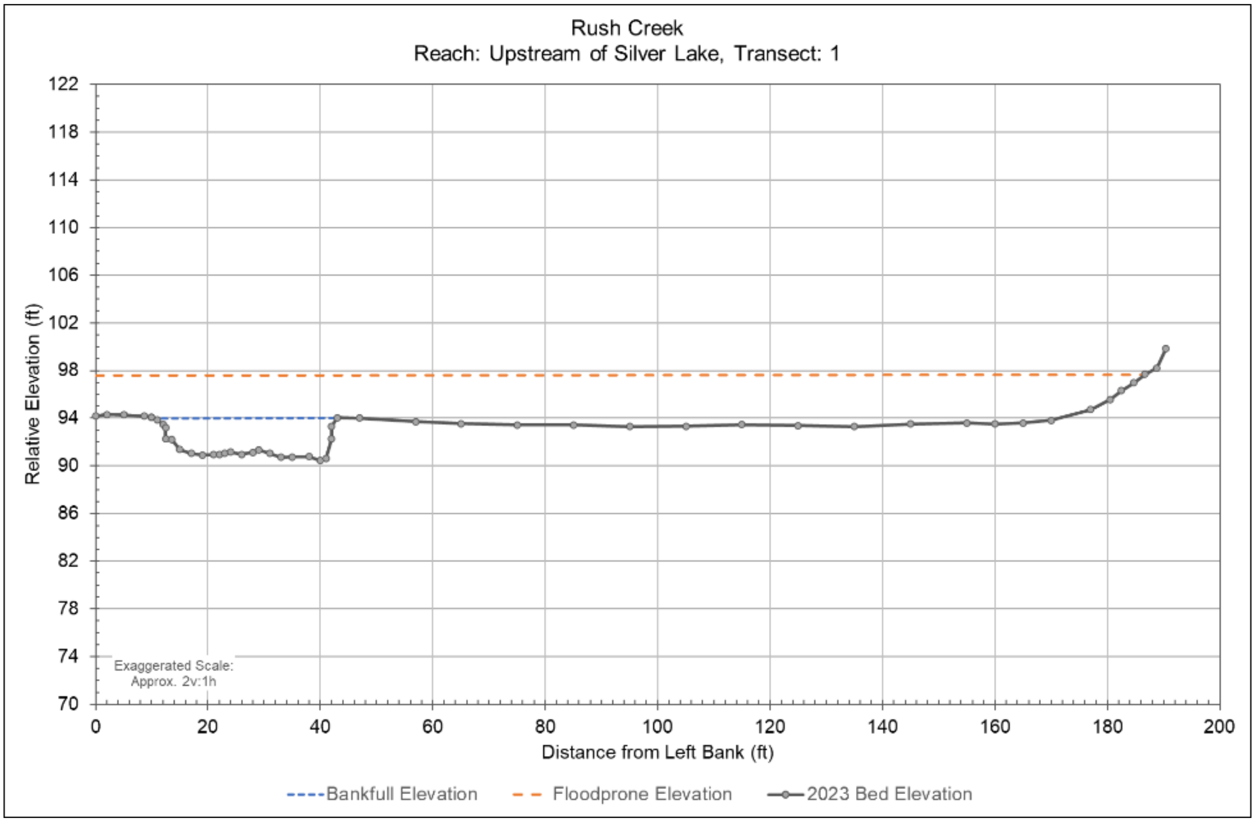

Figure C-4. Rush Creek Transect 1 Upstream of Silver Lake

Table C-4. Morphological Parameters for Rosgen Level II Stream Classification at Transect 1 Upstream of Silver Lake

Entrenchment Ratio[1]	>2.2
Bankfull Width-Depth Ratio	13.3
Channel Sinuosity[2]	1.9
Channel Slope (%)	0.016
Median Particle Size, D_{50} (mm)	Sand (<2)
Dominate Substrate (%)	Sand (<2)
Stream Type	C5c

Notes:

[1] The flood prone width spans the valley width and therefore the channel is not entrenched.

[2] Calculated as stream length/valley length

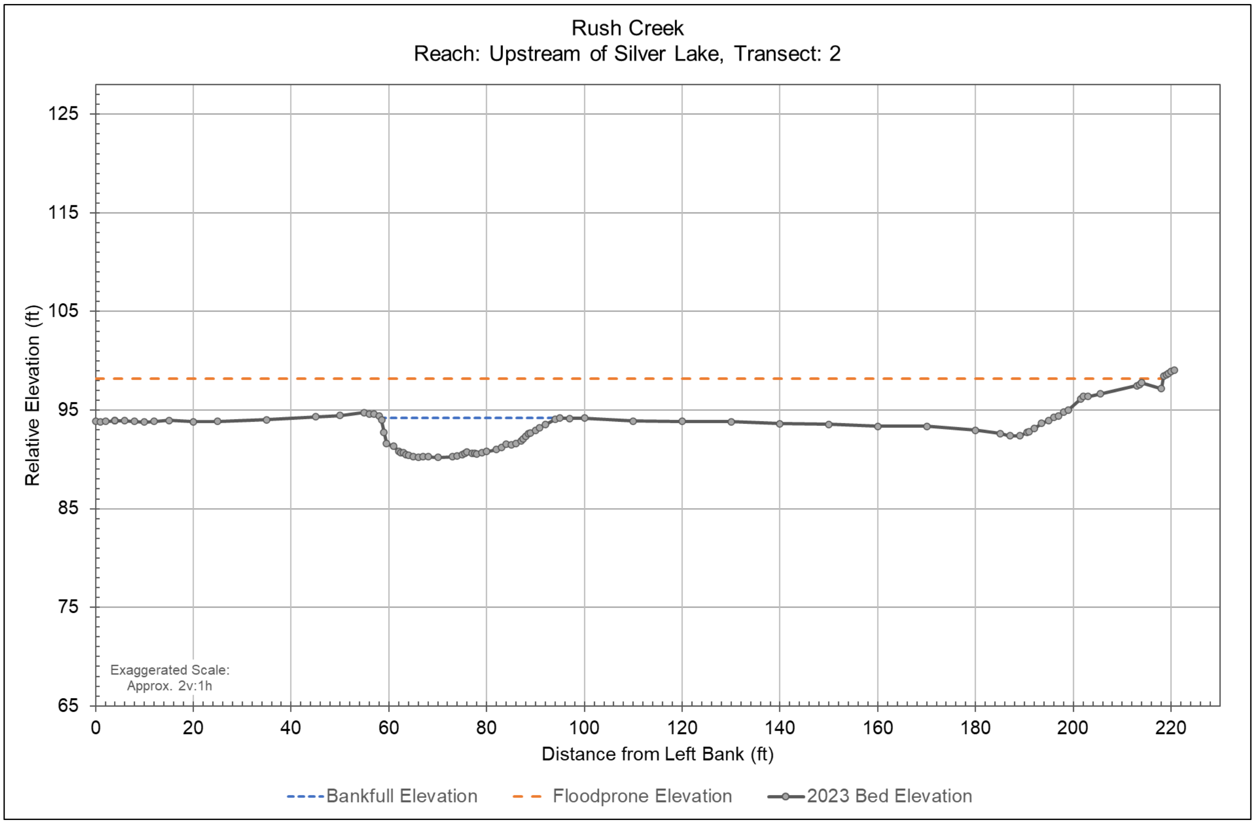

Figure C-5. Rush Creek Transect 2 Upstream of Silver Lake

Table C-5. Morphological Parameters for Rosgen Level II Stream Classification at Transect 2 Upstream of Silver Lake

Entrenchment Ratio[1]	>2.2
Bankfull Width-Depth Ratio	13.0
Channel Sinuosity[2]	1.9
Channel Slope (%)	0.016
Median Particle Size, D_{50} (mm)	Sand (<2)
Dominate Substrate (%)	Sand (<2)
Stream Type	C5c

Notes:

[1] The flood prone width spans the valley width and therefore the channel is not entrenched.

[2] Calculated as stream length/valley length

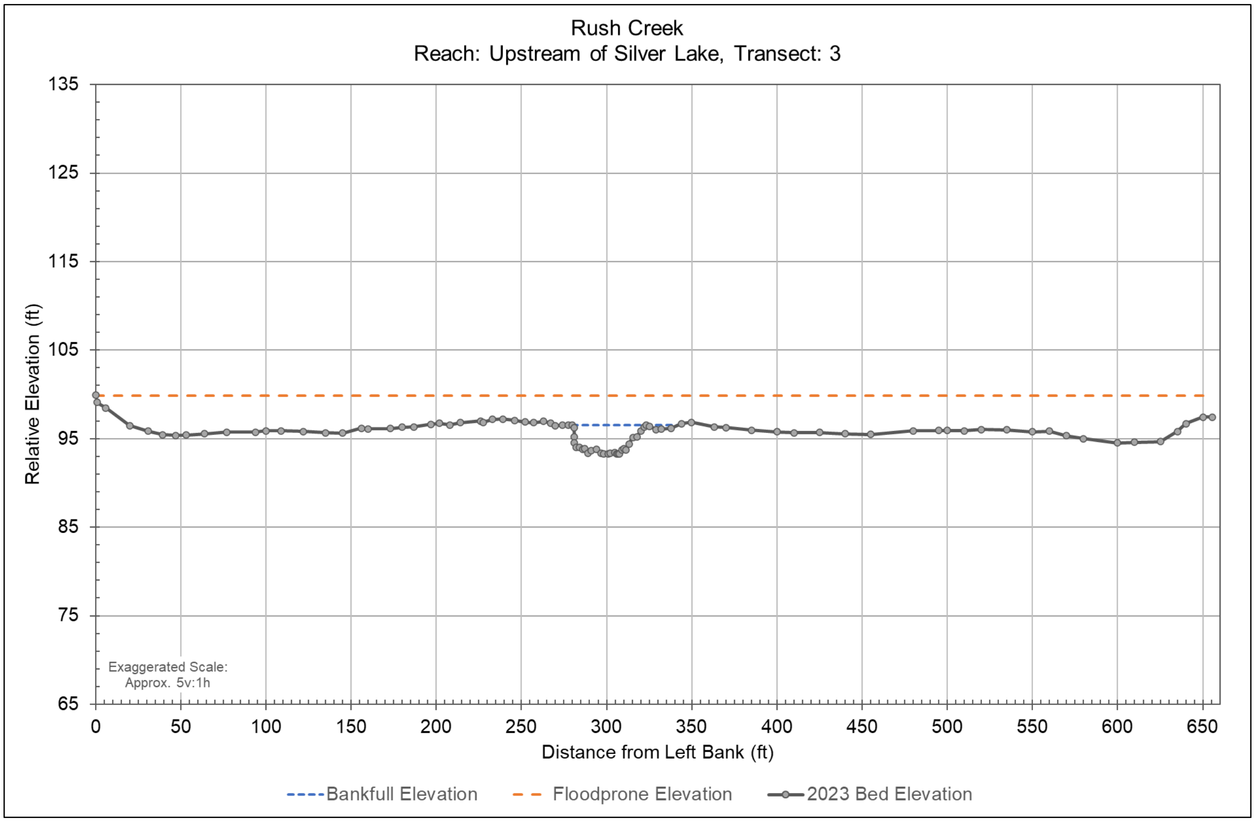

Figure C-6. Rush Creek Transect 3 Upstream of Silver Lake

Table C-6. Morphological Parameters for Rosgen Level II Stream Classification at Transect 3 Upstream of Silver Lake

Entrenchment Ratio[1]	>2.2
Bankfull Width-Depth Ratio	25.8
Channel Sinuosity[2]	1.9
Channel Slope (%)	0.016
Median Particle Size, D_{50} (mm)	Sand (1.6)
Dominate Substrate (%)	Clay/Silt/Sand (71)
Stream Type	C5c

Notes:

[1] The flood prone width spans the valley width and therefore the channel is not entrenched.

[2] Calculated as stream length/valley length

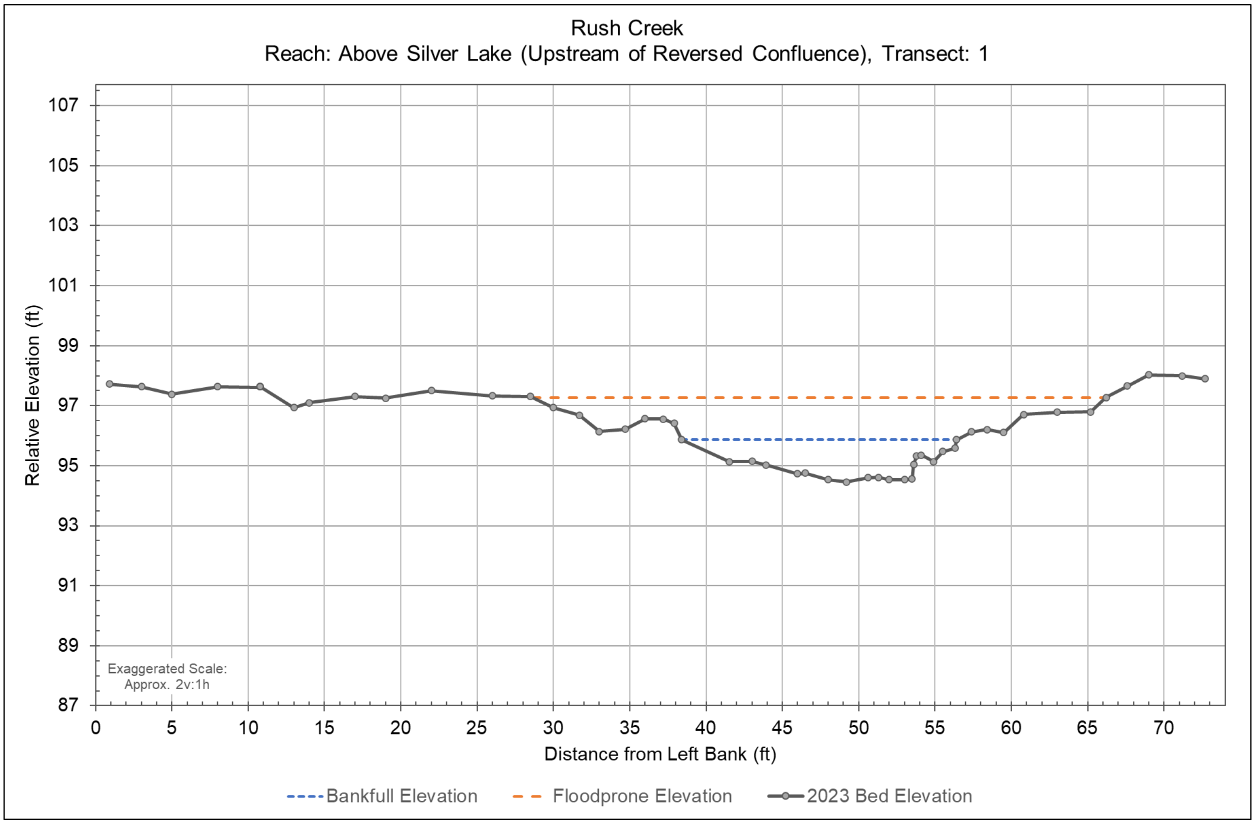

Figure C-7. Rush Creek Transect 1 Above of Silver Lake (Upstream of Reversed Creek Confluence)

Table C-7. Morphological Parameters for Rosgen Level II Stream Classification at Transect 1 Above of Silver Lake (Upstream of Reversed Creek Confluence)

Entrenchment Ratio	2.1
Bankfull Width-Depth Ratio	18.9
Channel Sinuosity[1]	1.2
Channel Slope (%)	0.3
Median Particle Size, D_{50} (mm)	Gravel (14)
Dominate Substrate (%)	Gravel (79)
Stream Type	B4c

Note:

[1] Calculated as stream length/valley length

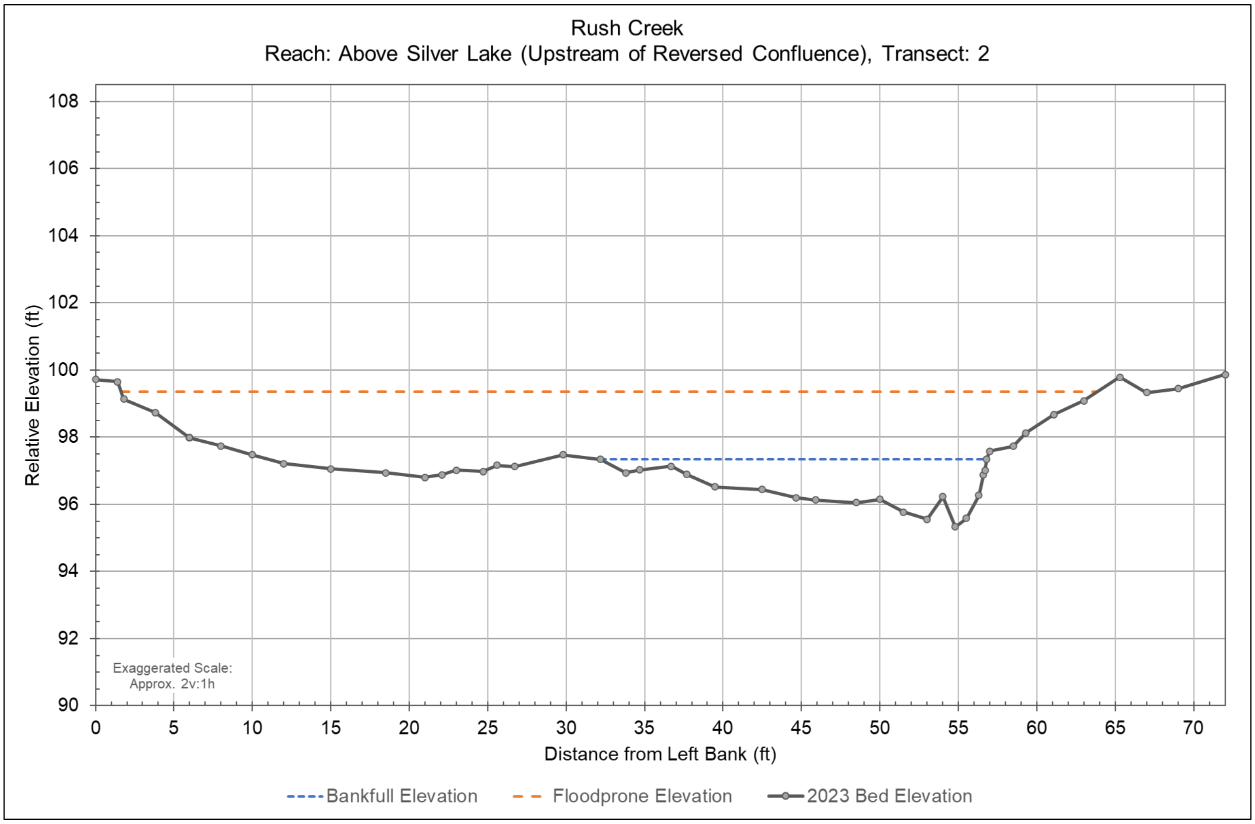

Figure C-8. Rush Creek Transect 2 Above of Silver Lake (Upstream of Reversed Creek Confluence)

Table C-8. Morphological Parameters for Rosgen Level II Stream Classification at Transect 2 Above of Silver Lake (Upstream of Reversed Creek Confluence)

Entrenchment Ratio	2.5
Bankfull Width-Depth Ratio	24.6
Channel Sinuosity[1]	1.2
Channel Slope (%)	2.3
Median Particle Size, D_{50} (mm)	Gravel (56)
Dominate Substrate (%)	Gravel (58)
Stream Type	C4b

Note:

[1] Calculated as strealength/valley length

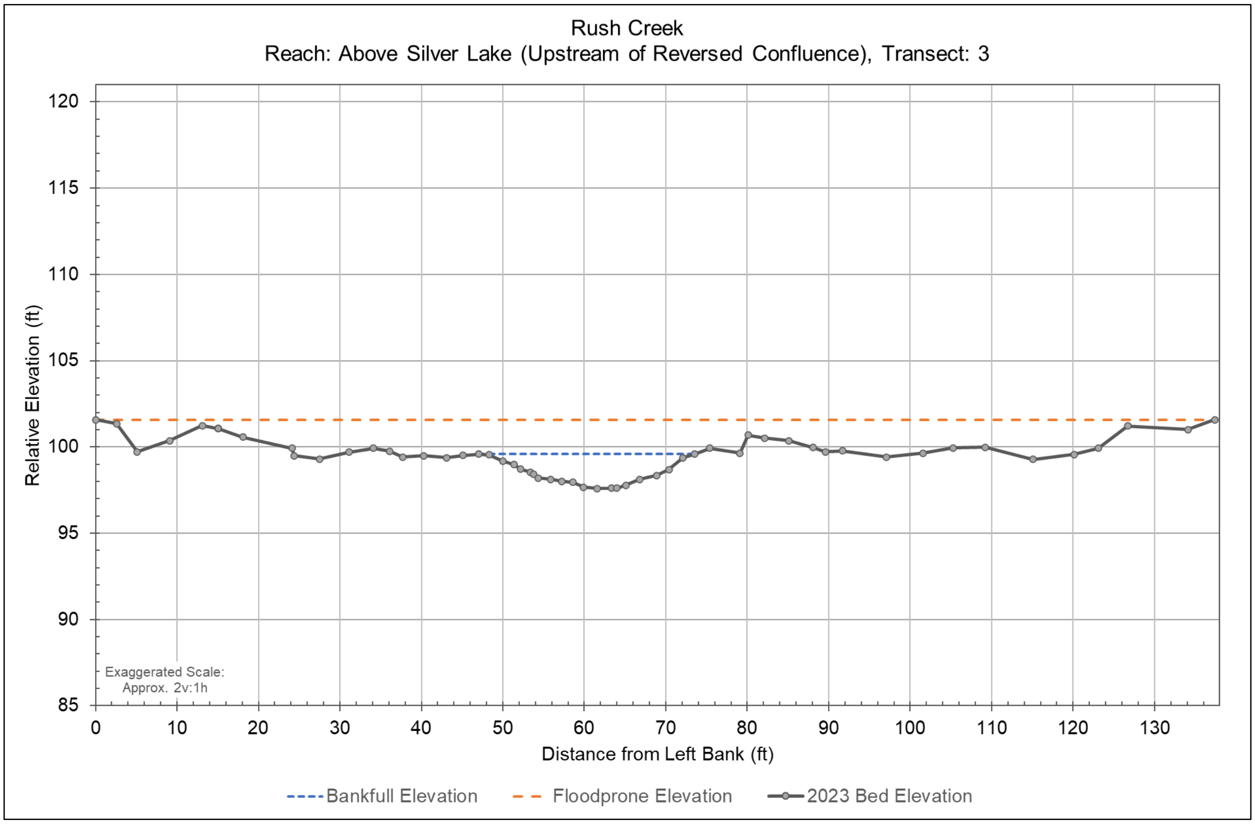

Figure C-9. Rush Creek Transect 3 Above Silver Lake (Upstream of Reversed Creek Confluence)

Table C-9. Morphological Parameters for Rosgen Level II Stream Classification at Transect 3 Above Silver Lake (Upstream of Reversed Creek Confluence)

Entrenchment Ratio	5.2
Bankfull Width-Depth Ratio	21.2
Channel Sinuosity[1]	1.2
Channel Slope (%)	0.57
Median Particle Size, D_{50} (mm)	Gravel (43)
Dominate Substrate (%)	Gravel (44)
Stream Type	C4

Note:

[1] Calculated as stream length/valley length

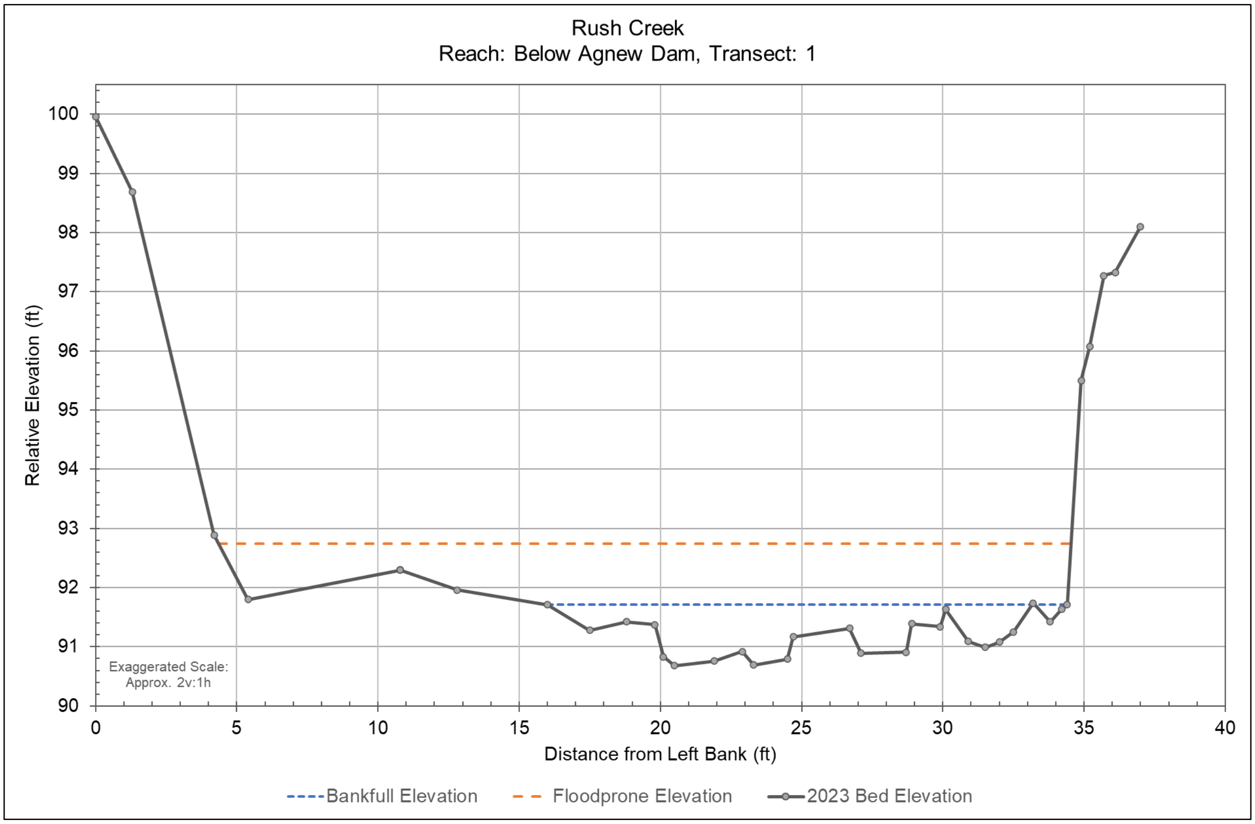

Figure C-10. Rush Creek Transect 1 Below Agnew Dam

Table C-10. Morphological Parameters for Rosgen Level II Stream Classification at Transect 1 Below Agnew Dam

Entrenchment Ratio[1]	1.6
Bankfull Width-Depth Ratio	31.7
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	3.9
Median Particle Size, D_{50} (mm)	Cobble (94)
Dominate Substrate (%)	Bedrock (60)
Stream Type	B1/3

Notes:

[1] Sinuosity ratios can vary +/- 0.2 units from the >1.2 ratio required to be a B or C-stream type.

[2] Calculated as stream length/valley length

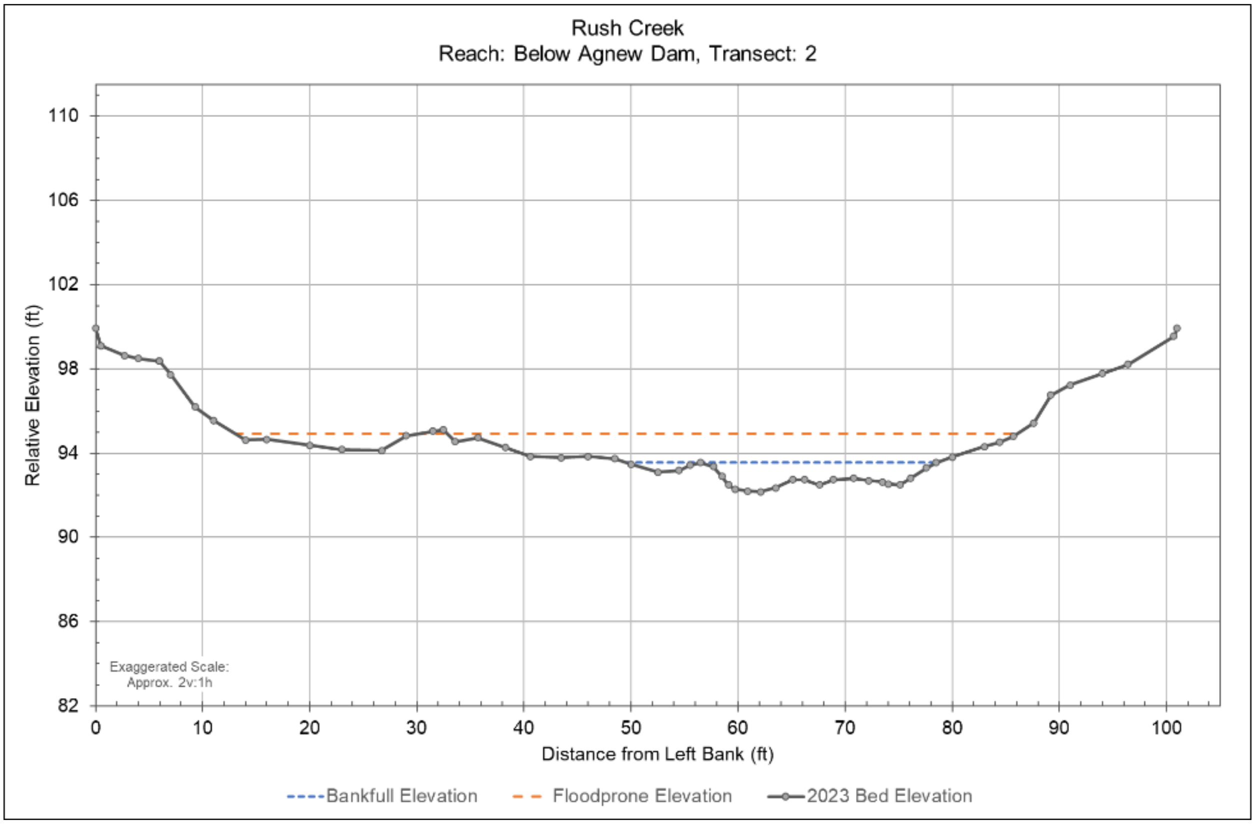

Figure C-11. Rush Creek Transect 2 Below Agnew Dam

Table C-11. Morphological Parameters for Rosgen Level II Stream Classification at Transect 2 Below Agnew Dam

Entrenchment Ratio	2.5
Bankfull Width-Depth Ratio	32.3
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	1.9
Median Particle Size, D_{50} (mm)	Cobble (110)
Dominate Substrate (%)	Cobble (69)
Stream Type	C3

Notes:

[1] Sinuosity ratios can vary +/- 0.2 units from the >1.2 ratio required to be a B or C-stream type.

[2] Calculated as stream length/valley length

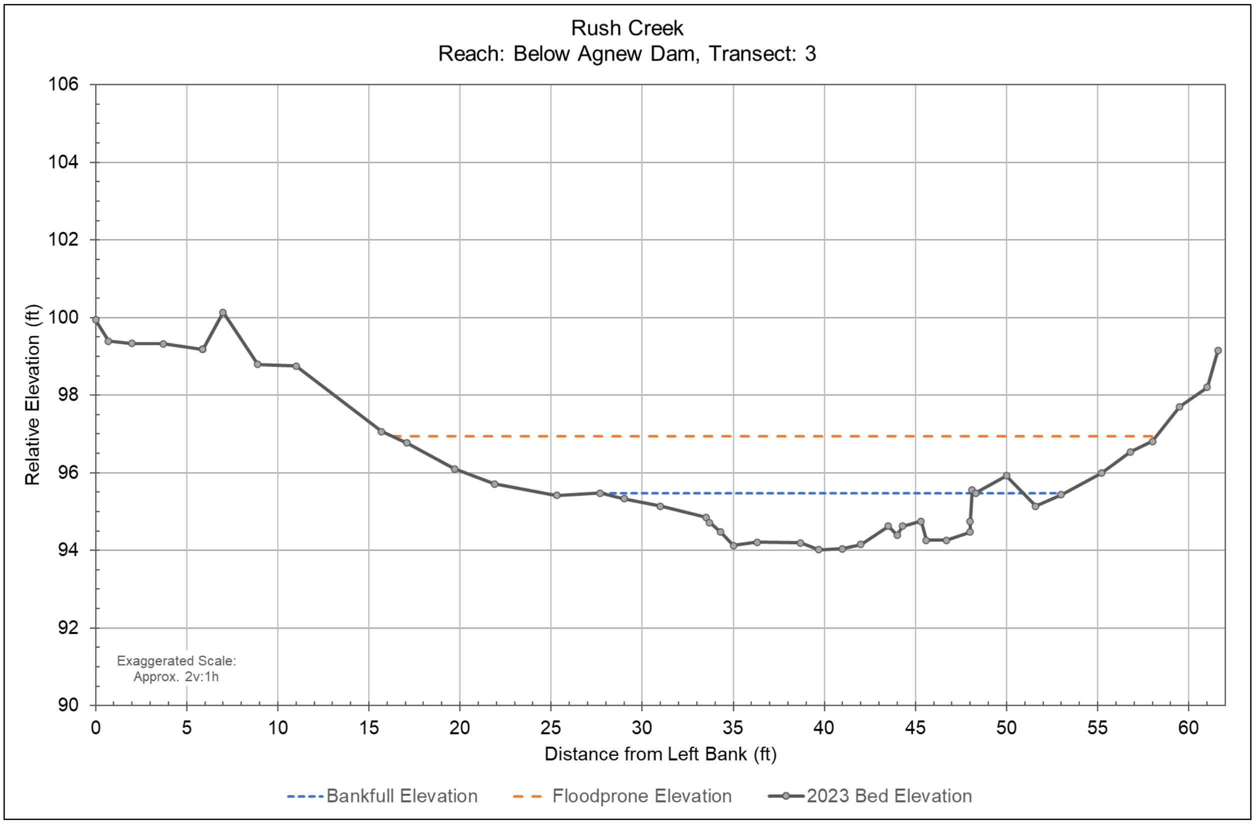

Figure C-12. Rush Creek Transect 3 Below Agnew Dam

Table C-12. Morphological Parameters for Rosgen Level II Stream Classification at Transect 3 Below Agnew Dam

Entrenchment Ratio	1.6
Bankfull Width-Depth Ratio	28.0
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	0.7
Median Particle Size, D_{50} (mm)	Cobble (100)
Dominate Substrate (%)	Cobble (77)
Stream Type	B3c

Notes:

[1] Sinuosity ratios can vary +/- 0.2 units from the >1.2 ratio required to be a B or C-stream type.

[2] Calculated as stream length/valley length

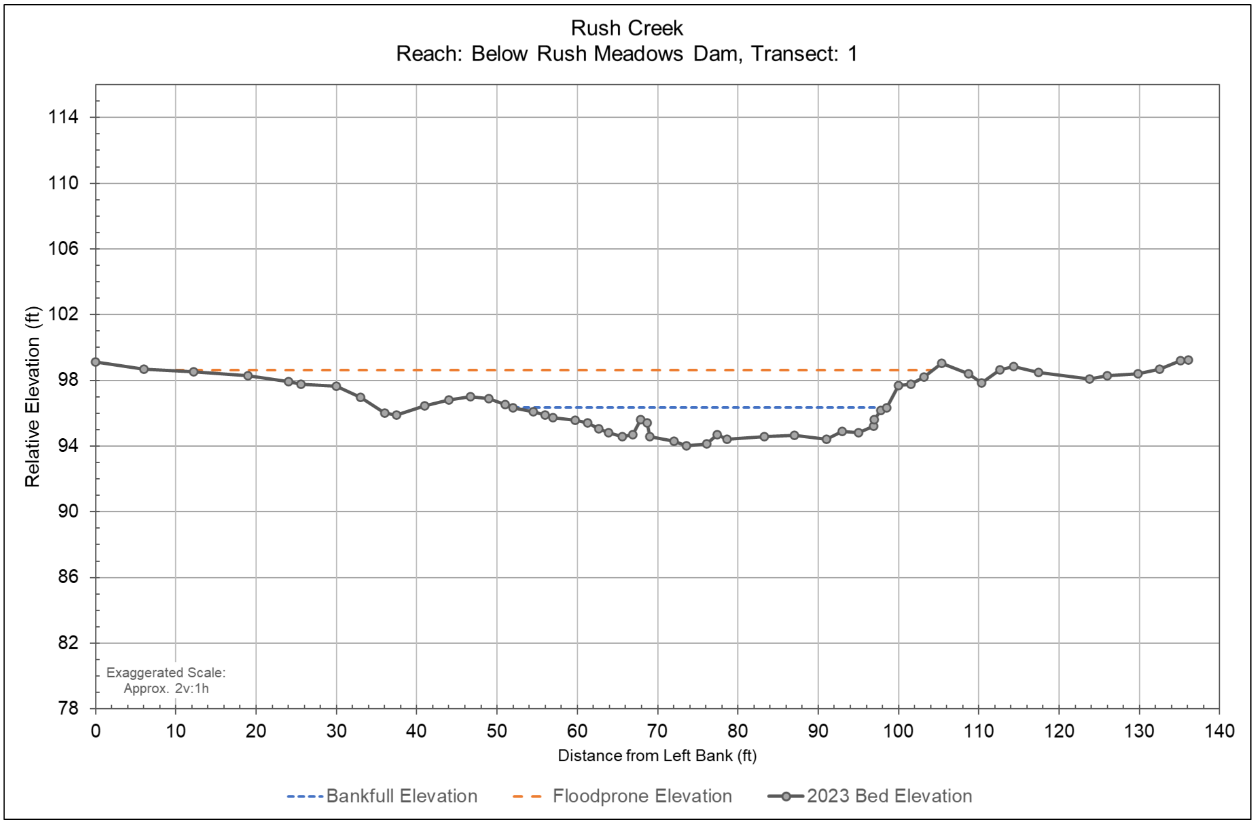

Figure C-13. Cross Section Transect 1 Below Rush Meadows Dam

Table C-13. Morphological Parameters for Rosgen Stream Classification at Transect 1 Below Rush Meadows Dam

Entrenchment Ratio	2.0
Bankfull Width-Depth Ratio	35.5
Channel Sinuosity[1]	1.2
Channel Slope (%)	2.3
Median Particle Size, D_{50} (mm)	Cobble (120)
Dominate Substrate (%)	Cobble (38)
Stream Type[2]	B3

Note:

[1] Calculated as stream length/valley length

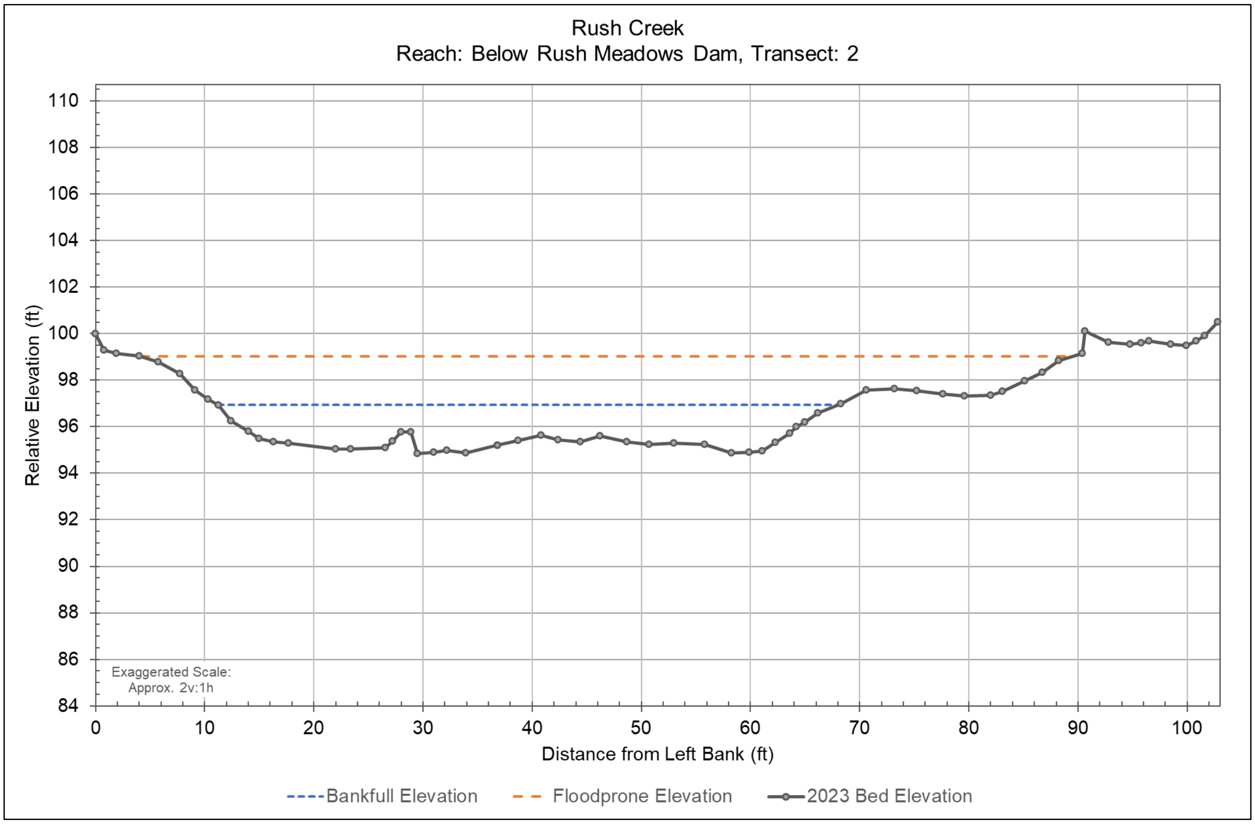

Figure C-14. Cross Section Transect 2 Below Rush Meadows Dam

Table C-14. Morphological Parameters for Rosgen Stream Classification at Transect 2 Below Rush Meadows Dam

Entrenchment Ratio	1.5
Bankfull Width-Depth Ratio	37.3
Channel Sinuosity[1]	1.3
Channel Slope (%)	0.8
Median Particle Size, D_{50} (mm)	Cobble (94)
Dominate Substrate (%)	Cobble (56)
Stream Type	B3c

Note:

[1] Calculated as stream length/valley length

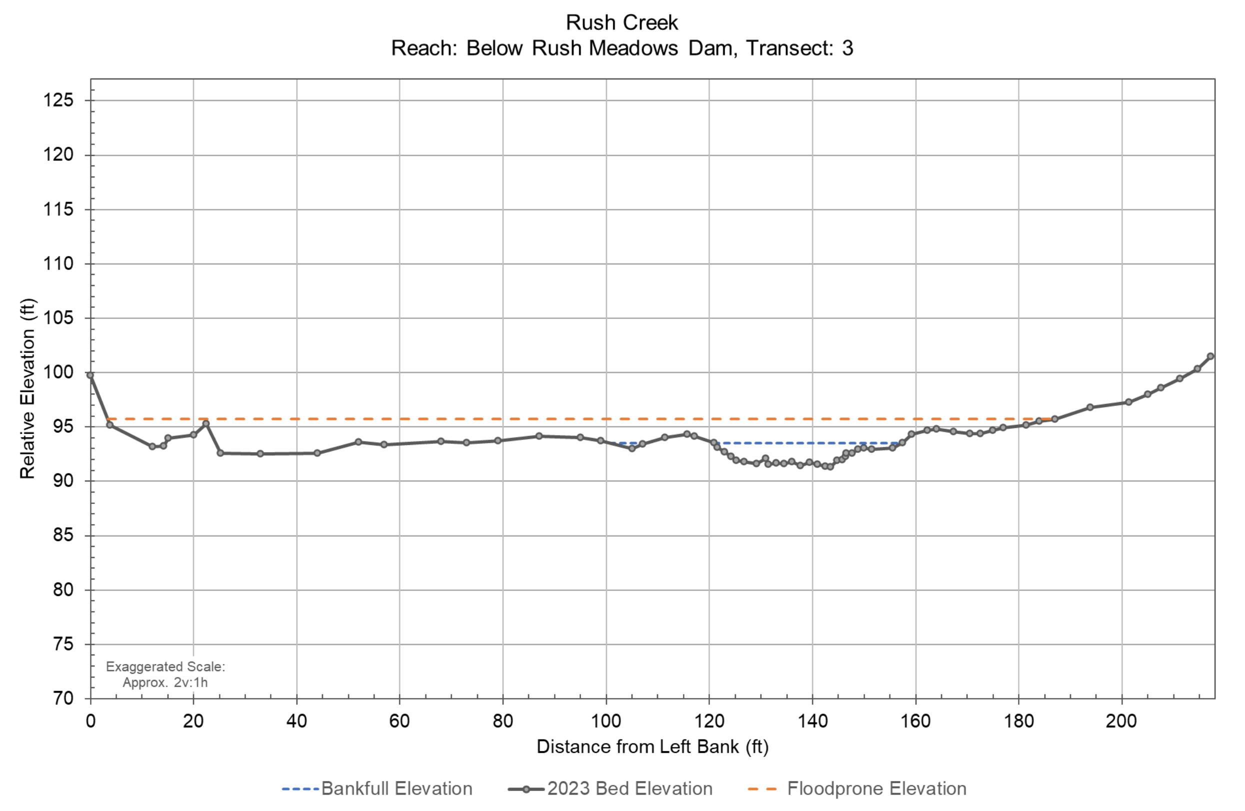

Figure C-15. Cross Section Transect 3 Below Rush Meadows Dam

Table C-15. Morphological Parameters for Rosgen Stream Classification at Transect 3 Below Rush Meadows Dam

Entrenchment Ratio	4.2
Bankfull Width-Depth Ratio	32.9
Channel Sinuosity[1,2]	1.1
Channel Slope (%)	2.9
Median Particle Size, D_{50} (mm)	Cobble (120)
Dominate Substrate (%)	Cobble (57)
Stream Type	C3b

Notes:

1 Sinuosity ratios can vary +/- 0.2 unit from the >1.2 ratio required to be a B or C-stream type.

2 Calculated as stream length/valley length

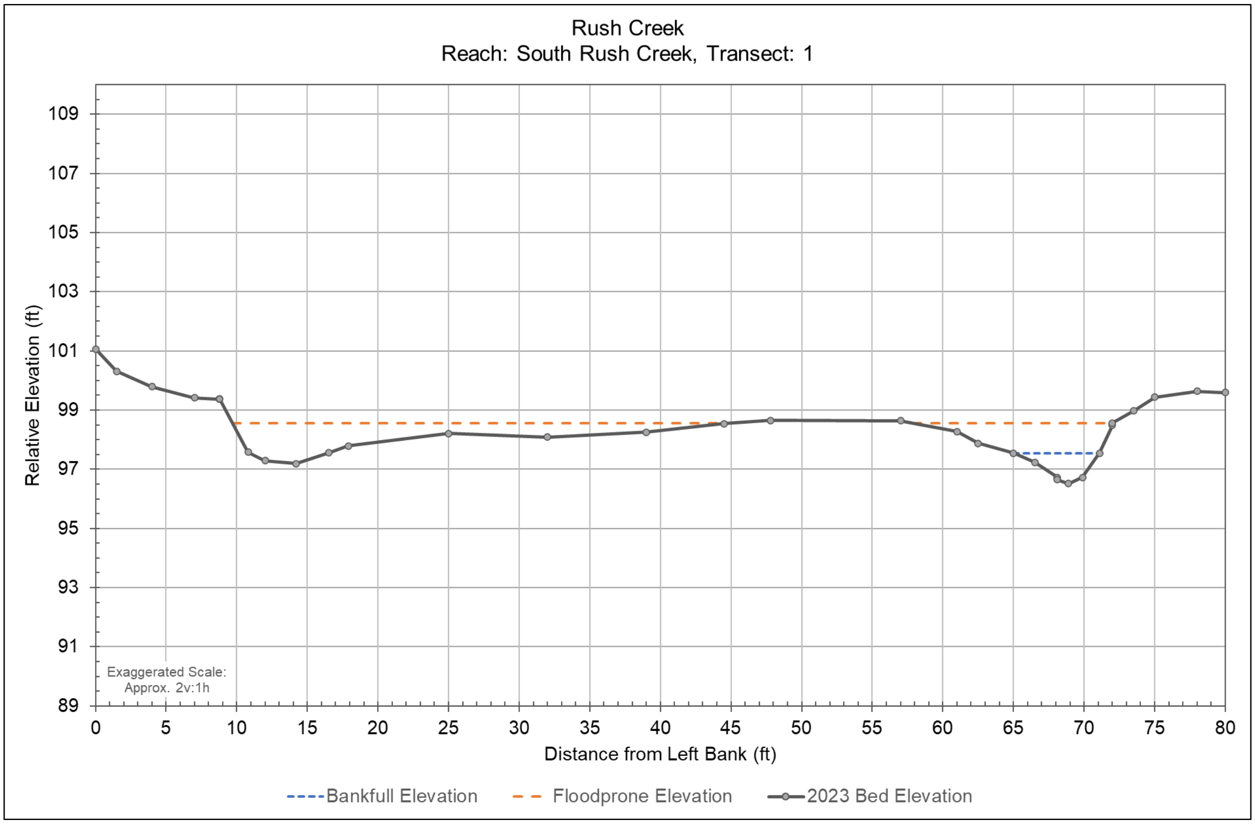

Figure C-16. South Rush Creek Cross Section Transect 1

Table C-16. Morphological Parameters for Rosgen Stream Classification at South Rush Creek Transect 1

Entrenchment Ratio	8.1
Bankfull Width-Depth Ratio[1]	11.4
Channel Sinuosity[2,3]	1.2
Channel Slope (%)	0.39
Median Particle Size, D_{50} (mm)	Sand (1.7)
Dominate Substrate (%)	Sand (66)
Stream Type	C5

Notes:

[1] Values for width-depth ratio can vary +/-2.0 units from the >12 ratio required to be a C-stream type.

[2] Sinuosity ratios can vary +/- 0.2 units from the >1.2 ratio required to be a B or C-stream type.

[3] Calculated as stream length/valley length

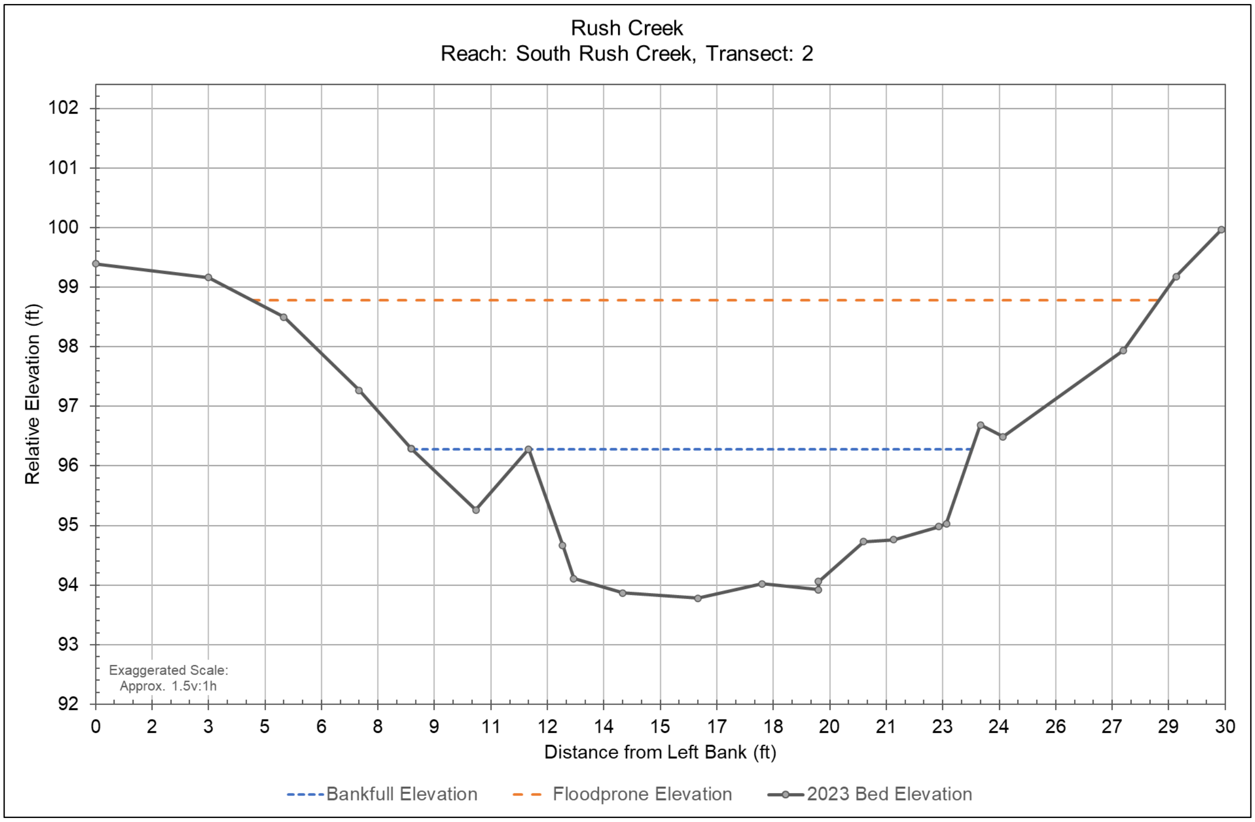

Figure C-17. South Rush Creek Cross Section Transect 2

Table C-17. Morphological Parameters for Rosgen Stream Classification at South Rush Creek Transect 2

Entrenchment Ratio	1.6
Bankfull Width-Depth Ratio[1]	9.2
Channel Sinuosity[2,3]	1.0
Channel Slope (%)	2.0
Median Particle Size, D_{50} (mm)	Cobble (69)
Dominate Substrate (%)	Cobble (48)
Stream Type	B3

Notes:

[1] Values for width-depth ratio can vary +/-2.0 units from the >12 ratio required to be a B-stream type.

[2] Sinuosity ratios can vary +/- 0.2 units from the >1.2 ratio required to be a B or C-stream type.

[3] Calculated as stream length/valley length

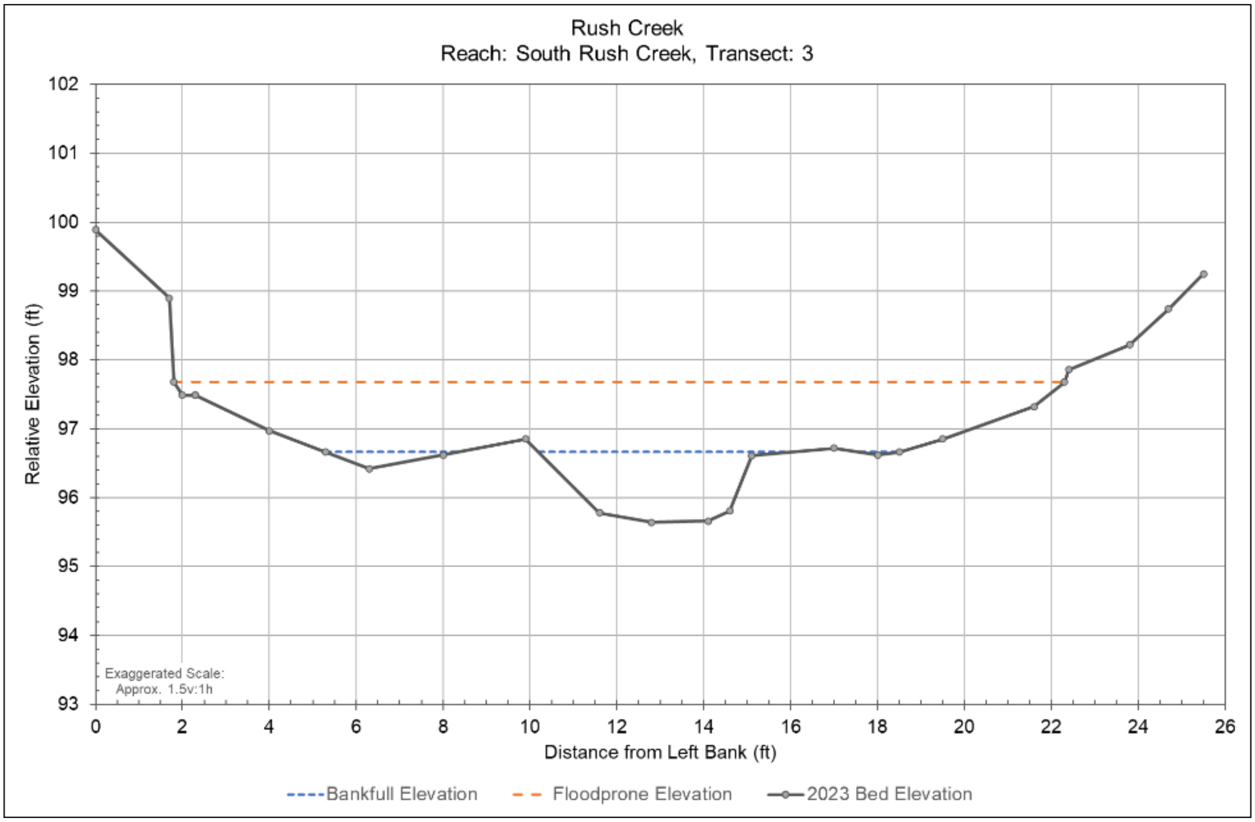

Figure C-18. South Rush Creek Cross Section Transect 3

Table C-18. Morphological Parameters for Rosgen Stream Classification at South Rush Creek Transect 3

Entrenchment Ratio[1]	2.1
Bankfull Width-Depth Ratio	25.0
Channel Sinuosity[2,3]	1.0
Channel Slope (%)	5.9
Median Particle Size, D_{50} (mm)	Cobble (86)
Dominate Substrate (%)	Cobble (44)
Stream Type	B3a

Notes:

[1] Entrenchment ratio can vary +/- 0.2 unit from the 1.4 - 2.2 ratio required to be a B-stream type.

[2] Sinuosity ratio can vary +/- 0.2 unit from the >1.2 ratio required to be a B-stream type.

[3] Calculated as stream length/valley length

APPENDIX D

V* Pool Site Photographs

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Photo D-1. Rush Creek Above Waugh Lake Upstream, V* Pool 1

Photo D-2. Rush Creek Above Waugh Lake, V* Pool 2

Photo D-3. Rush Creek Above Waugh Lake, V* Pool 3

Photo D-4. Rush Creek below Rush Meadows Dam Upstream of V* Pool 1 Riffle Crest

Photo D-5. Rush Creek below Rush Meadows Dam Downstream of V* Pool 1 Riffle Crest

Photo D-6. Rush Creek below Rush Meadows Dam V* Pool 2 Riffle Crest

Photo D-7. Rush Creek below Rush Meadows Dam Downstream of V* Pool 2 Riffle Crest

Photo D-8. Rush Creek below Rush Meadows Dam Upstream of V* Pool 3 Riffle Crest

Photo D-9. Rush Creek below Rush Meadows Dam Downstream of V* Pool 3 Riffle Crest

Photo D-10. Rush Creek below Rush Meadows Dam V* Pool 4 Riffle Crest

Photo D-11. Rush Creek below Rush Meadows Dam Upstream of V* Pool 4 Riffle Crest

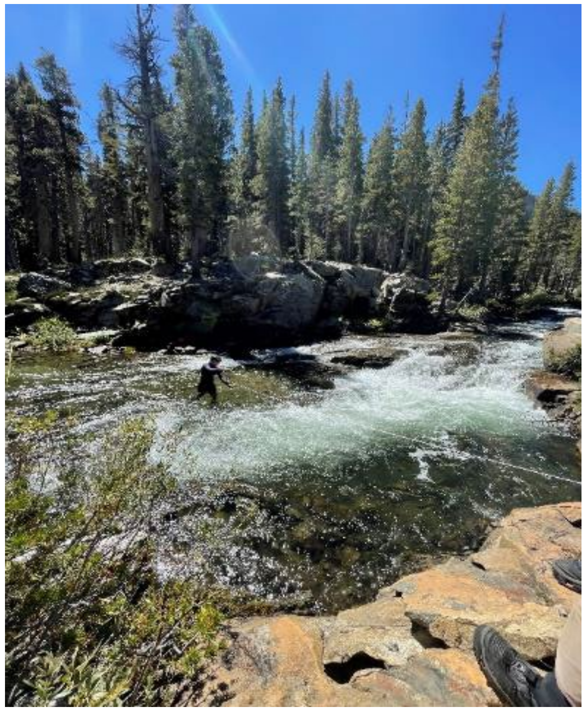

Photo D-12. Rush Creek below Rush Meadows Dam Upstream of V* Pool 5 Riffle Crest

Photo D-13. Rush Creek below Rush Meadows Dam V* Pool 5

Photo D-14. Rush Creek below Agnew Dam Upstream of V* Pool 1 Riffle Crest

Photo D-15. Rush Creek below Agnew Dam Downstream of V* Pool 1 Riffle Crest

Photo D-16. Rush Creek below Agnew Dam Upstream of V* Pool 2 Riffle Crest

Photo D-17. Rush Creek below Agnew Dam Downstream of V* Pool 2 Riffle Crest

Photo D-18. Rush Creek below Agnew Dam Upstream of V* Pool 3 Riffle Crest

Photo D-19. Rush Creek below Agnew Dam Downstream of V* Pool 3 Riffle Crest

Photo D-20. Rush Creek below Agnew Dam Upstream of V* Pool 4 Riffle Crest

Photo D-21. Rush Creek below Agnew Dam Downstream of V* Pool 4 Riffle Crest

Photo D-22. Rush Creek below Agnew Dam Upstream of V* Pool 5 Riffle Crest

Photo D-23. Rush Creek below Agnew Dam Downstream of V* Pool 5 Riffle Crest

Photo D-24. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Upstream of V* Pool 1Riffle Crest

Photo D-25. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Downstream of V* Pool 1 Riffle Crest

Photo D-26. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Upstream of V* Pool 2 Riffle Crest

Photo D-27. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Downstream of V* Pool 2 Riffle Crest

Photo D-28. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Upstream of V* Pool 3 Riffle Crest

Photo D-29. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Downstream of V* Pool 3 Riffle Crest

Photo D-30. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Upstream of V* Pool 4 Riffle Crest

Photo D-31. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Downstream of V* Pool 4 Riffle Crest

Photo D-32. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Upstream of V* Pool 5 Riffle Crest

Photo D-33. Rush Creek above Silver Lake (Upstream of Reversed Confluence) Downstream of V* Pool 5 Riffle Crest

Photo D-34. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 1

Photo D-35. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 1

Photo D-36. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 2

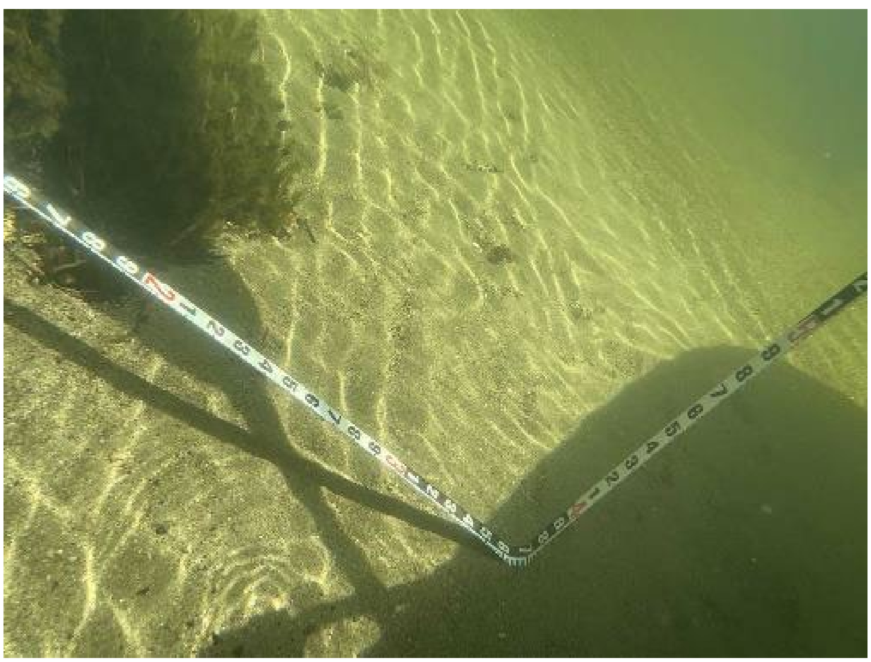

Photo D-37. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 2 Substrate

Photo D-38. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 3

Photo D-39. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 3 Substrate

Photo D-40. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 4

Photo D-41. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 4 Substrate

Photo D-42. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 5

Photo D-43. Rush Creek above Silver Lake (Downstream of Reversed Confluence) Pool 5 Substrate

Photo D-44. Rush Creek below Silver Lake Upstream of V* Pool 1 Riffle Crest

Photo D-45. Rush Creek below Silver Lake Downstream of V* Pool 1 Riffle Crest

Photo D-46. Rush Creek below Silver Lake Upstream of V* Pool 2 Riffle Crest

Photo D-47. Rush Creek below Silver Lake Downstream of V* Pool 2 Riffle Crest

Photo D-48. Rush Creek below Silver Lake Upstream of V* Pool 3 Riffle Crest

Photo D-49. Rush Creek below Silver Lake Downstream of V* Pool 3 Riffle Crest

Photo D-50. Rush Creek below Silver Lake Upstream of V* Pool 4 Riffle Crest

Photo D-51. Rush Creek below Silver Lake Downstream of V* Pool 4 Riffle Crest

Photo D-52. Rush Creek below Silver Lake Upstream of V* Pool 5 Riffle Crest

Photo D-53. Rush Creek below Silver Lake Downstream of V* Pool 5 Riffle Crest

Photo D-54. South Rush Creek Upstream of V* Pool 1 Riffle Crest

Photo D-55. South Rush Creek Downstream of V* Pool 1 Riffle Crest

Photo D-56. South Rush Creek Upstream of V* Pool 2 Riffle Crest

Photo D-57. South Rush Creek Downstream of V* Pool 2 Riffle Crest

Photo D-58. South Rush Creek Upstream of V* Pool 3 Riffle Crest

Photo D-59. South Rush Creek Downstream of V* Pool 3 Riffle Crest

Photo D-60. South Rush Creek Upstream of V* Pool 4 Riffle Crest

Photo D-61. South Rush Creek Downstream of V* Pool 4 Riffle Crest

Photo D-62. South Rush Creek Upstream of V* Pool 5 Riffle Crest

Photo D-63. South Rush Creek Downstream of V* Pool 5 Riffle Crest

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APPENDIX E

Spawning Gravel Bulk Sampling Histograms and Cumulative Particle-Size Distribution Curves with Site Photographs

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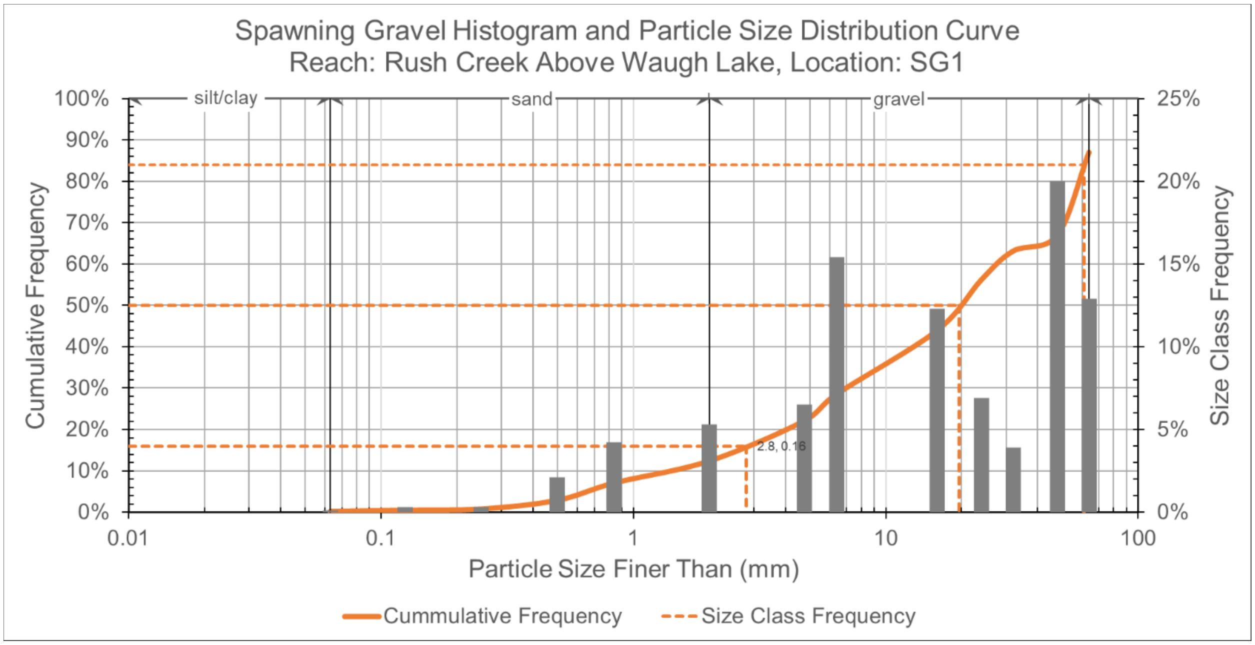

Figure E-1. Rush Creek Above Waugh Lake Spawning Gravel Sample SG1: Histogram and Particle Size Distribution Curve

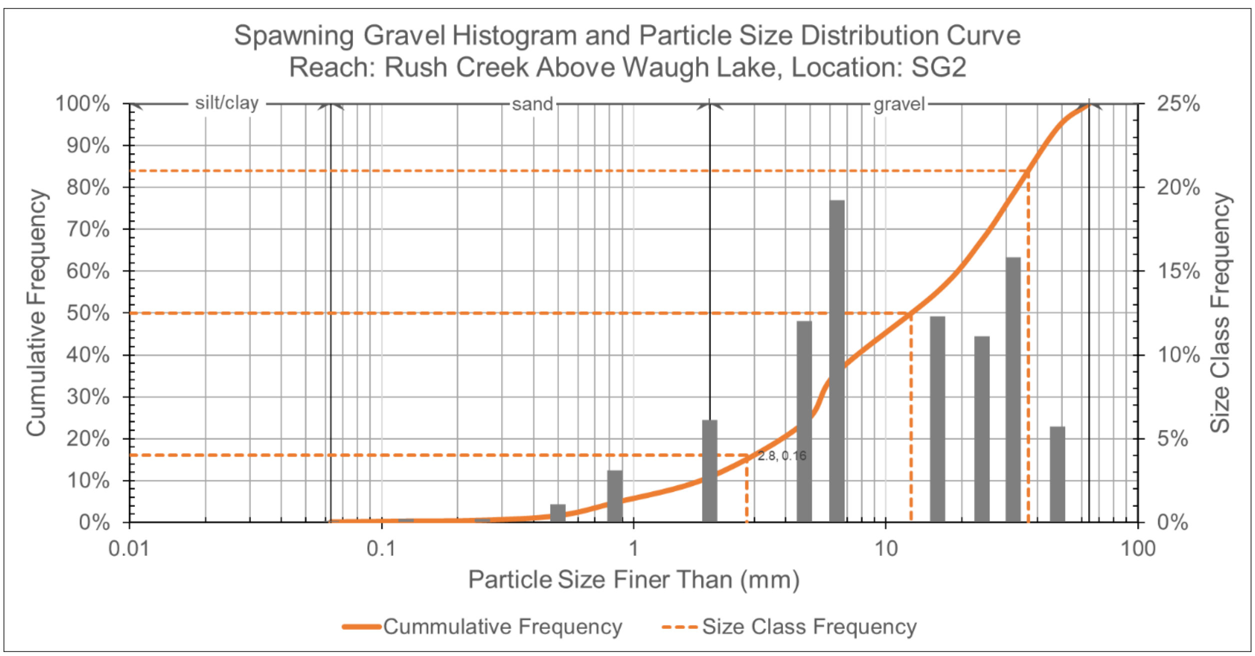

Figure E-2. Rush Creek Above Waugh Lake Spawning Gravel Sample SG2: Histogram and Particle Size Distribution Curve

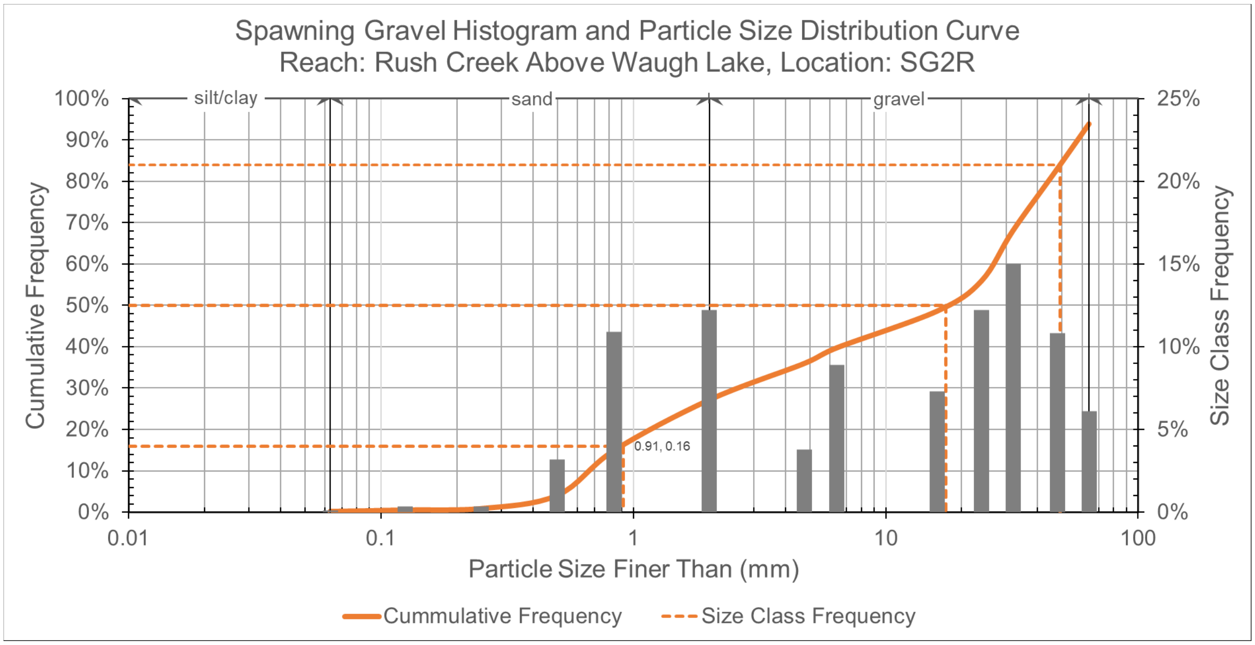

Figure E-3. Rush Creek Above Waugh Lake Spawning Gravel Sample SG2R: Histogram and Particle Size Distribution Curve

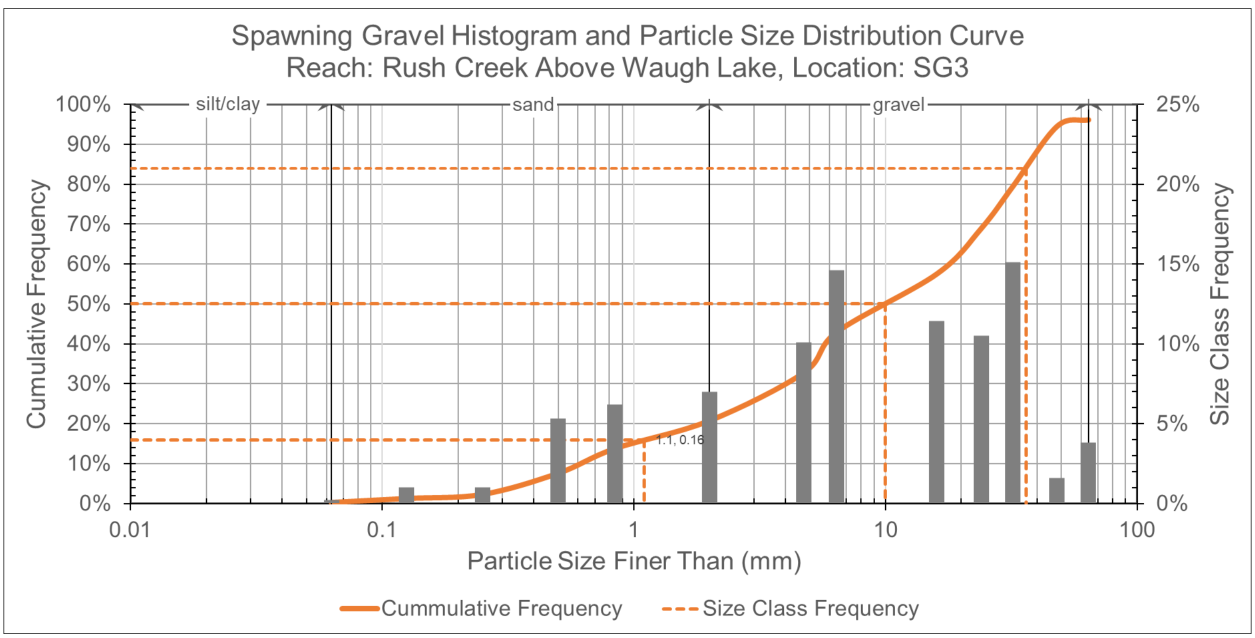

Figure E-4. Rush Creek Above Waugh Lake Spawning Gravel Sample SG3: Histogram and Particle Size Distribution Curve

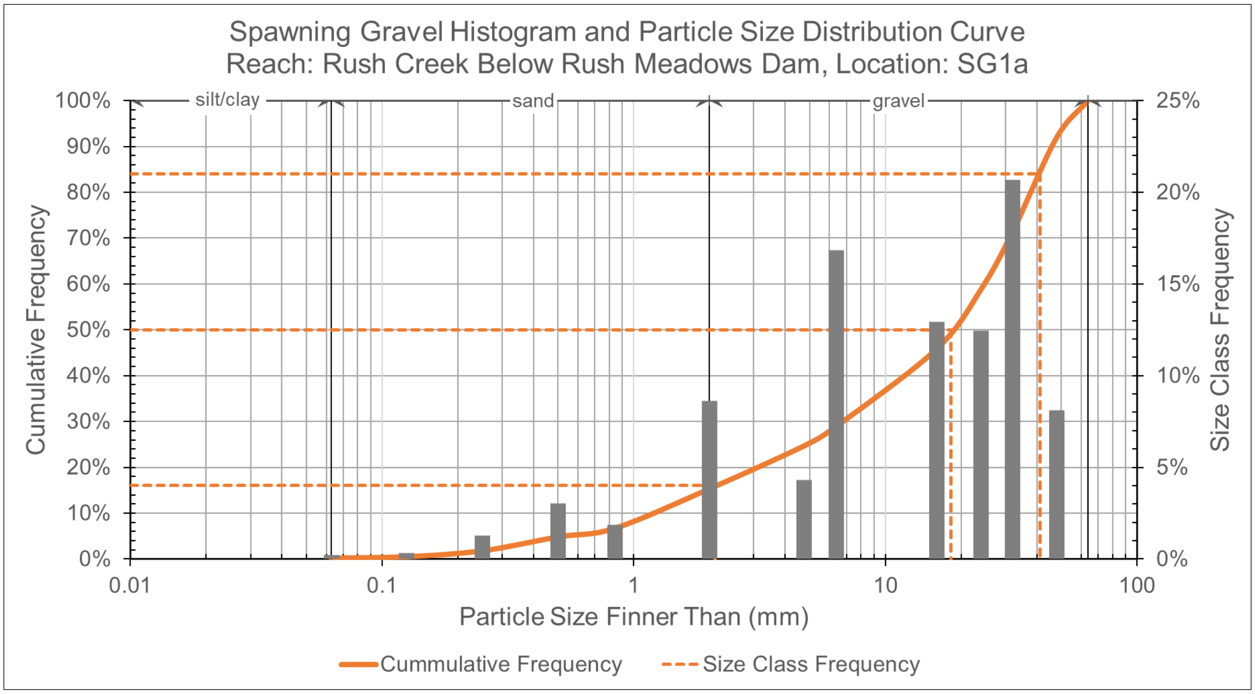

Figure E-5. Rush Creek below Rush Meadows Dam Spawning Gravel Sample SG1a: Histogram and Particle Size Distribution Curve

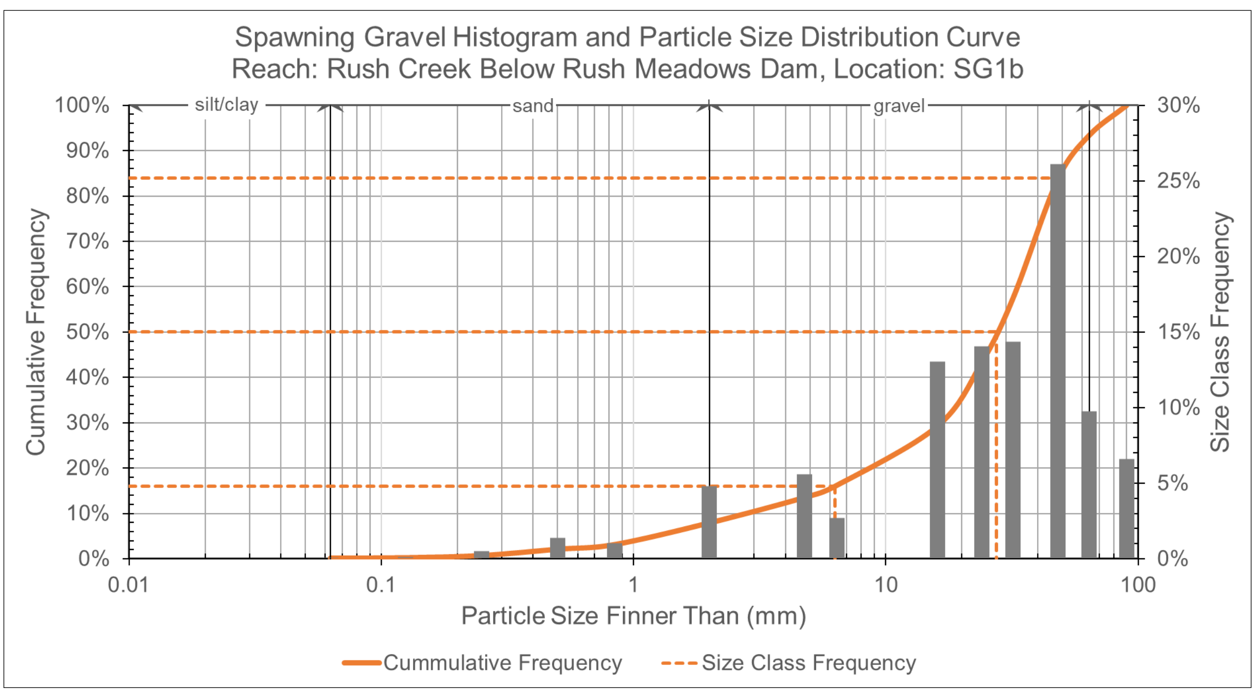

Figure E-6. Rush Creek below Rush Meadows Dam Spawning Gravel Sample SG1b: Histogram and Particle Size Distribution Curve

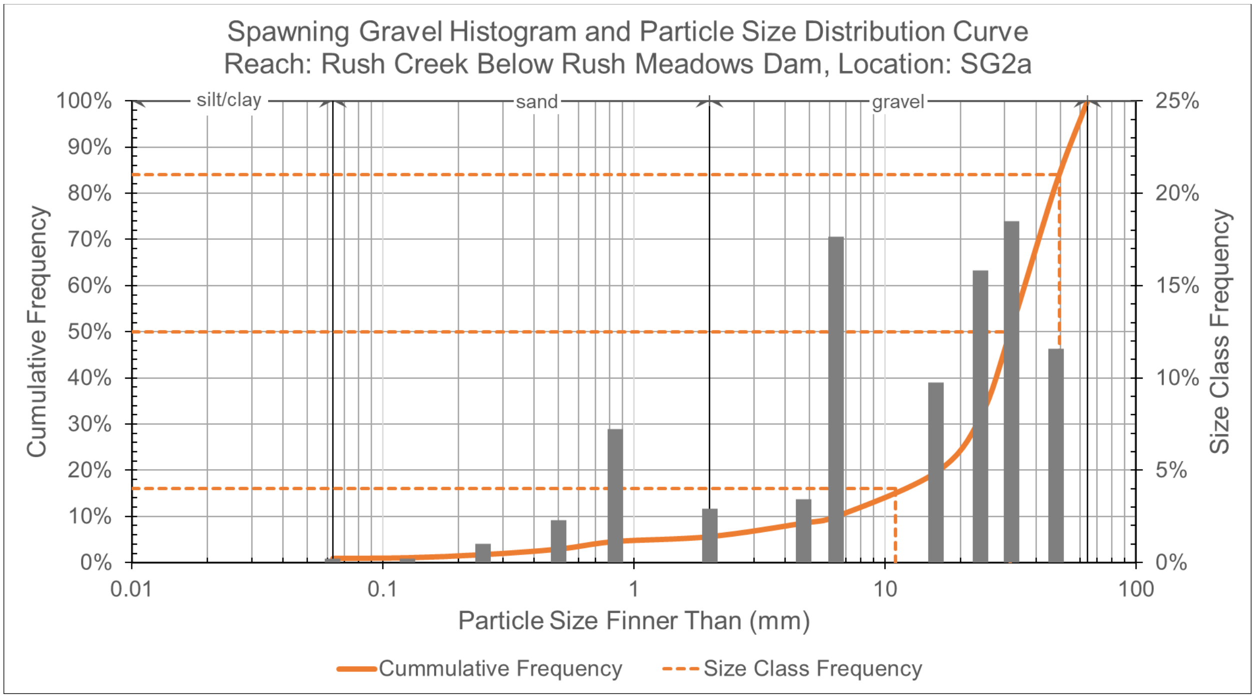

Figure E-7. Rush Creek below Rush Meadows Dam Spawning Gravel Sample SG2a: Histogram and Particle Size Distribution Curve

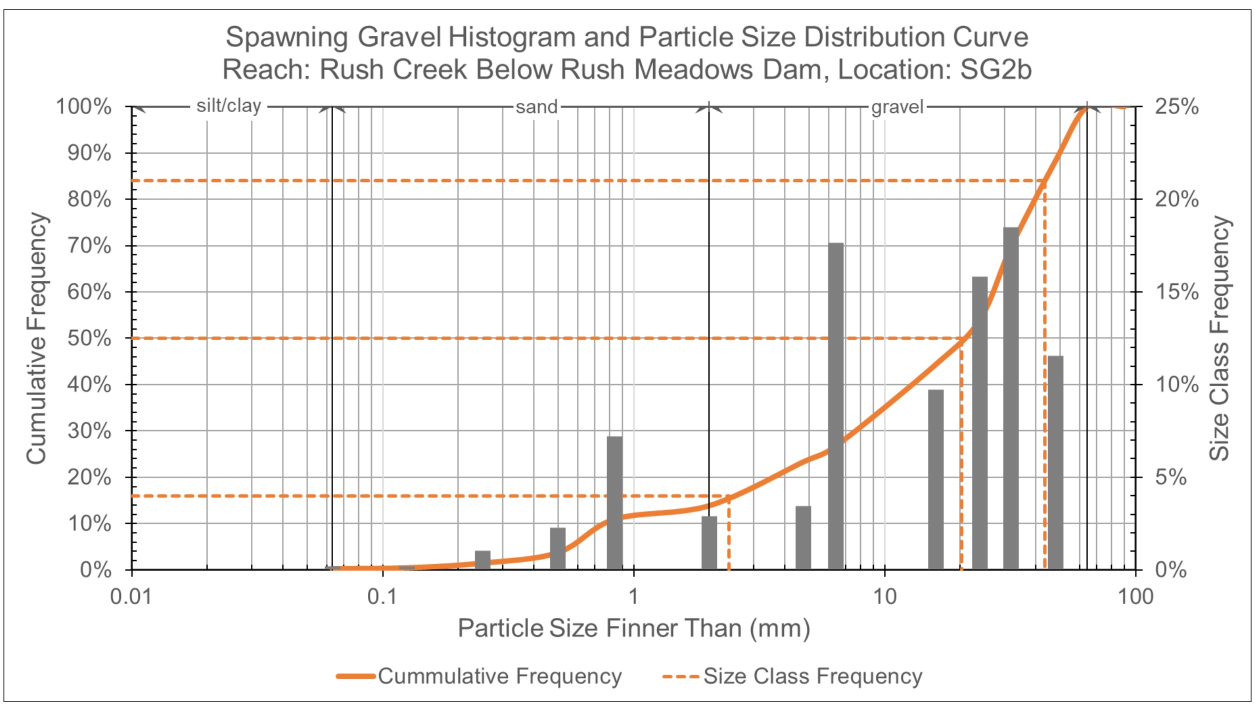

Figure E-8. Rush Creek below Rush Meadows Dam Spawning Gravel Sample SG2b: Histogram and Particle Size Distribution Curve

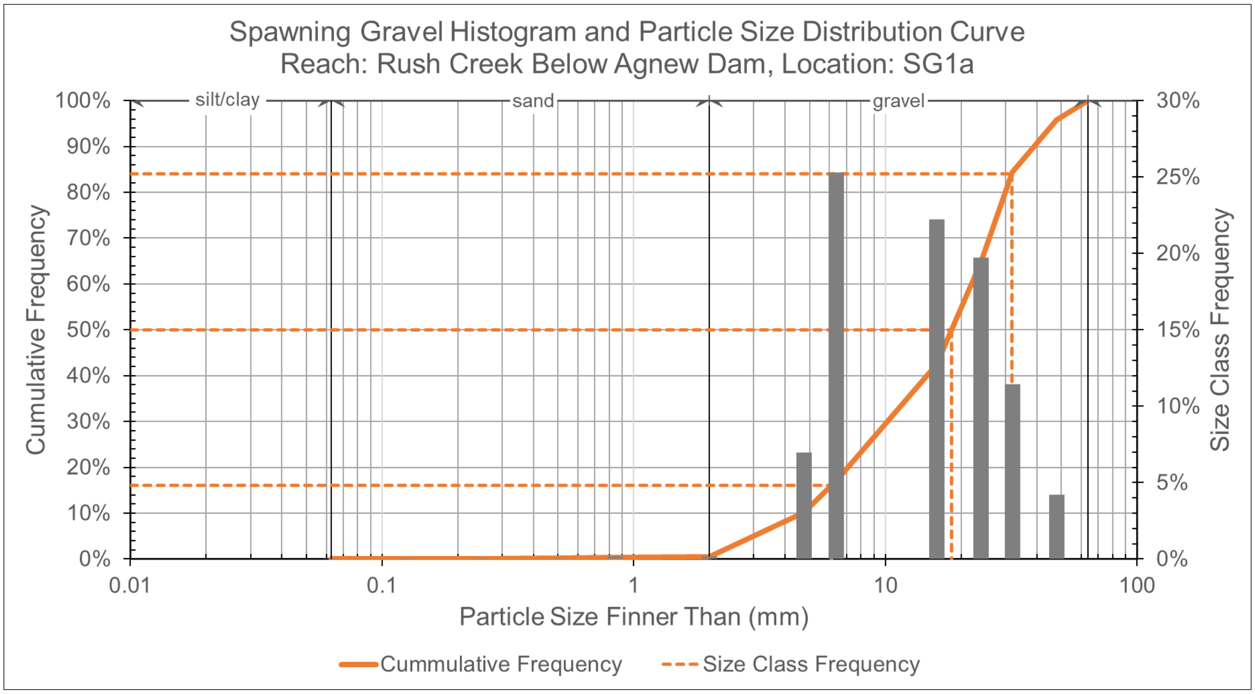

Figure E-9. Rush Creek below Agnew Dam Spawning Gravel Sample SG1a: Histogram and Particle Size Distribution Curve

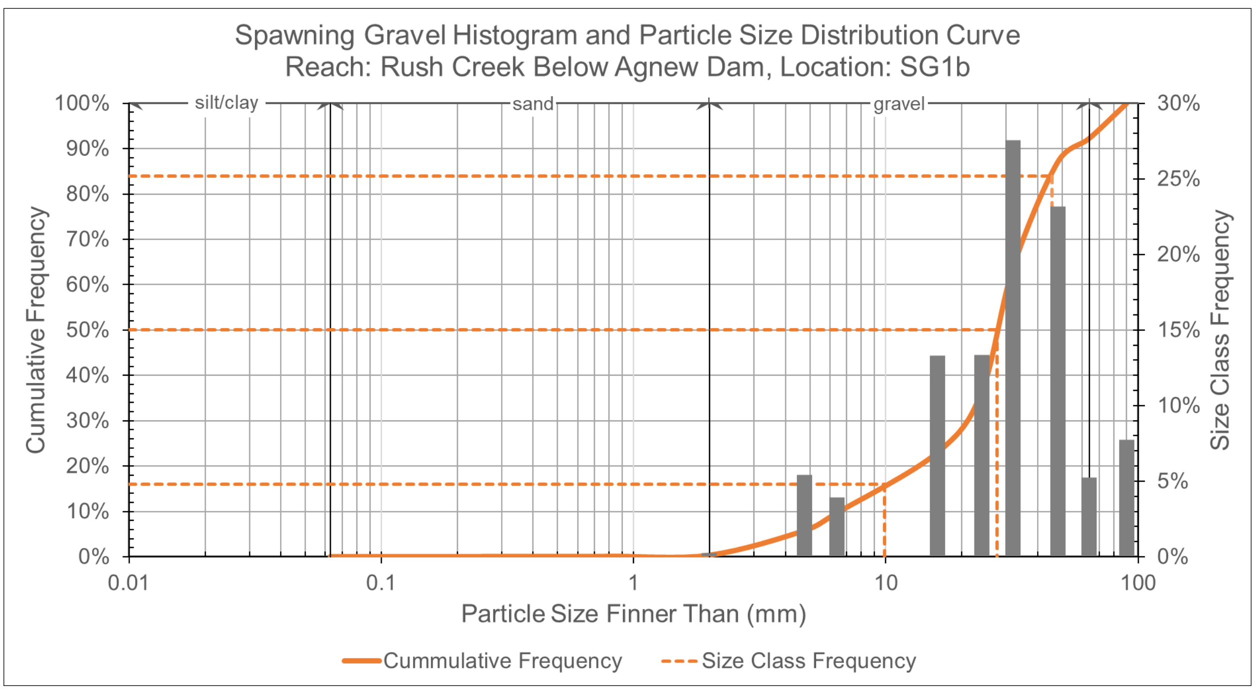

Figure E-10. Rush Creek below Agnew Dam Spawning Gravel Sample SG1b: Histogram and Particle Size Distribution Curve

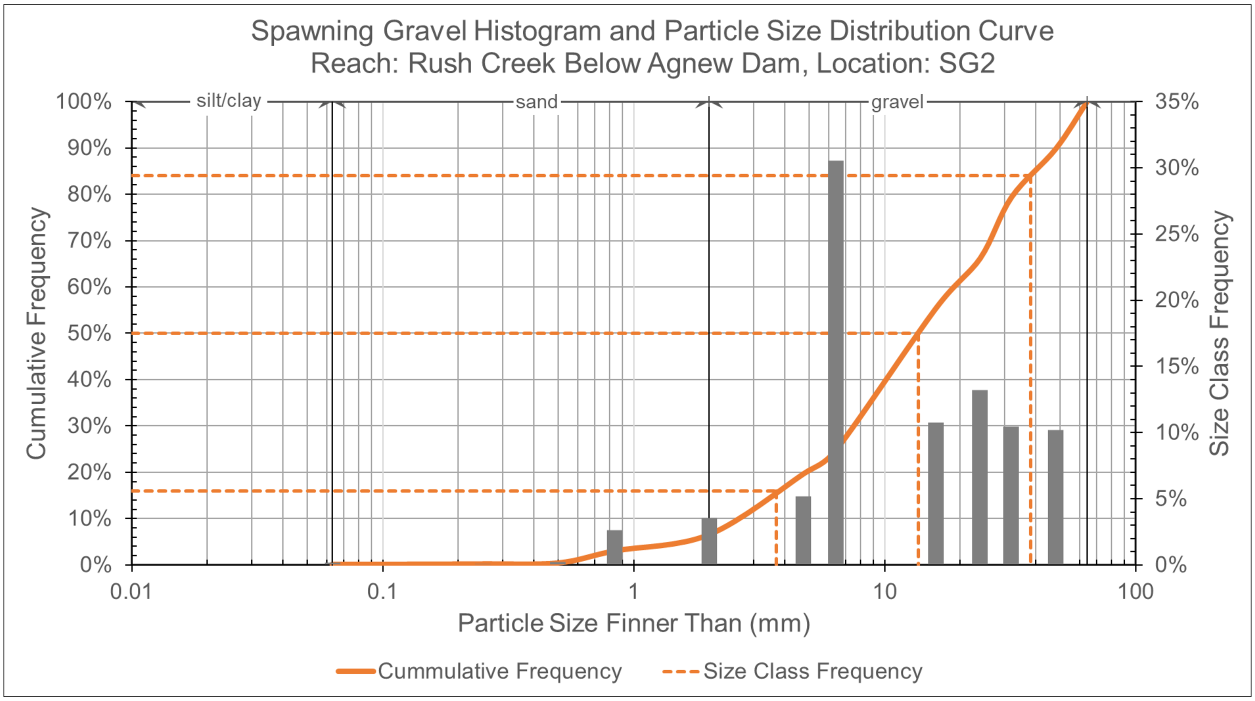

Figure E-11. Rush Creek below Agnew Dam Spawning Gravel Sample SG2: Histogram and Particle Size Distribution Curve

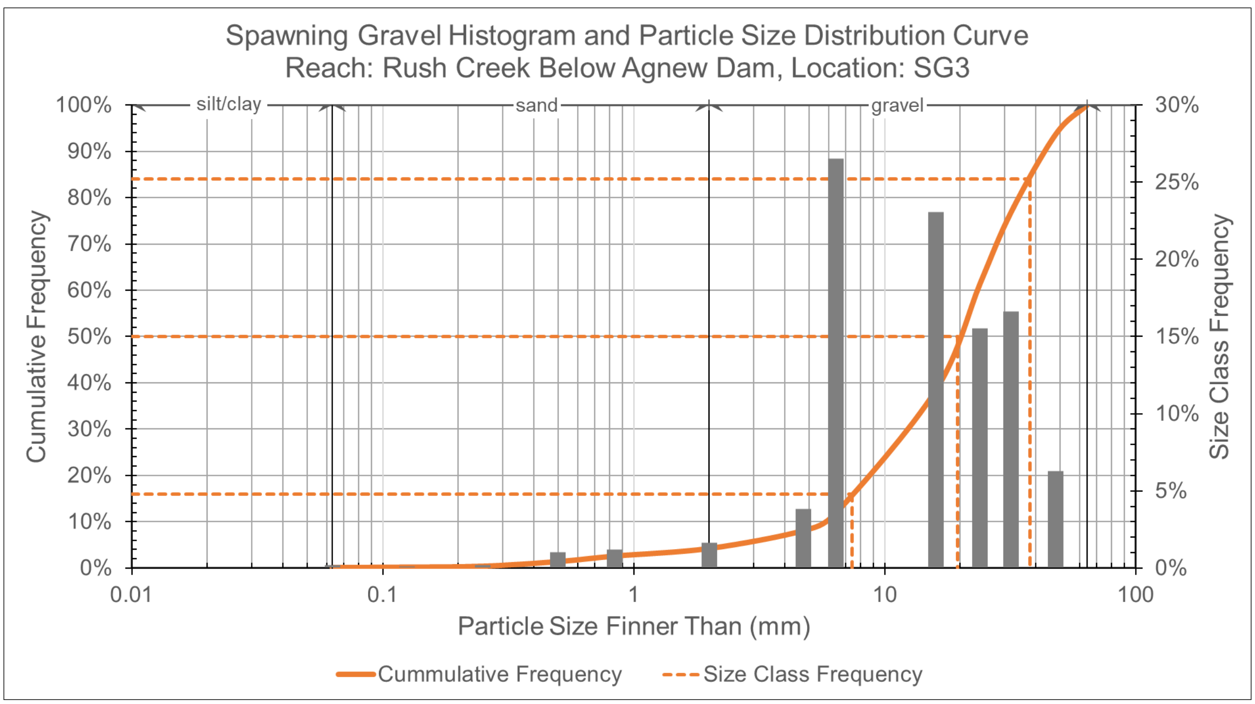

Figure E-12. Rush Creek below Agnew Dam Spawning Gravel Sample SG3: Histogram and Particle Size Distribution Curve

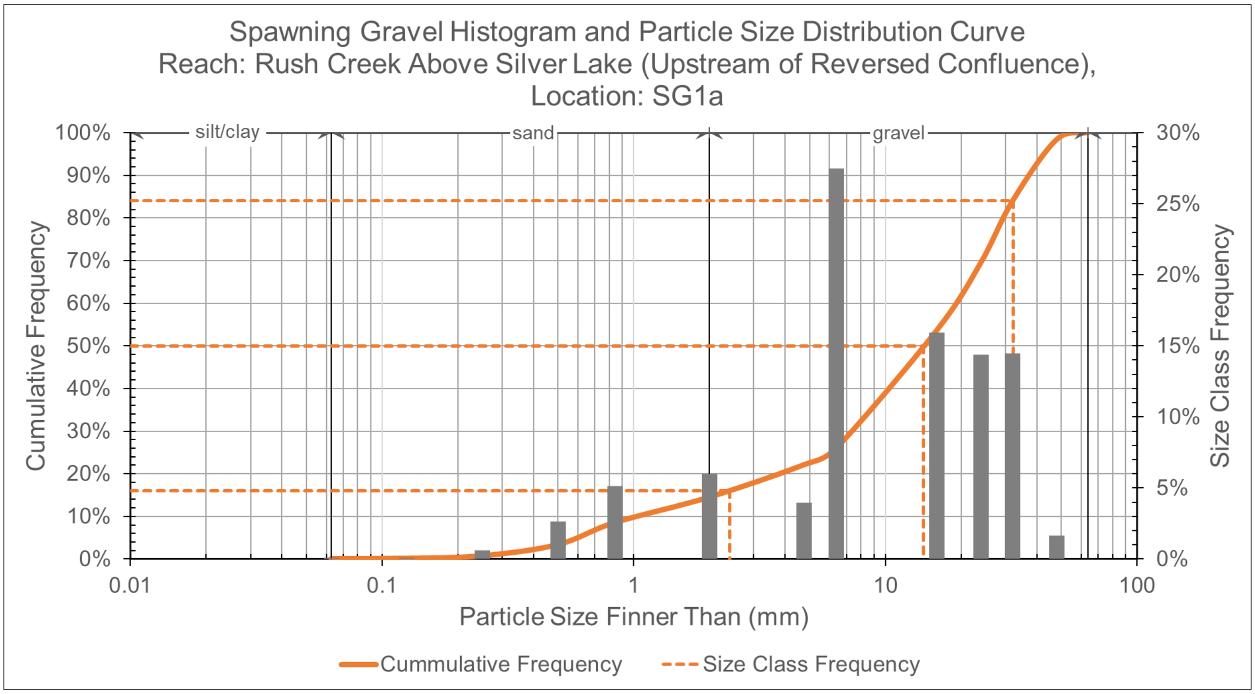

Figure E-13. Rush Creek Above Silver Lake (Upstream of Reversed Creek) Gravel Sample SG1a: Histogram and Particle Size Distribution Curve

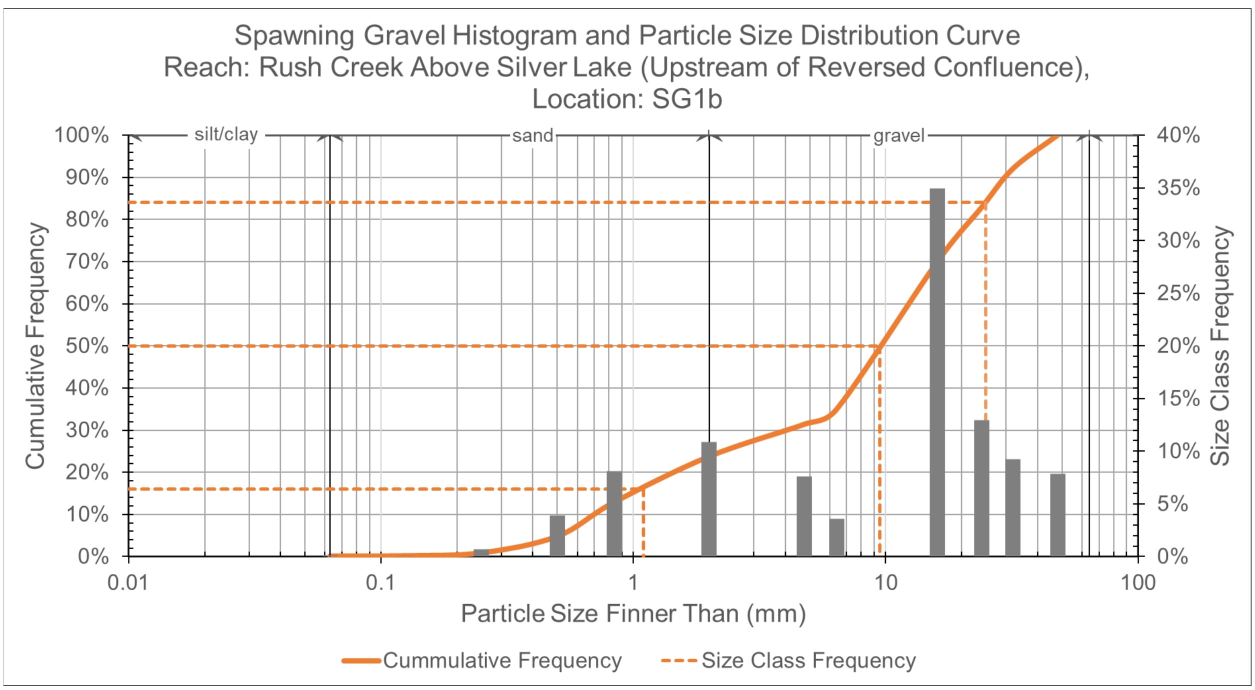

Figure E-14. Rush Creek Above Silver Lake (Upstream of Reversed Creek) Gravel Sample SG1b: Histogram and Particle Size Distribution Curve

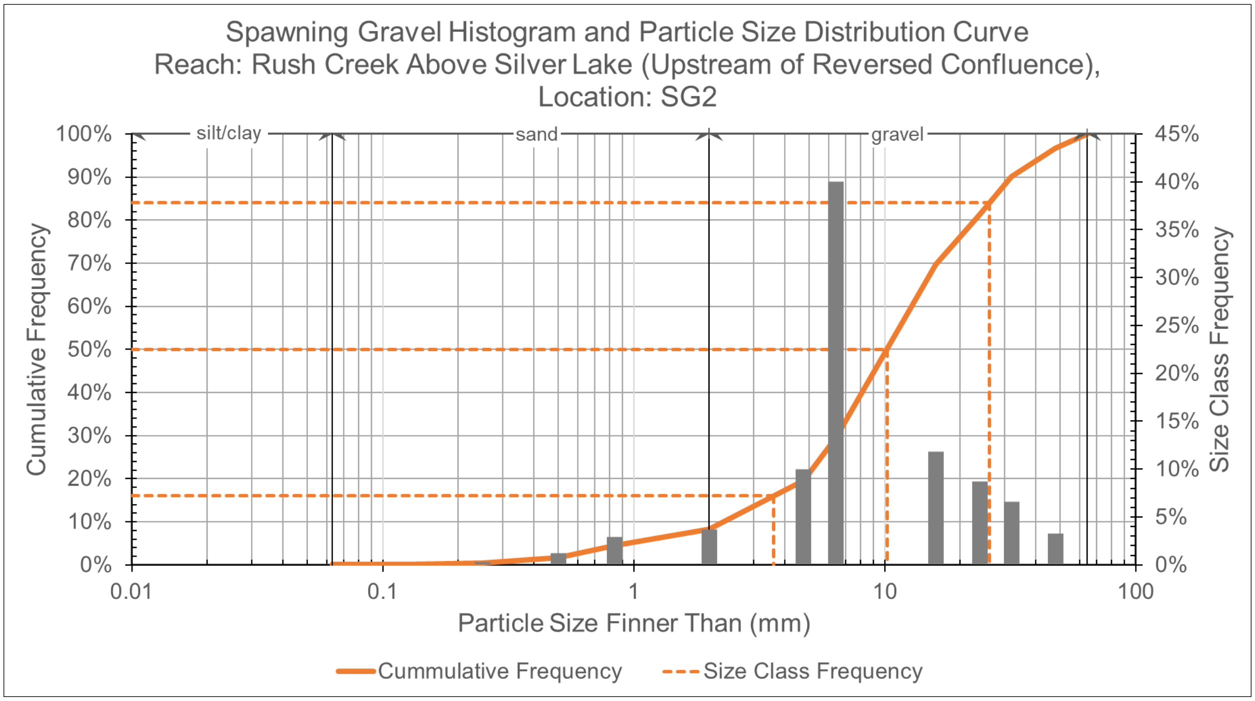

Figure E-15. Rush Creek Above Silver Lake (Upstream of Reversed Creek) Gravel Sample SG2: Histogram and Particle Size Distribution Curve

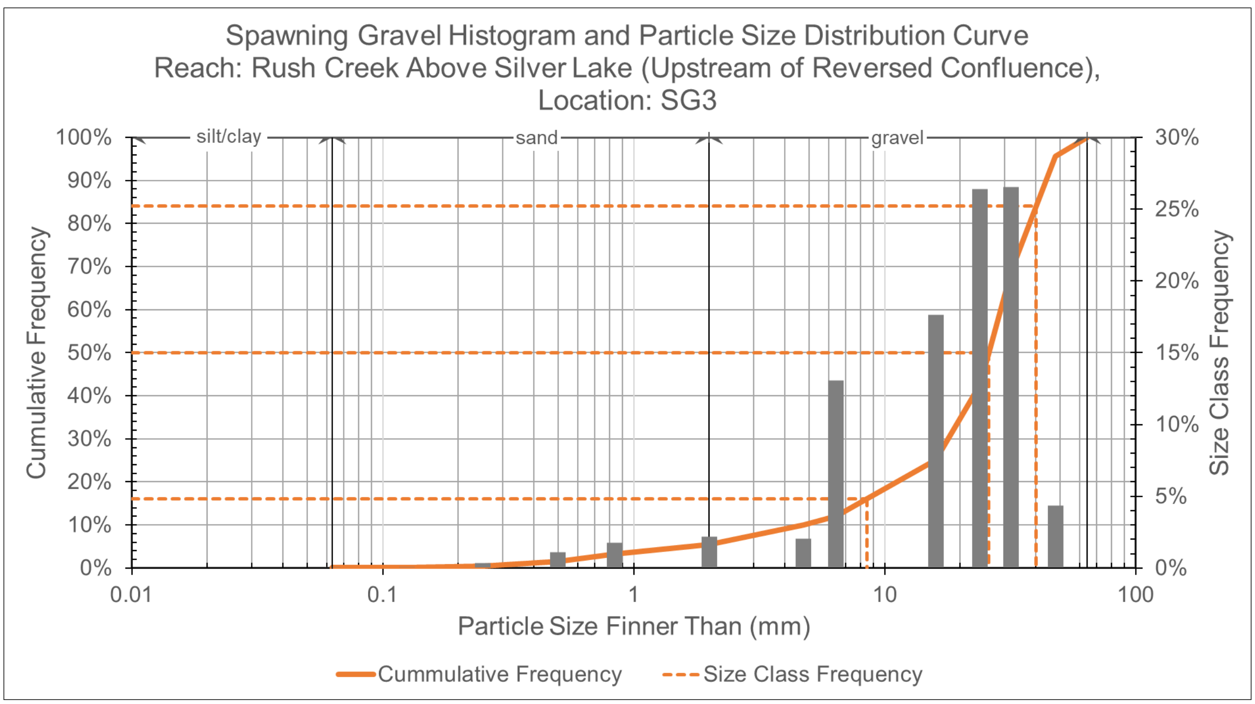

Figure E-16. Rush Creek Above Silver Lake (Upstream of Reversed Creek) Gravel Sample SG3: Histogram and Particle Size Distribution Curve

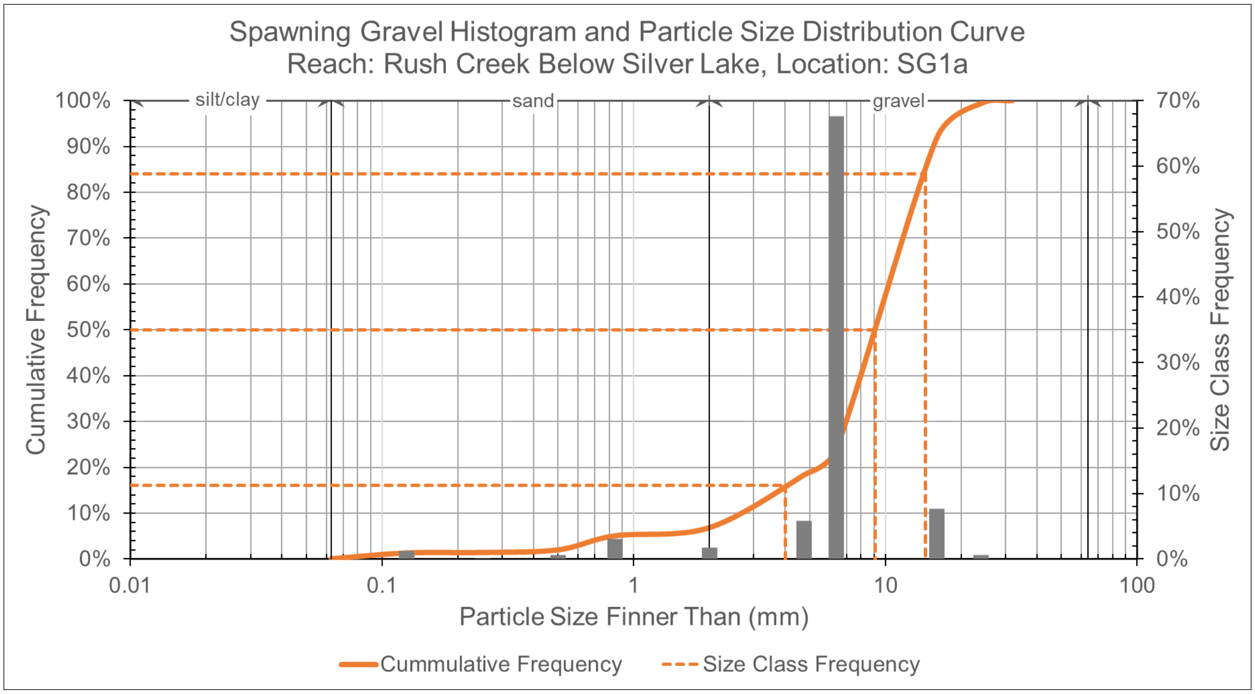

Figure E-17. Rush Creek below Silver Lake Spawning Gravel Sample SG1a: Histogram and Particle Size Distribution Curve

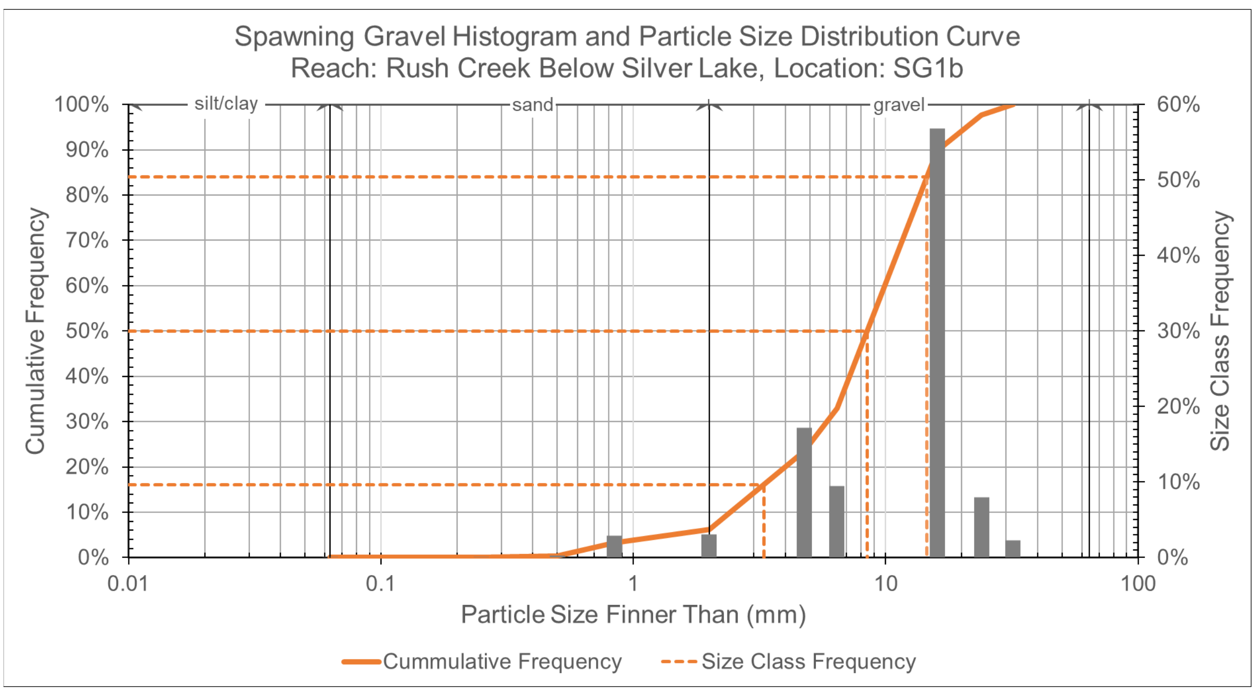

Figure E-18. Rush Creek below Silver Lake Spawning Gravel Sample SG1b: Histogram and Particle Size Distribution Curve

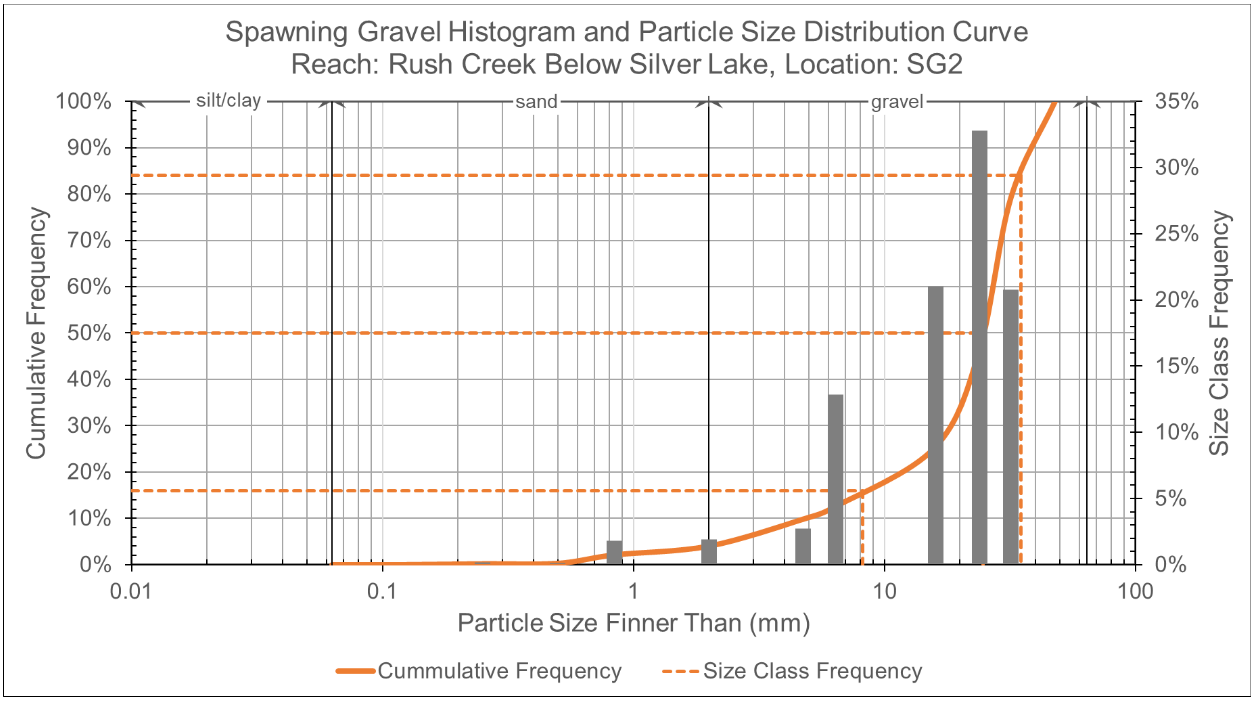

Figure E-19. Rush Creek below Silver Lake Spawning Gravel Sample SG2: Histogram and Particle Size Distribution Curve

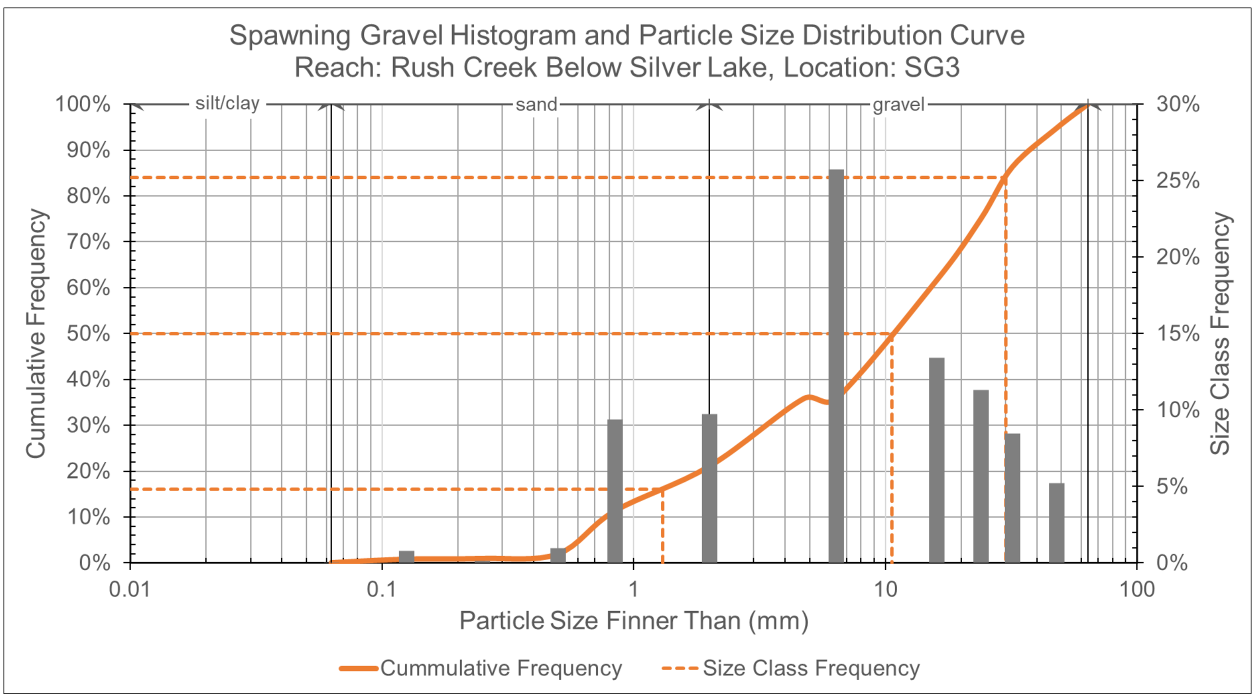

Figure E-20. Rush Creek below Silver Lake Spawning Gravel Sample SG3: Histogram and Particle Size Distribution Curve

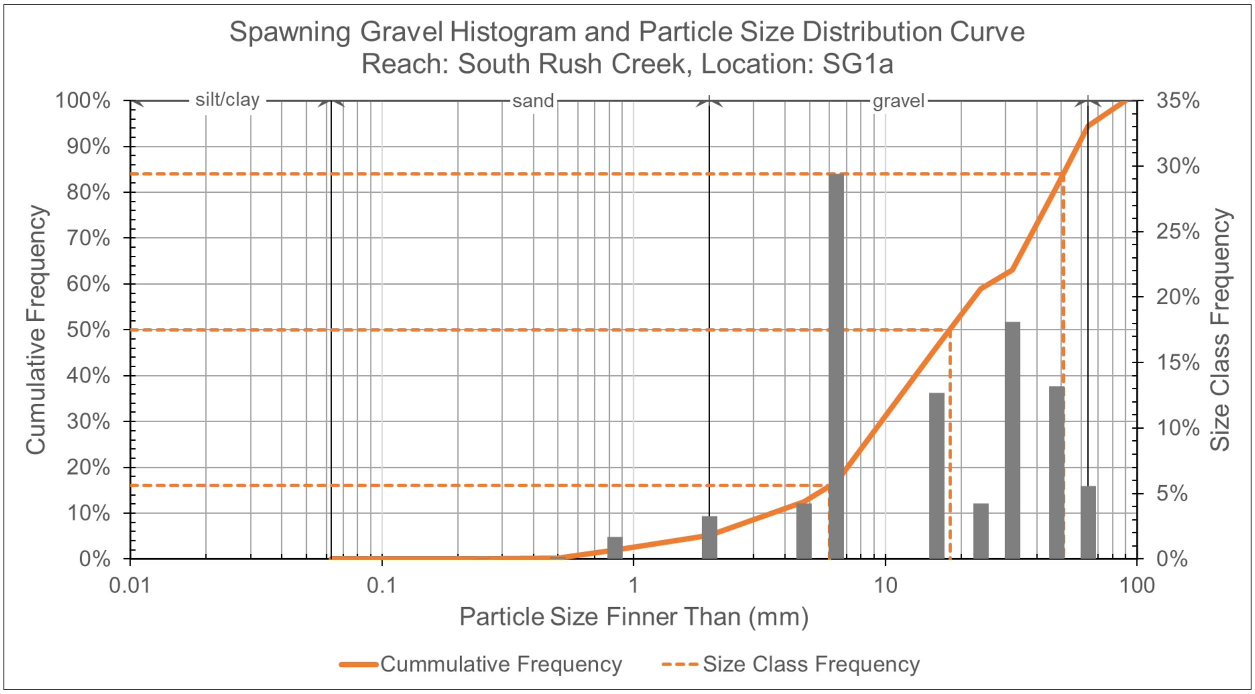

Figure E-21. South Rush Creek Spawning Gravel Sample SG1a: Histogram and Particle Size Distribution Curve

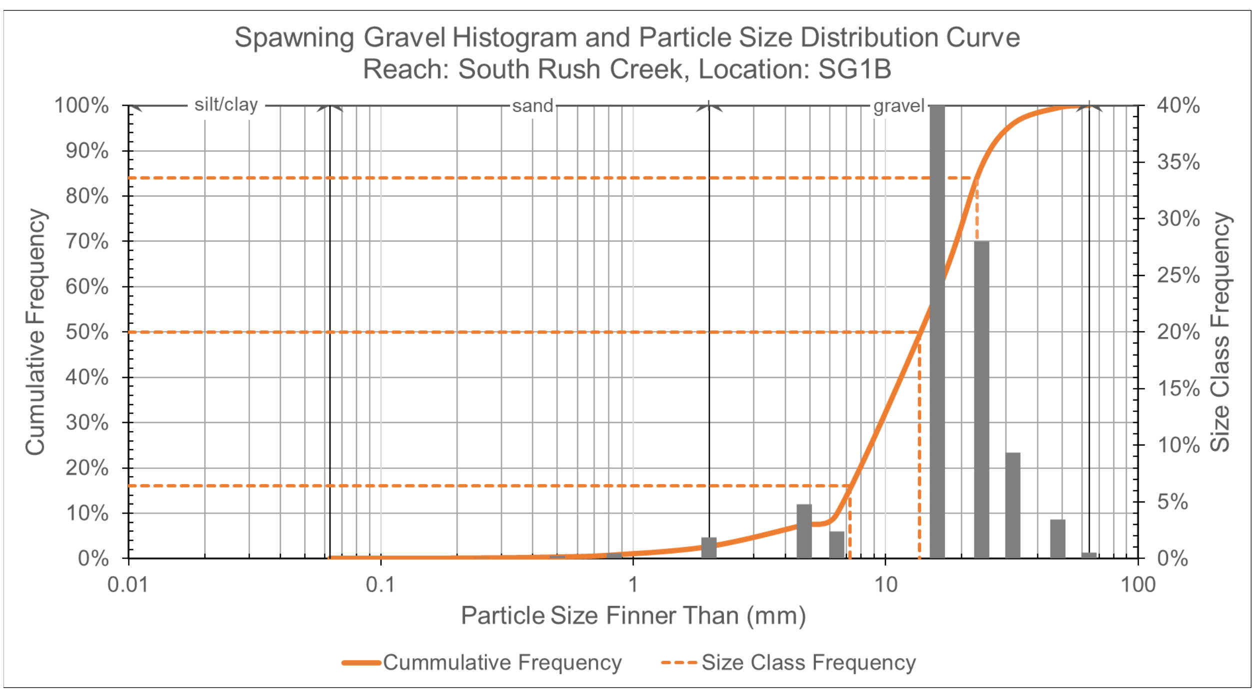

Figure E-22. South Rush Creek Spawning Gravel Sample SG1b: Histogram and Particle Size Distribution Curve

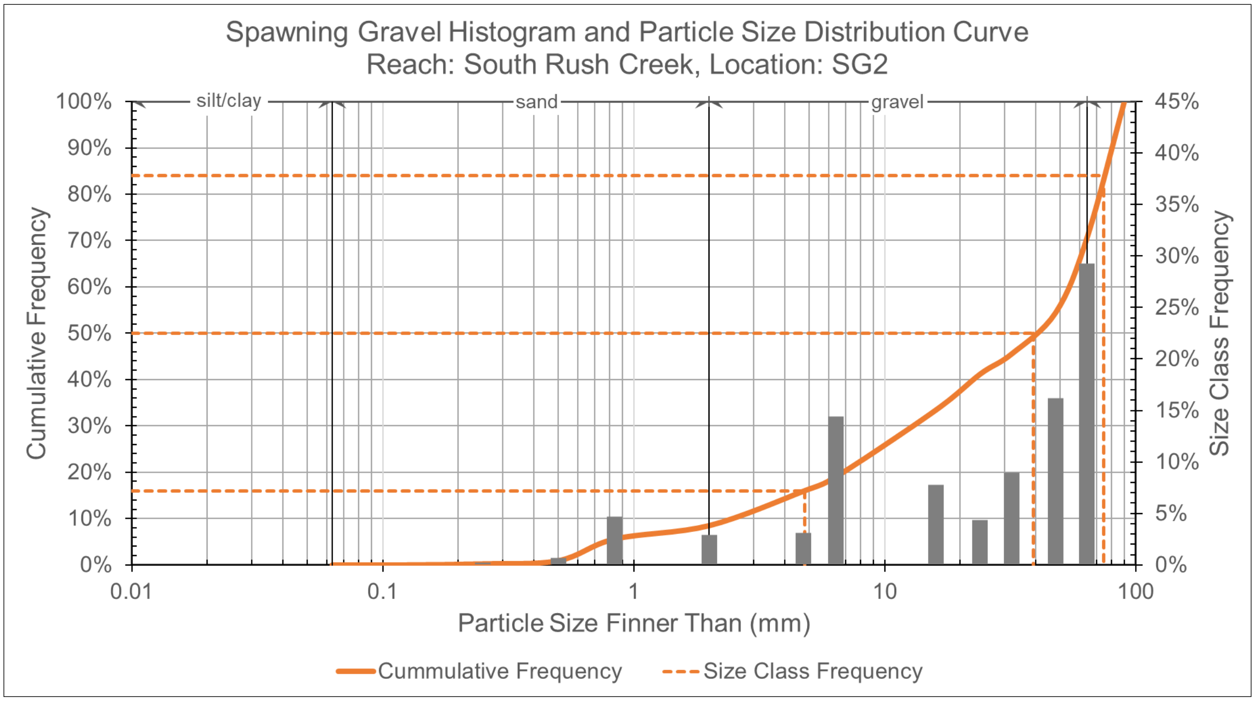

Figure E-23. South Rush Creek Spawning Gravel Sample SG2: Histogram and Particle Size Distribution Curve

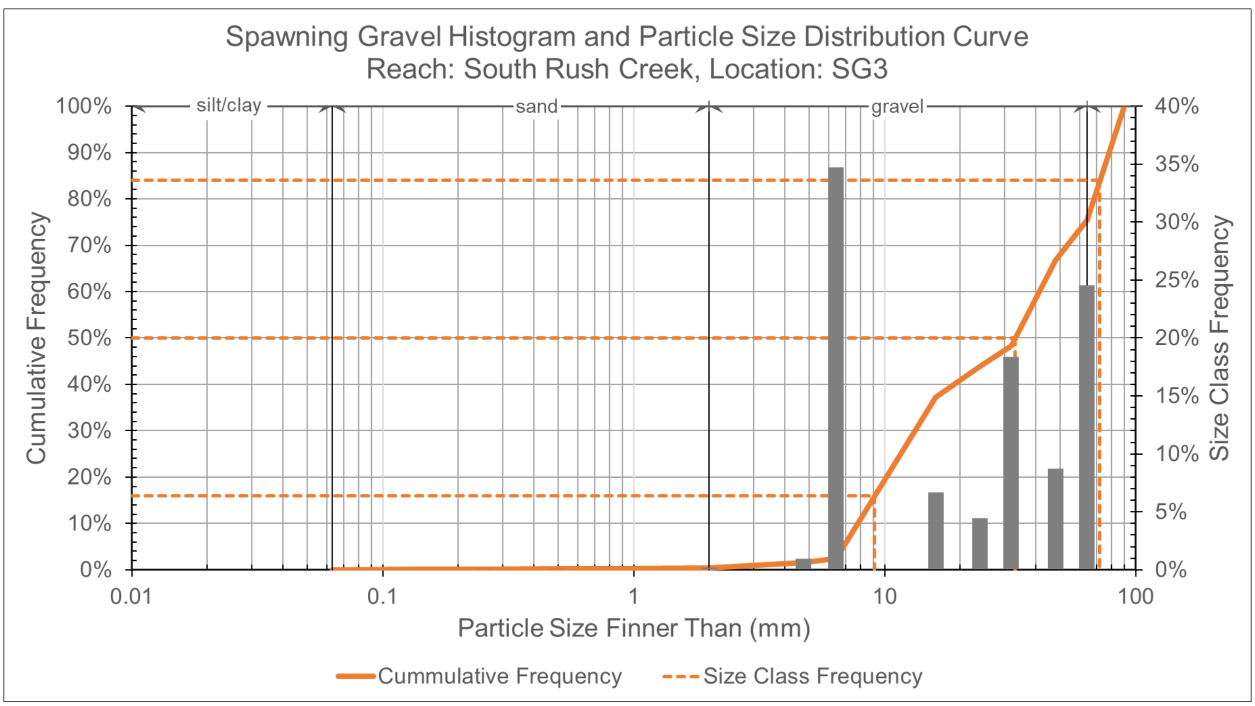

Figure E-24. South Rush Creek Spawning Gravel Sample SG3: Histogram and Particle Size Distribution Curve

Photo E-1. Rush Creek Above Waugh Lake SG1 Sample Site

Photo E-2. Rush Creek Above Waugh Lake SG2 and SG2 Replicate Sample Site

Photo E-3. Rush Creek Above Waugh Lake SG3 Sample Site

Photo E-4. Rush Creek below Agnew Dam SG1a Sample Site

Photo E-5. Rush Creek below Agnew Dam SG1a Sample

Photo E-6. Rush Creek below Agnew Dam SG1b Sample Site

Photo E-7. Rush Creek below Agnew Dam SG1b Sample

Photo E-8. Rush Creek below Agnew Dam SG2 Sample Site

Photo E-9. Rush Creek below Agnew Dam SG2 Sample

Photo E-10. Rush Creek below Agnew Dam SG3 Sample Site

Photo E-11. Rush Creek below Agnew Dam SG3 Sample

Photo E-12. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG1a Sample Site

Photo E-13. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG1a Sample

Photo E-14. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG1b Sample Site

Photo E-15. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG1b Sample

Photo E-16. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG2 Sample Site

Photo E-17. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG2 Sample

Photo E-18. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG3 Sample Site

Photo E-19. Rush Creek Above Silver Lake (Upstream of Reversed Confluence) SG3 Sample

Photo E-20. Rush Creek below Silver Lake SG1a and SG1b Sample Site

Photo E-21. Rush Creek below Silver Lake SG1a and SG1b Sample

Photo E-22. Rush Creek below Silver Lake SG2 Sample Site

Photo E-23. Rush Creek below Silver Lake SG2 Sample

Photo E-24. Rush Creek below Silver Lake SG3 Sample Site

Photo E-25. Rush Creek below Silver Lake SG3 Sample

Photo E-26. South Rush Creek SG1a Sample Site

Photo E-27. South Rush Creek SG1a Sample

Photo E-28. South Rush Creek SG1b Sample Site

Photo E-29. South Rush Creek SG1b Sample

Photo E-30. South Rush Creek SG2 Sample Site

Photo E-31. South Rush Creek SG2 Sample

Photo E-32. South Rush Creek SG3 Sample Site

Photo E-33. South Rush Creek SG3 Sample

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APPENDIX F

Streambed Sediment Core Sampling Histogram and Particle-Size Distribution Curves with Site Photographs

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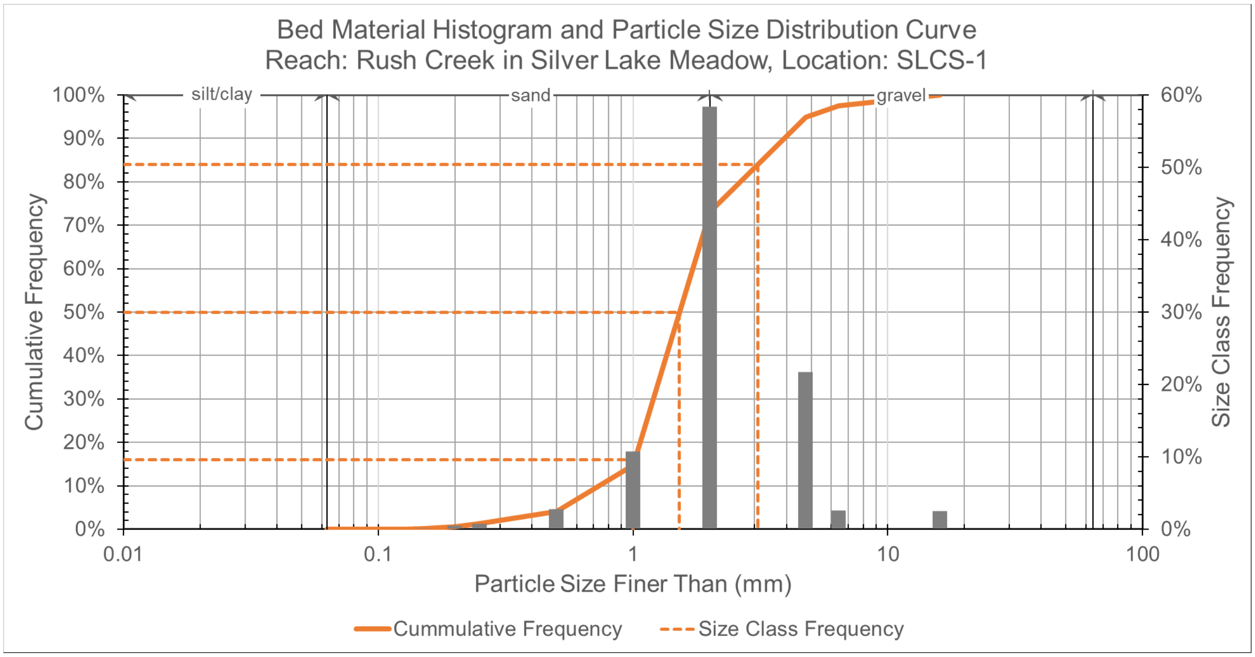

Figure F-1. SLCS-1 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-1. SLCS-1 Sample Site (Looking Downstream), Streambed, and Sediment Core

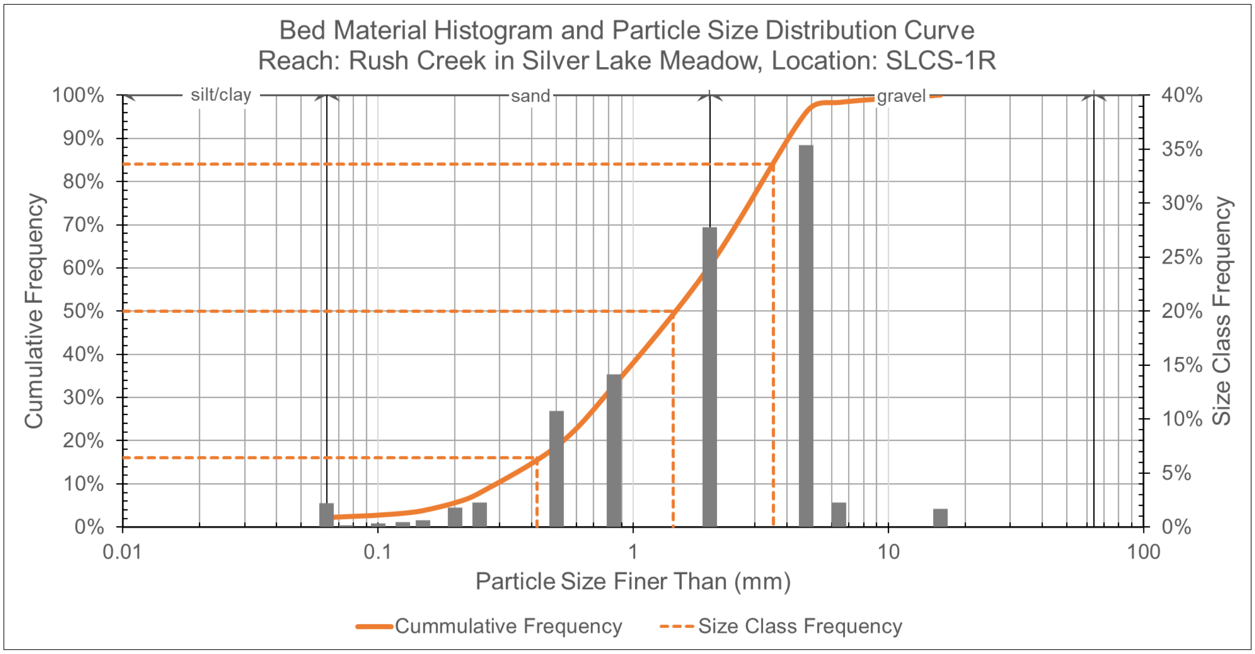

Figure F-2. SLCS-1R Replicate Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow (Site Adjacent to SLCS-1)

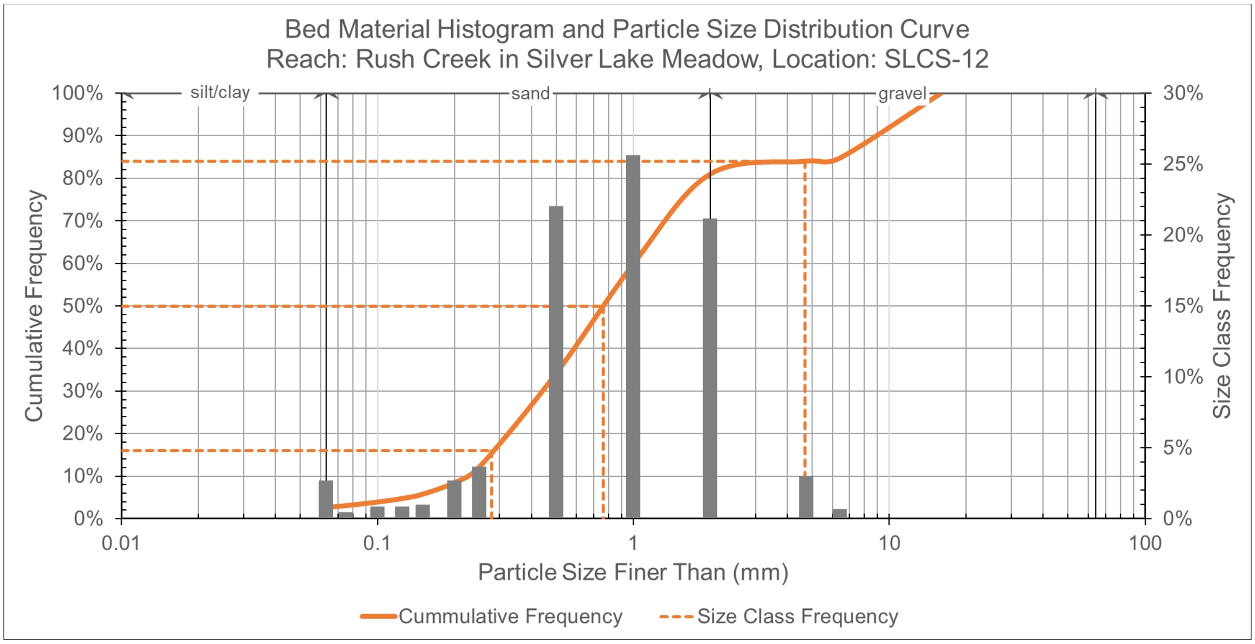

Figure F-3. SLCS-12 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-3. SLCS-12 Sample Site (Looking Downstream and Towards the Left Bank) and Sediment Core

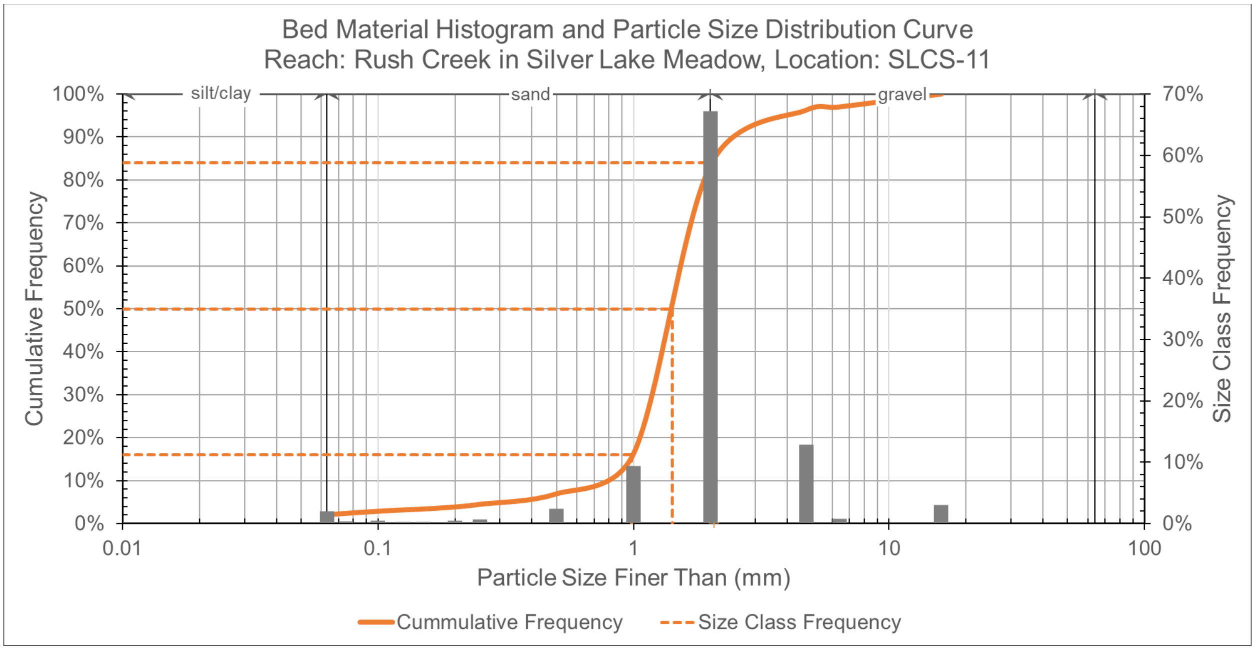

Figure F-4. SLCS-11 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-4. SLCS-11 Sample Site (Looking to the Right Bank), Streambed, and Sediment Core

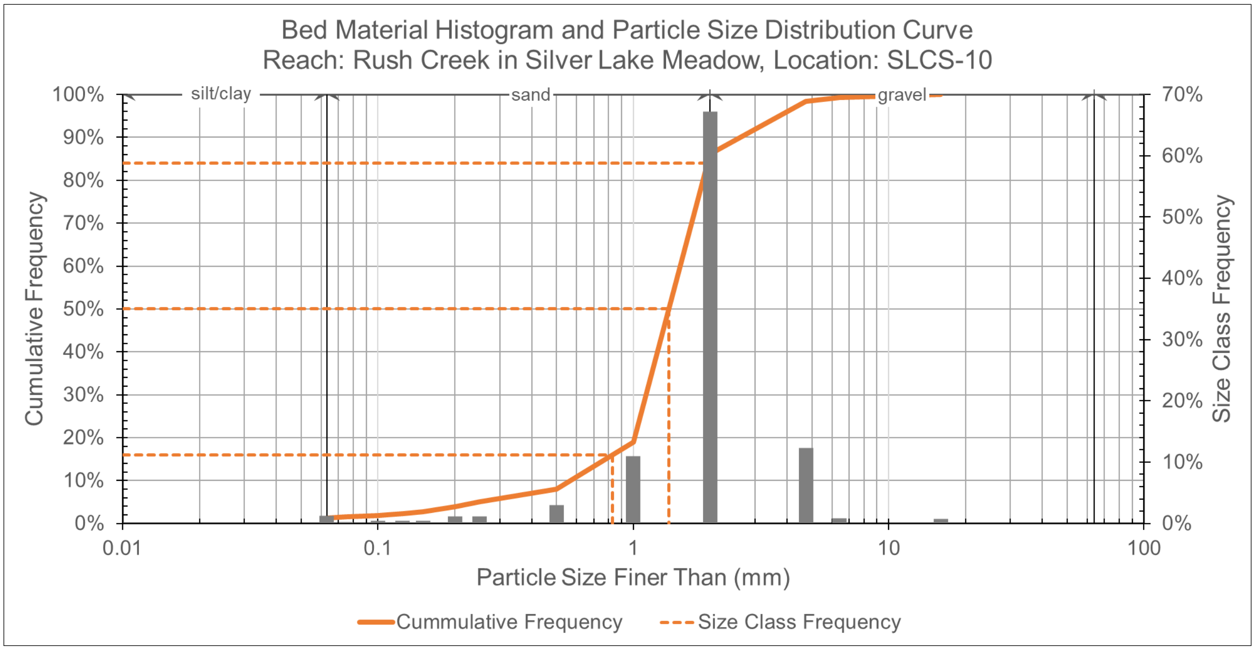

Figure F-5. SLCS-10 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-5. SLCS-10 Sample Site (Looking Upstream), Streambed, and Sediment Core

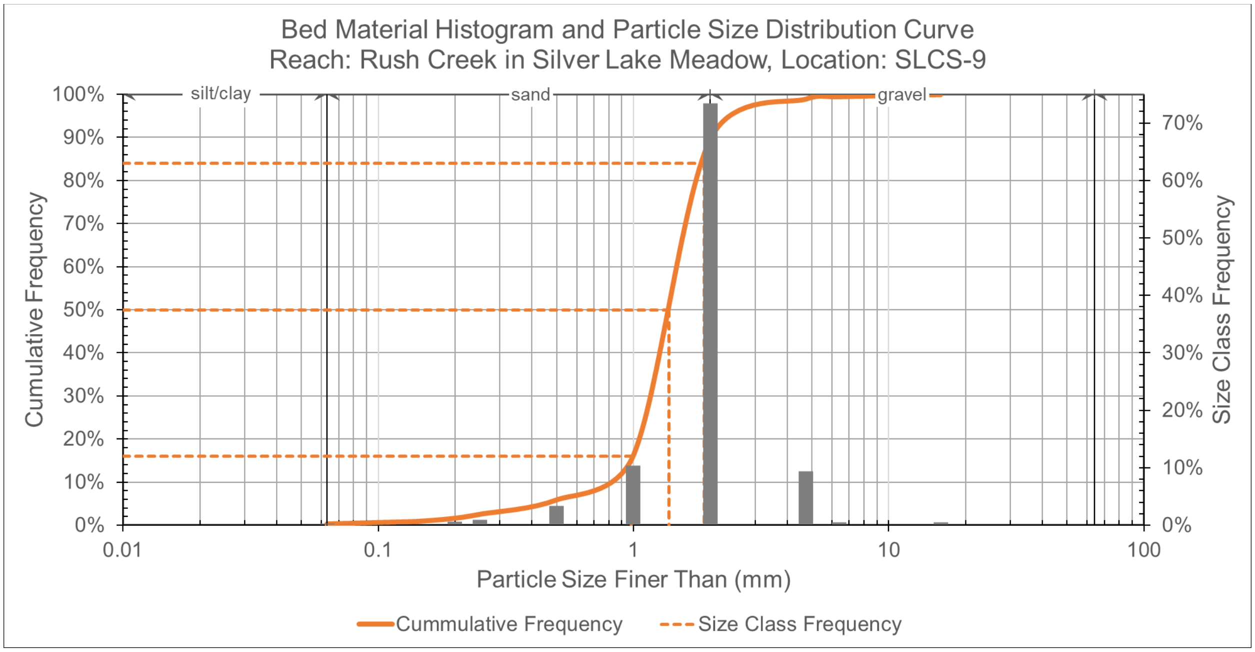

Figure F-6. SLCS-9 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-6. SLCS-9 Sample Site (Looking at the Left Bank), Streambed, and Sediment Core

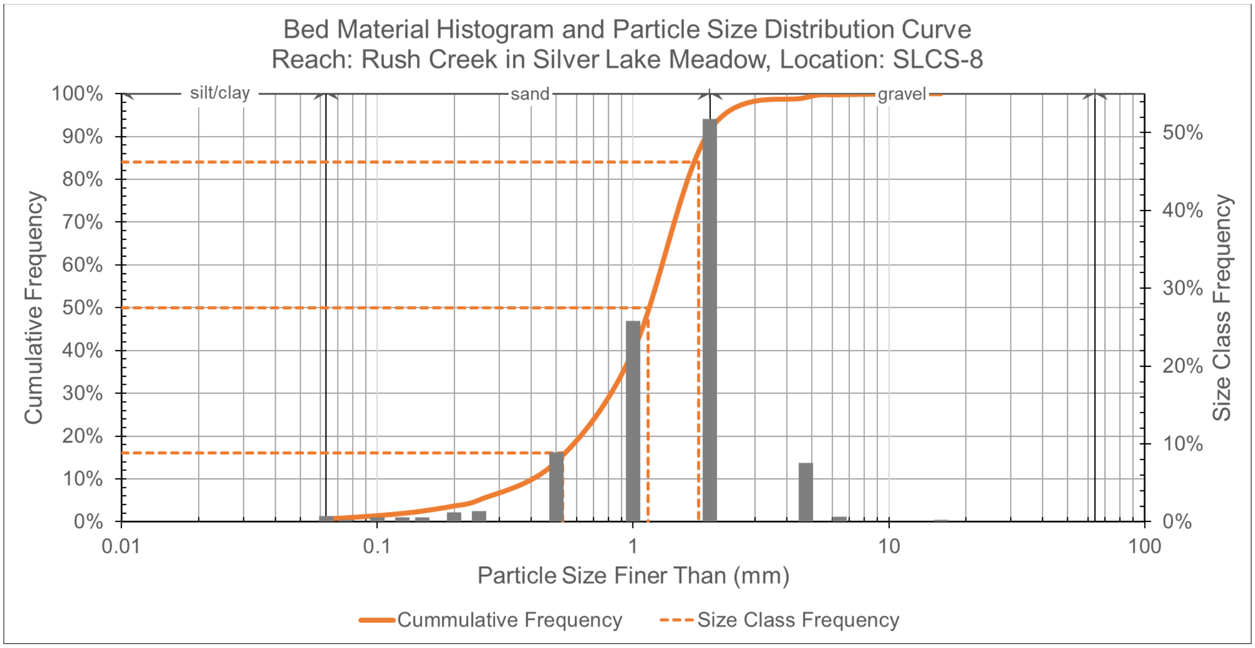

Figure F-7. SLCS-8 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

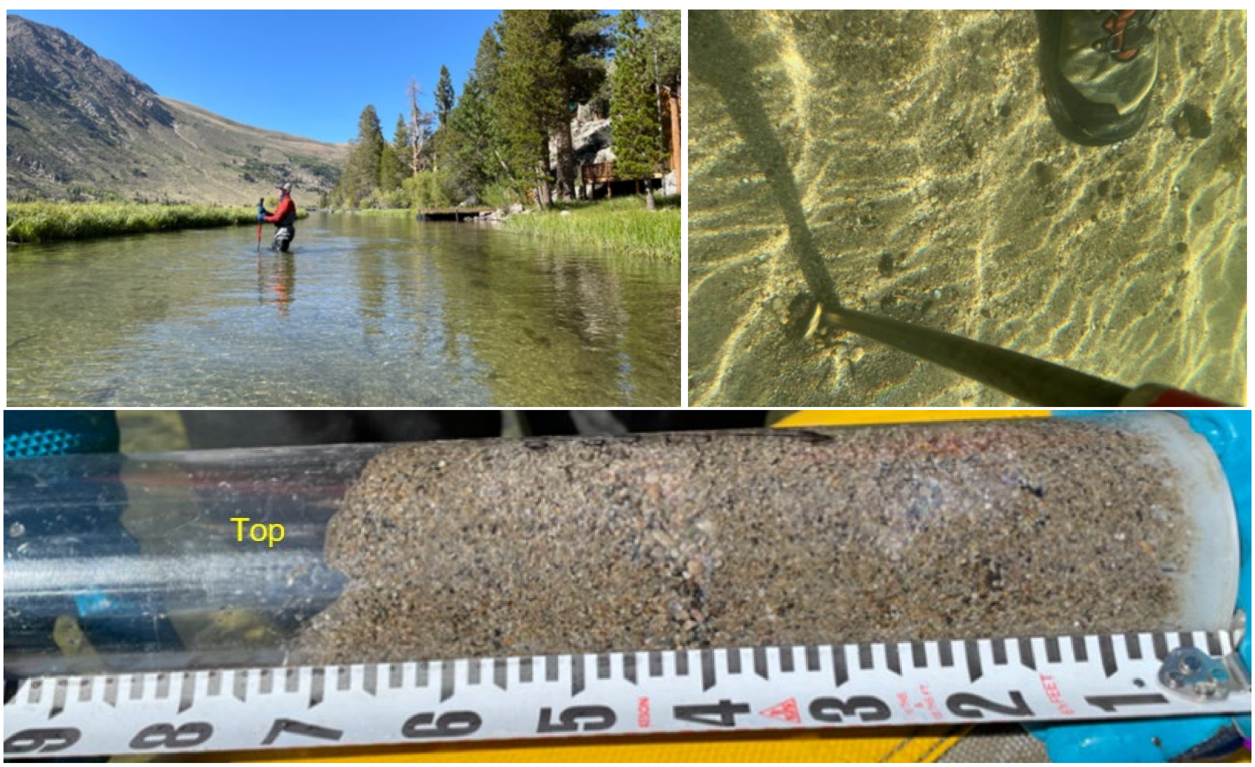

Photo F-7. SLCS-8 Sample Site (Looking Downstream), Streambed, and Sediment Core

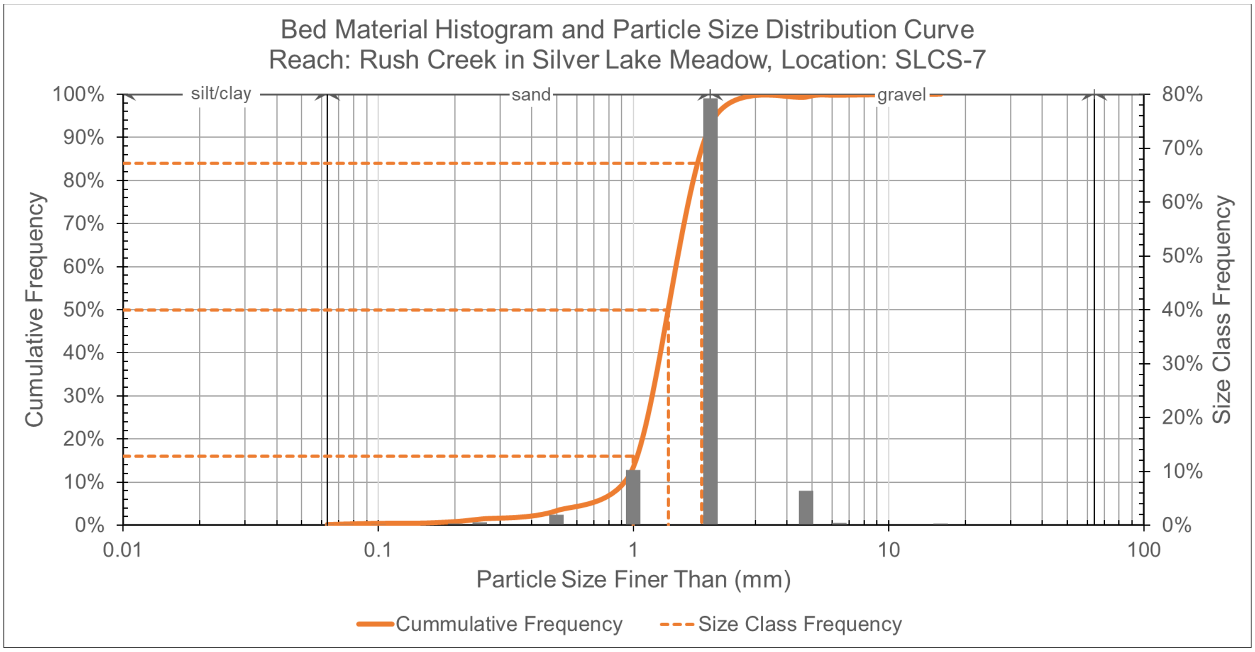

Figure F-8. SLCS-7 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek in Silver Lake Meadow

Photo F-8. SLCS-7 Sample Site (Looking Upstream), Streambed, and Sediment Core

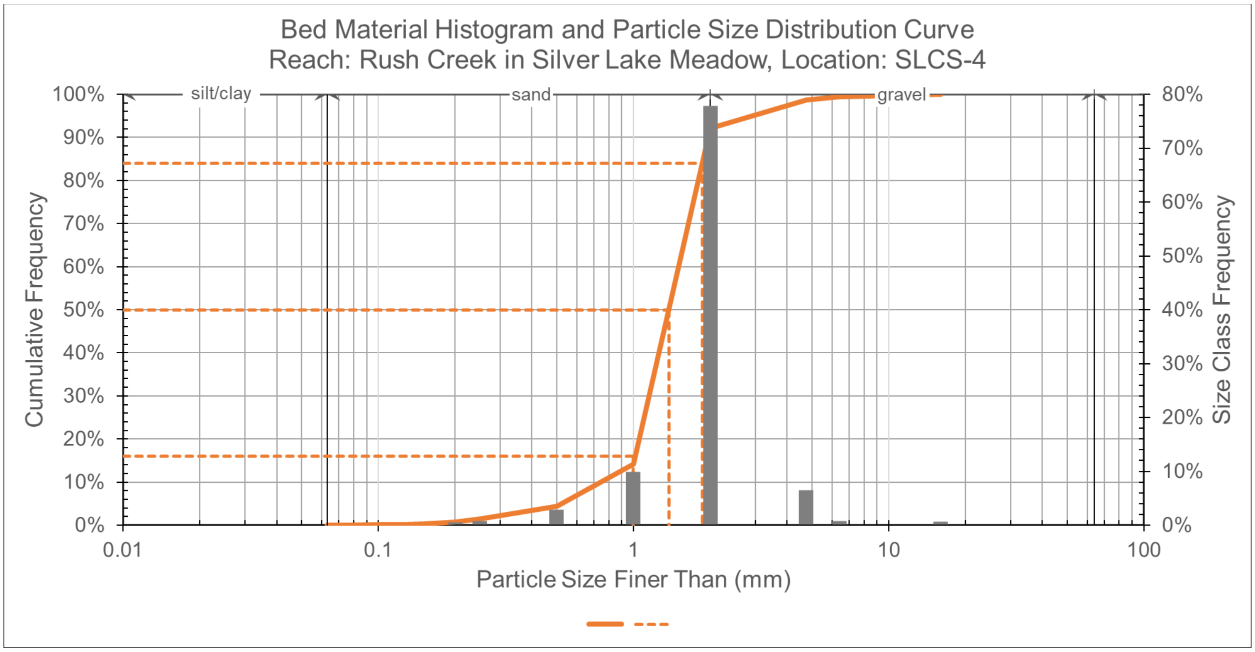

Figure F-9. SLCS-4 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek Delta Inlet to Silver Lake

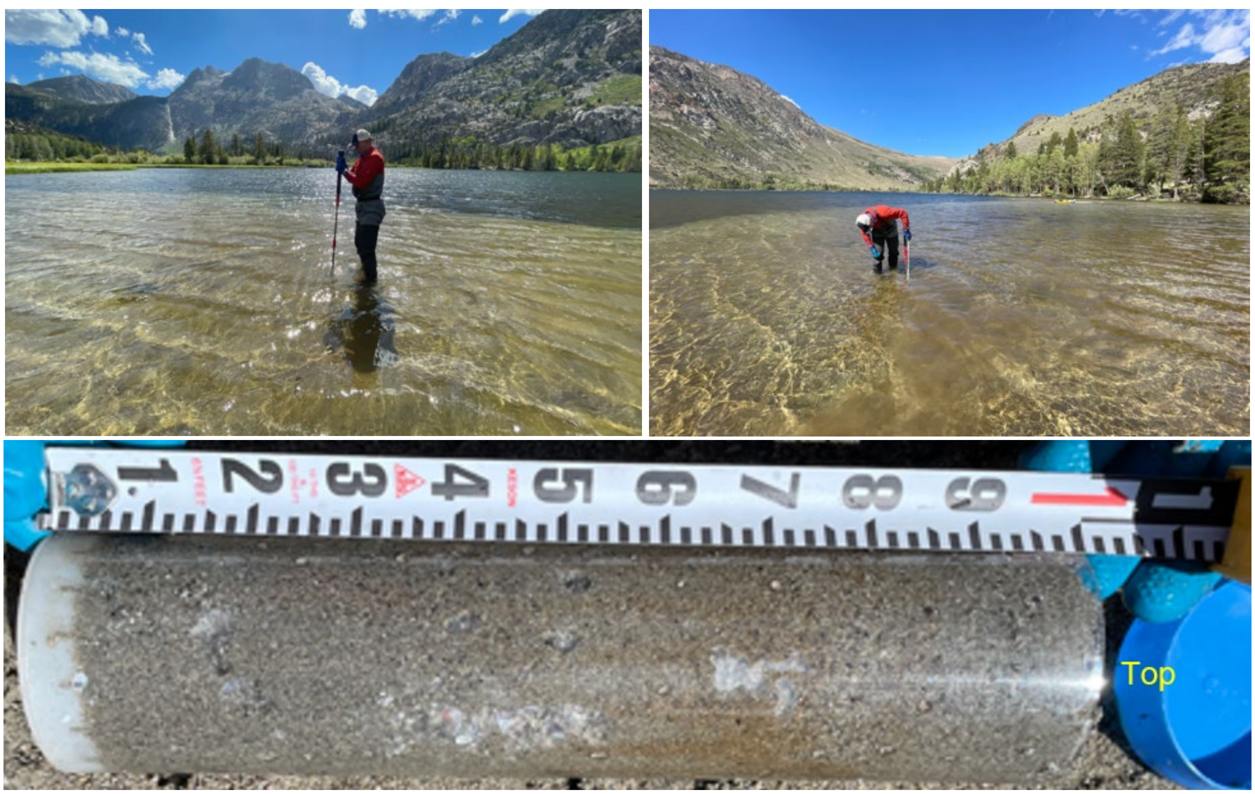

Photo F-9. SLCS-4 Delta Sample Site Looking South (Left Photo) and North (Right Photo) and Sediment Core

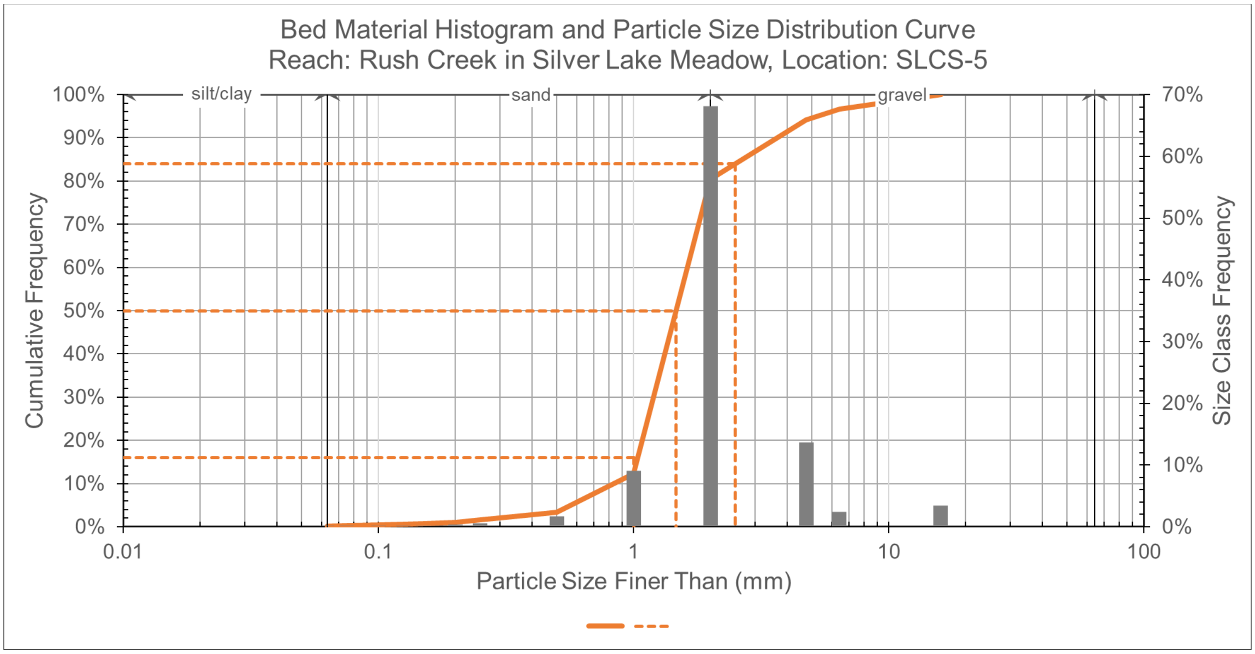

Figure F-10. SLCS-5 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek Delta Inlet to Silver Lake

Photo F-10. SLCS-5 Delta Sample Site Looking East (Left Photo) and South (Right Photo) and Sediment Core

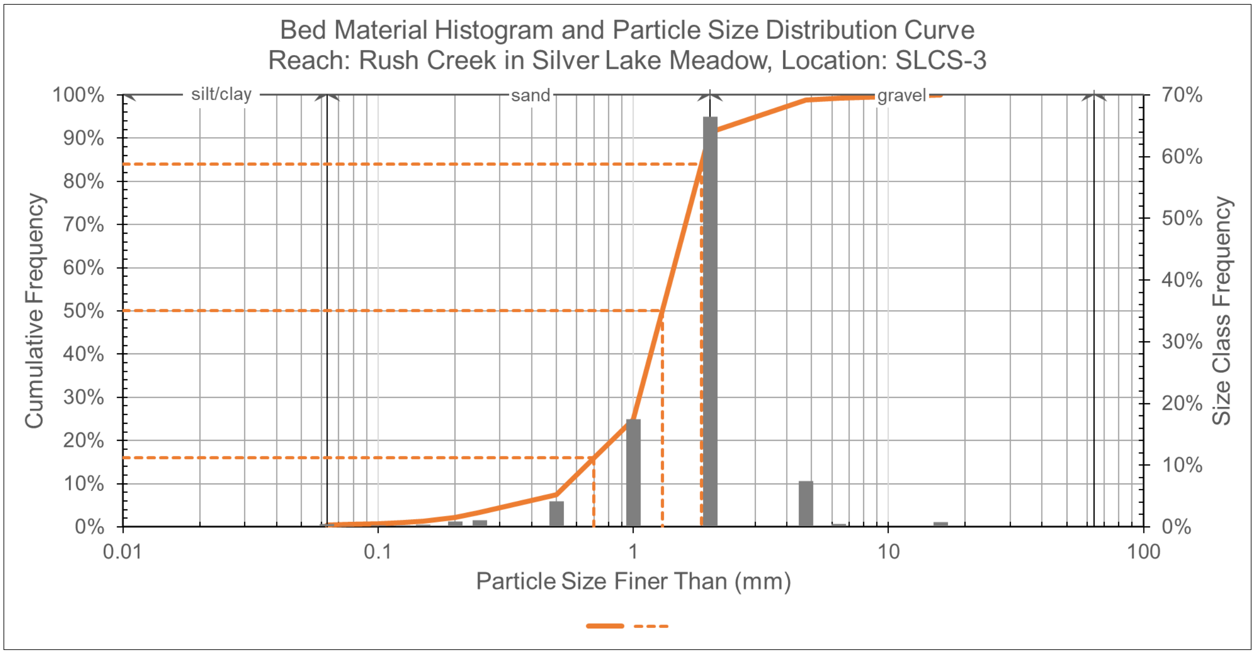

Figure F-11. SLCS-3 Bed Core Sample Histogram and Particle Size Distribution Curve for Rush Creek Delta Inlet to Silver Lake

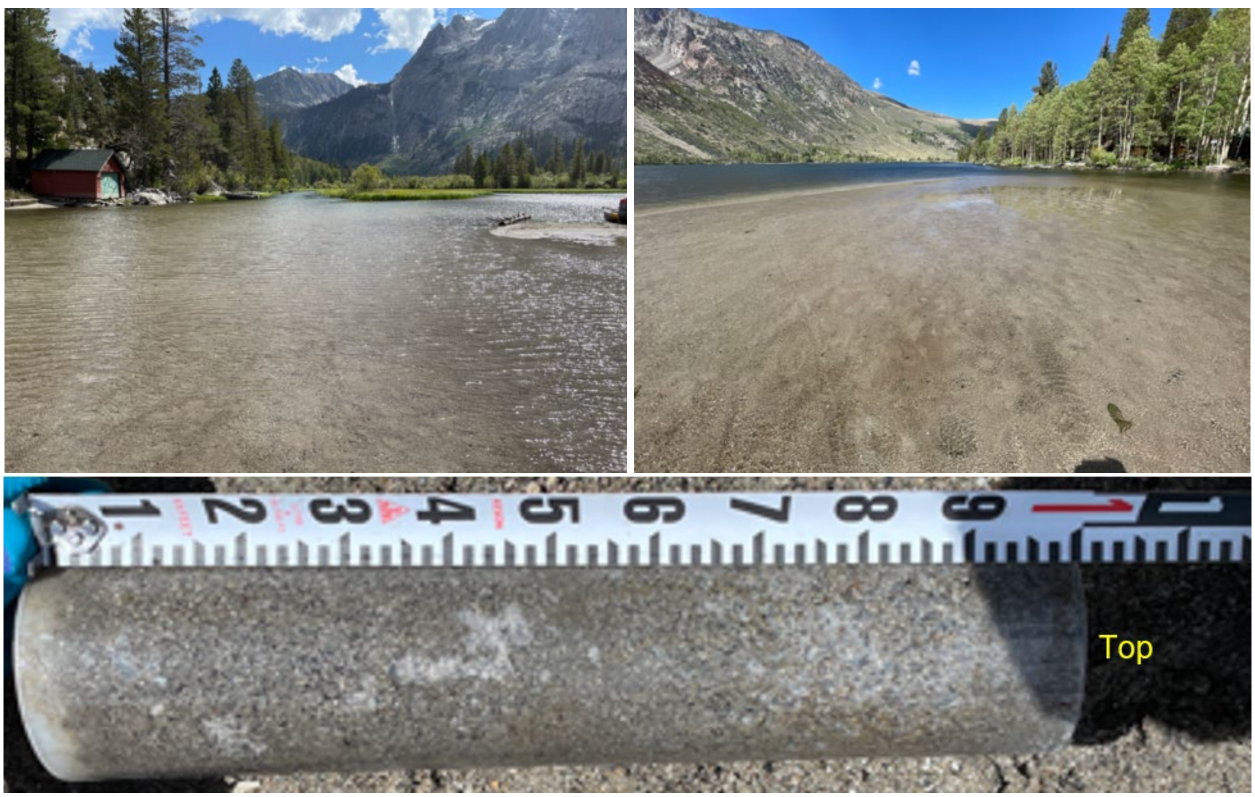

Photo F-11. SLCS-3 Delta Sample Site Looking South (Left Photo) and North (Right Photo) and Sediment Core

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APPENDIX G

Details of Sediment Recruitment from Mass-Wasting in the Rush Creek Watershed

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Table G-1. Details of Mass-Wasting Sites in the Waugh Lake Basin

Drainage Basin	Mass wasting ploygon ID	Polygon area (acres)	Subwatershed	Direct contact with creek (Y/N)	Direct contact with lake (Y/N)	Direct sediment delivery to waterways	Lithology	Lithology abbreviations
Waugh Lake	Waugh_MW_1	42.40	Marie Lakes	N	Y	**Y**	V, MV	G = granitic
Waugh Lake	Waugh_MW_2	44.00	Marie Lakes	N	Y	**Y**	V, MV, G	MV = metavolcanic
Waugh Lake	Waugh_MW_3	9.81	Marie Lakes	N	N		V, MV	MS = metasedimentary
Waugh Lake	Waugh_MW_4	29.90	Marie Lakes	N	Y	**Y**	V, MV	V = volcanic
Waugh Lake	Waugh_MW_5	15.00	Marie Lakes	N	Y	**Y**	V, MV	Ma = marine (limestone)
Waugh Lake	Waugh_MW_6	34.60	Marie Lakes	N	N		V, MV	S = sedimentary
Waugh Lake	Waugh_MW_7	96.7	Marie Lakes	N	Y	**Y**	V, MV	VF = volcanic flow rocks
Waugh Lake	Waugh_MW_8	19	Marie Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_9	0.21	Marie Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_10	0.47	Marie Lakes	N	Y	**Y**	G	
Waugh Lake	Waugh_MW_11	1.62	Marie Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_12	1.3	Marie Lakes	N	Y	**Y**	V, MV, G	
Waugh Lake	Waugh_MW_13	31.1	Marie Lakes	N	Y	**Y**	V, MV, G	
Waugh Lake	Waugh_MW_14	6.43	Marie Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_15	8.33	Marie Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_16	55.9	Marie Lakes	N	Y	**Y**	G	
Waugh Lake	Waugh_MW_17	4.3	Marie Lakes	N	Y	**Y**	V, MV, G	
Waugh Lake	Waugh_MW_18	42.4	Rush Creek	Y	N	**Y**	G	
Waugh Lake	Waugh_MW_19	4.59	Rodgers Lakes	Y	N	**Y**	G	
Waugh Lake	Waugh_MW_20	1.96	Rodgers Lakes	N	N		V, MV, G	
Waugh Lake	Waugh_MW_21	15	Rodgers Lakes	Y	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_22	16.4	Rodgers Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_23	25	Rodgers Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_24	36.7	Rodgers Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_25	119	Davis Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_26	2.72	Davis Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_27	1.86	Rodgers Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_28	0.94	Rodgers Lakes	N	N		V, MV	
Waugh Lake	Waugh_MW_29	3.12	Davis Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_30	85.4	Davis Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_31	18.9	Davis Lakes	N	Y	**Y**	V, MV	
Waugh Lake	Waugh_MW_32	7.46	Waugh Lake	N	N		V, MV, Ma	
Waugh Lake	Waugh_MW_33	1.32	Waugh Lake	N	Y	**Y**	Ma, G	
Waugh Lake	Waugh_MW_34	21.4	Rush Creek	Y	N	**Y**	G	
Waugh Lake	Waugh_MW_35	5.87	Rush Creek	N	N		G	
Waugh Lake	Waugh_MW_36	7.51	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_37	3.27	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_38	76	Unnamed trib	N	Y	**Y**	G	
Waugh Lake	Waugh_MW_39	50.5	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_40	11	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_41	23.5	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_42	44	Unnamed trib	N	N		G	
Waugh Lake	Waugh_MW_43	86.4	Unnamed trib	N	Y	**Y**	G	
Waugh Lake	Waugh_MW_44	203	Unnamed trib	N	N		MV, G	
Waugh Lake	Waugh_MW_45	98.5	Unnamed trib	Y	N	**Y**	MV	
Waugh Lake	Waugh_MW_46	5.67	Unnamed trib	N	N		G	

Table G-2. Details of Mass-Wasting Sites in the Gem Lake Basin

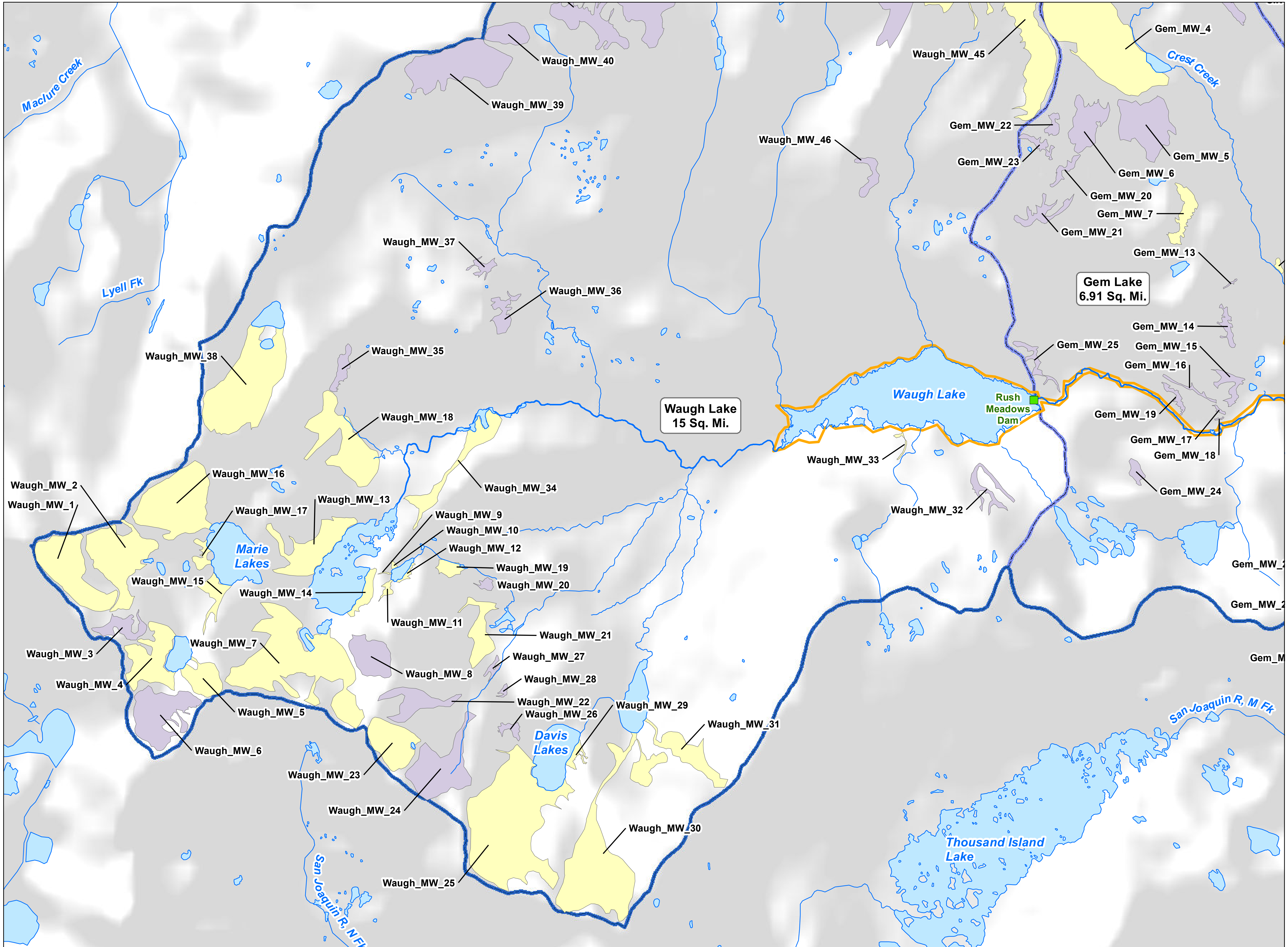
Drainage Basin	Mass wasting ploygon ID	Polygon area (acres)	Subwatershed	Direct contact with creek (Y/N)	Direct contact with lake (Y/N)	Direct sediment delivery to waterways	Lithology	Lithology abbreviations
Gem Lake	Gem_MW_1	15.9	Crest Creek	N	N		MV	G = granitic
Gem Lake	Gem_MW_2	62.4	Crest Creek	N	N		MV	MV = metavolcanic
Gem Lake	Gem_MW_3	75.5	Crest Creek	N	Y	**Y**	MV	MS = metasedimentary
Gem Lake	Gem_MW_4	122.0	Crest Creek	Y	Y	**Y**	MV	V = volcanic
Gem Lake	Gem_MW_5	33.9	Crest Creek	N	N		MV	Ma = marine (limestone)
Gem Lake	Gem_MW_6	18.9	Crest Creek	N	N		MV	S = sedimentary
Gem Lake	Gem_MW_7	10.0	unnamed trib	Y	N	**Y**	MV, G	VF = volcanic flow rocks
Gem Lake	Gem_MW_8	3.9	Crest Creek	N	N		MV	
Gem Lake	Gem_MW_9	5.7	Crest Creek	N	N		MV	
Gem Lake	Gem_MW_10	13.0	Crest Creek	N	N		MV	
Gem Lake	Gem_MW_11	2.5	Crest Creek	N	N		MV, S, Ma	
Gem Lake	Gem_MW_12	6.2	Crest Creek	N	N		MV	
Gem Lake	Gem_MW_13	0.4	Crest Creek	N	N		MV	
Gem Lake	Gem_MW_14	3.9	Rush Creek	N	N		MV, G	
Gem Lake	Gem_MW_15	5.7	Rush Creek	N	N		G	
Gem Lake	Gem_MW_16	1.9	Rush Creek	N	N		G	
Gem Lake	Gem_MW_17	0.5	Rush Creek	N	N		G	
Gem Lake	Gem_MW_18	0.2	Rush Creek	N	N		G	
Gem Lake	Gem_MW_19	2.5	Rush Creek	N	N		G	
Gem Lake	Gem_MW_20	3.2	Rush Creek	N	N		MV, G	
Gem Lake	Gem_MW_21	7.9	Rush Creek	N	N		G	
Gem Lake	Gem_MW_22	2.9	Rush Creek	N	N		MV, G	
Gem Lake	Gem_MW_23	3.4	Rush Creek	N	N		G	
Gem Lake	Gem_MW_24	3.4	Rush Creek	N	N		G, V, MV	
Gem Lake	Gem_MW_25	4.7	Rush Creek	N	N		Ma, G	
Gem Lake	Gem_MW_26	6.0	unnamed trib	N	N		V, MV	
Gem Lake	Gem_MW_27	2.9	unnamed trib	N	N		V, MV	
Gem Lake	Gem_MW_28	3.0	unnamed trib	N	N		V, MV	
Gem Lake	Gem_MW_29	1.6	Clark Lakes	N	Y	**Y**	V, MV, VF	
Gem Lake	Gem_MW_30	2.3	Clark Lakes	N	Y	**Y**	VF	
Gem Lake	Gem_MW_31	3.1	unnamed trib	Y	N	**Y**	V, MV	
Gem Lake	Gem_MW_32	3.4	unnamed trib	N	N		V, MV	
Gem Lake	Gem_MW_33	17.2	unnamed trib	Y	Y	**Y**	V, MV	
Gem Lake	Gem_MW_34	1.1	unnamed trib	Y	Y	**Y**	V, MV	
Gem Lake	Gem_MW_35	0.6	Gem Lake	N	N		Ma	
Gem Lake	Gem_MW_36	1.6	Gem Lake	N	Y	**Y**	MV	
Gem Lake	Gem_MW_37	1.0	Crest Creek	Y	N	**Y**	MV	
Gem Lake	Gem_MW_38	1.9	Gem Lake	N	Y	**Y**	MV	
Gem Lake	Gem_MW_39	0.4	Gem Lake	N	Y	**Y**	MV	
Gem Lake	Gem_MW_40	2.3	Gem Lake	N	N		Ma	
Gem Lake	Gem_MW_41	3.7	Clark Lakes	N	N		VF	
Gem Lake	Gem_MW_42	7.2	Clark Lakes	N	N		VF	

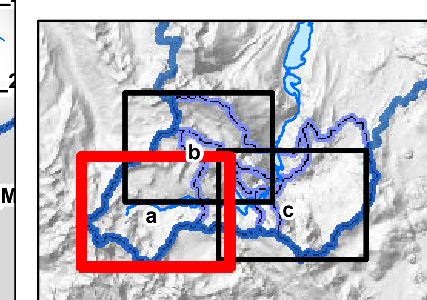
Table G-3. Details of Mass-Wasting Sites in the Agnew Lake Basin

Drainage Basin	Mass wasting ploygon ID	Polygon area (acres)	Subwatershed	Direct contact with creek (Y/N)	Direct contact with lake (Y/N)	Direct sediment delivery to waterways	Lithology	Lithology abbreviations
Agnew Lake	Agnew_MW_1	85.00	Rush Creek	Y	Y	**Y**	VF, G, Ma	G = granitic
Agnew Lake	Agnew_MW_2	29.30	Rush Creek	Y	N	**Y**	G	MV = metavolcanic
Agnew Lake	Agnew_MW_3	77.60	Rush Creek	Y	N	**Y**	Ma, G	MS = metasedimentary
Agnew Lake	Agnew_MW_4	61.00	Rush Creek	N	Y	**Y**	Ma, G	V = volcanic
Agnew Lake	Agnew_MW_5	4.00	Rush Creek	N	N		G	Ma = marine (limestone)
Agnew Lake	Agnew_MW_6	1.84	Rush Creek	N	N		Ma	S = sedimentary
Agnew Lake	Agnew_MW_7	7.86	Rush Creek	N	Y	**Y**	Ma	VF = volcanic flow rocks
Agnew Lake	Agnew_MW_8	24.3	Rush Creek	N	Y	**Y**	Ma	

Table G-4. Details of Mass-Wasting Sites in the Below Agnew Lake, Silver Lake and June Lake Basins

Drainage Basin	Mass wasting ploygon ID	Polygon area (acres)	Subwatershed	Direct contact with creek (Y/N)	Direct contact with lake (Y/N)	New ID	Direct sediment delivery to waterways with unimpeded connection to Silver Lake	Lithology	Lithology abbreviations
Alger Lakes	Alger_MW_1	4.4	Alger Lakes	N	Y		**Y**	Ma	G = granitic
Alger Lakes	Alger_MW_2	4.8	Alger Lakes	N	N			Ma	MV = metavolcanic
Alger Lakes	Alger_MW_3	6.4	Alger Lakes	N	N			MV	MS = metasedimentary
Alger Lakes	Alger_MW_4	25.4	Alger Lakes	N	Y		**Y**	MV	V = volcanic
Alger Lakes	Alger_MW_5	31.0	Alger Lakes	N	N			MV	Ma = marine (limestone)
Alger Lakes	Alger_MW_6	49.2	Alger Lakes	N	N			MV	S = sedimentary
Alger Lakes	Alger_MW_7	54.5	Alger Lakes	Y	Y		**Y**	MV	VF = volcanic flow rocks
Alger Lakes	Alger_MW_8	80.9	Alger Lakes	N	Y		**Y**	MV	GD = glacial deposits
Alger Lakes	Alger_MW_9	40.0	Alger Lakes	N	Y		**Y**	MV	
Alger Lakes	Alger_MW_10	100.0	Alger Lakes	N	Y		**Y**	MV	
Silver Lake	Silver_MW_1	156.0	Alger Creek	Y	N		**Y**	Ma, G	
Silver Lake	Silver_MW_2	53.5	Alger Creek	Y	N		**Y**	Ma, G	
Silver Lake	Silver_MW_3	21.8	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_4	14.8	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_5	6.2	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_6	1.4	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_7	2.9	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_8	1.0	Alger Creek	Y	N		**Y**	Ma	
Silver Lake	Silver_MW_9	742.0	Alger Creek	N	N			Ma	
Silver Lake	Silver_MW_10	18.5	Silver Lake	N	N			G	
June Lake	June_Lake_1	10.3	South Rush Creek	N	N	June_Lake_1		G	
June Lake	June_Lake_2	34.0	South Rush Creek	N	N	June_Lake_2		G	
June Lake	June_Lake_3	25.2	South Rush Creek	N	N	June_Lake_3		G	
June Lake	June_Lake_4	3.3	South Rush Creek	N	N	June_Lake_4		G	
June Lake	June_Lake_5	0.7	South Rush Creek	N	N	June_Lake_5		G	
June Lake	June_Lake_6	12.3	South Rush Creek	N	N	June_Lake_6		G	
Silver Lake	Silver_MW_17	1.2	Silver Lake	N	N			Ma	
Silver Lake	Silver_MW_18	0.3	Silver Lake	N	N			Ma	
Silver Lake	Silver_MW_19	0.3	Silver Lake	N	N			Ma	
Silver Lake	Silver_MW_20	0.1	Silver Lake	N	N			Ma	
Silver Lake	Silver_MW_21	3.0	Silver Lake	N	N			Ma	
Silver Lake	Silver_MW_22	121.0	Silver Lake	N	N			Ma, G	
Silver Lake	Silver_MW_23	7.3	Silver Lake	N	N			G	
Below Agnew	Below_Agnew_1	3.3	Rush Creek	N	N	Below_Agnew_1		Ma	
Below Agnew	Below_Agnew_2	13.6	Rush Creek	N	Y	Below_Agnew_2	**Y**	Ma	
Below Agnew	Below_Agnew_3	0.9	Rush Creek	N	N	Below_Agnew_3		Ma	
Below Agnew	Below_Agnew_4	66.1	Unnamed trib	Y	Y	Below_Agnew_4	**Y**	Ma	
Below Agnew	Below_Agnew_5	14.8	Rush Creek	N	N	Below_Agnew_5		Ma, G	
Below Agnew	Below_Agnew_6	11.1	Rush Creek	Y	N	Below_Agnew_6	**Y**	Ma, G	
June Lake	June_Lake_7	139.0	Fern Creek	Y	N	June_Lake_7	**Y**	G	
June Lake	June_Lake_8	51.3	Fern Creek	Y	N	June_Lake_8	**Y**	G	
June Lake	June_Lake_9	18.8	Fern Creek	N	N	June_Lake_9		G	
June Lake	June_Lake_10	15.6	Fern Creek	Y	Y	June_Lake_10	**Y**	G	
June Lake	June_Lake_11	1.4	Fern Creek	N	N	June_Lake_11		G	
June Lake	June_Lake_12	1.3	Fern Creek	N	N	June_Lake_12		GD	
June Lake	June_Lake_13	1.4	Fern Creek	N	N	June_Lake_13		GD	
June Lake	June_Lake_14	5.4	Yost Creek	N	N	June_Lake_14		GD	
June Lake	June_Lake_15	2.3	Yost Creek	N	Y	June_Lake_15	**Y**	GD	
June Lake	June_Lake_16	31.7	Yost Creek	Y	N	June_Lake_16	**Y**	G, GD	
June Lake	June_Lake_17	36.9	Yost Creek	Y	N	June_Lake_17	**Y**	Ma, GD	
June Lake	June_Lake_18	76.5	Yost Creek	N	N	June_Lake_18	**Y**	Ma	
June Lake	June_Lake_19	62.1	Yost Creek	N	N	June_Lake_19	**Y**	Ma	
June Lake	June_Lake_20	31.8	Yost Creek	Y	N	June_Lake_20	**Y**	Ma	





SCE Facilities

- Dam
- Powerhouse

Other Features

- Highway
- FERC Boundary
- River/Stream
- Lake/Reservoir
- Drainage Basins
- Rush Creek Watershed Boundary

Mass Wasting Areas

Sediment Recruitment

- Hillslope Storage
- Direct Sediment Delivery to Waterways
- Direct Sediment Delivery to Waterways with Unimpeded Connection to Silver Lake

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Rush Creek Project (FERC 1389)

Map G-1

Sediment Recruitment from Mass Wasting in the Rush Creek Watershed

0 500 1,000 2,000 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 1/30/2024

Southern California Edison (SCE) has no reason to believe that there are any inaccuracies or defects with information incorporated in this work and make no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties tobe implied, with respect to the information or data, furnished herein. No part of this map may be reproduced ortransmitted in any form or by any means, electronic or mechanical, including photocopying and recording system, except as expressly permitted in writing by SCE.

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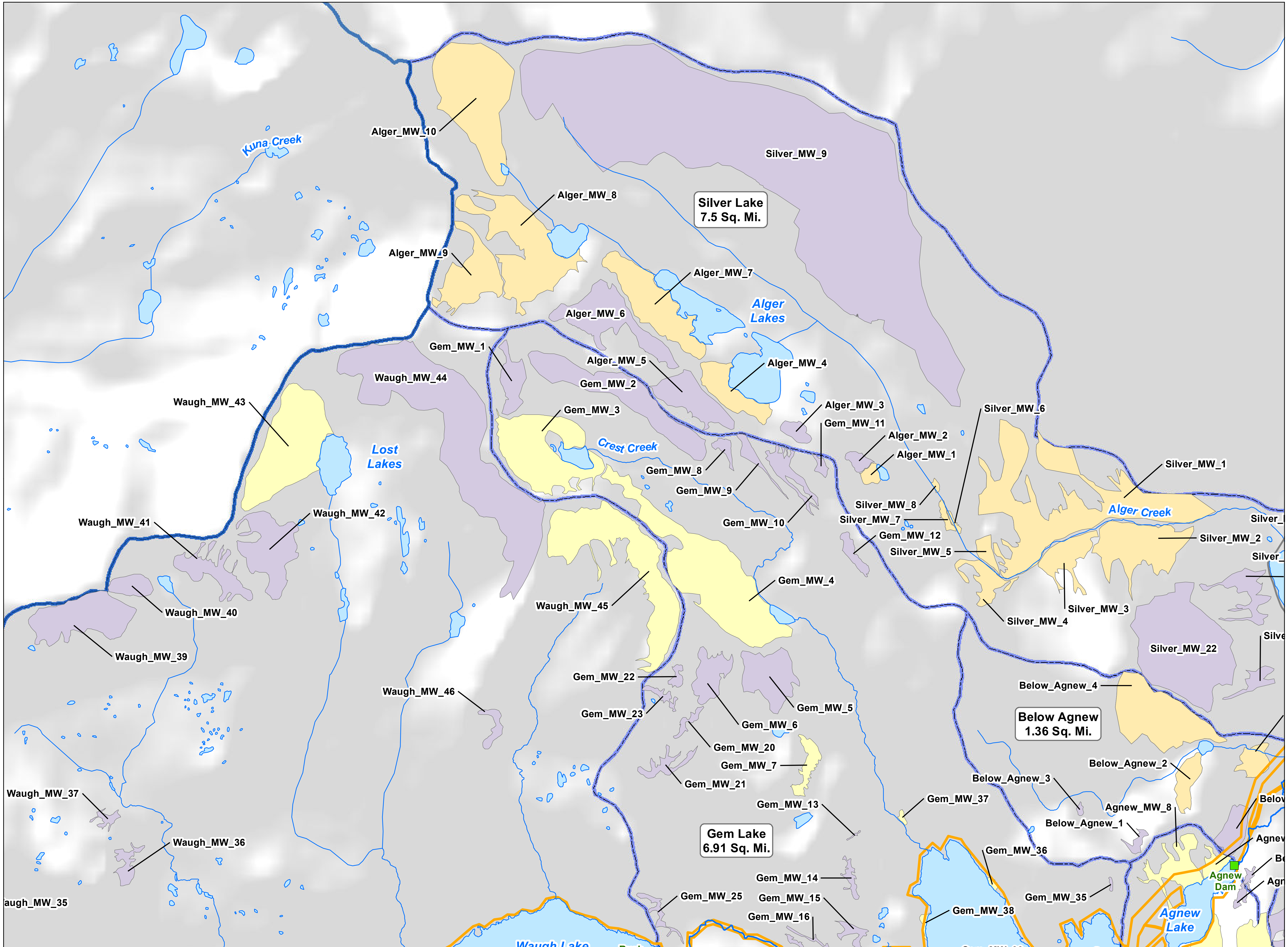


SCE Facilities

Dam | Powerhouse

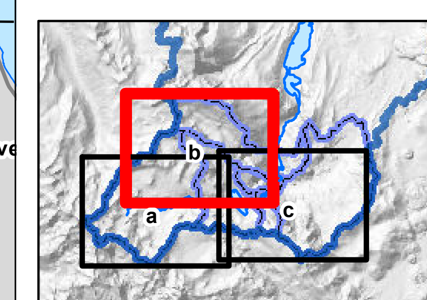
Other Features

Highway | FERC Boundary
River/Stream
Lake/Reservoir
Drainage Basins
Rush Creek Watershed Boundary

Mass Wasting Areas

Sediment Recruitment

Hillslope Storage
Direct Sediment Delivery to Waterways
Direct Sediment Delivery to Waterways with Unimpeded Connection to Silver Lake



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Rush Creek Project (FERC 1389)

Map G-2

Sediment Recruitment from Mass Wasting in the Rush Creek Watershed

0 500 1,000 2,000 Feet

Date: 1/30/2024

Projection: UTM Zone 11
Datum: NAD 83

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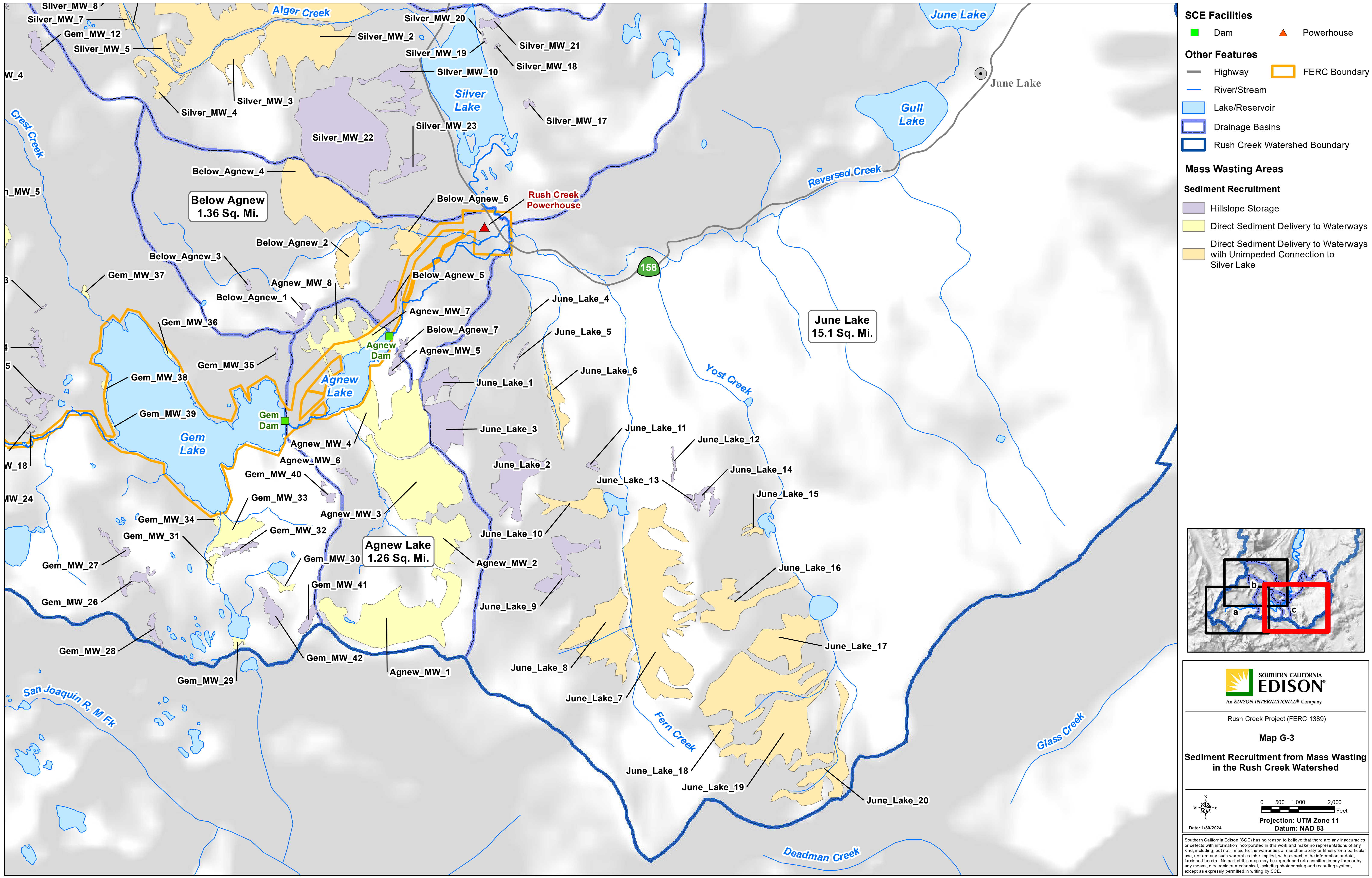

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APPENDIX H

Photographs of Large Woody Debris in Rush Creek and South Rush Creek Near SR-158

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SOUTH RUSH CREEK

SRWD_1

SRWD_2

SRWD_3

SRWD_4

SRWD_5

SRWD_6

SRWD_7

SRWD_8


PREFS
-037.766064° / -119.120699°
7249ft
MAIL
MAP
09/22/23
11:09:16
LOG
-02.9°
-15.4°
SHOW EXTRAS
199° S19W 3538mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
S
210
COLOR
0.5 X


PREFS
-037.766131° / -119.120642°
7247ft
MAIL
MAP
09/22/23
11:08:59
LOG
+05.4°
-18.2°
SHOW EXTRAS
219° S39W 3893mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
210
240
COLOR
0.5 X


PREFS
+037.765848° / -119.120625°
MAIL
MAP
09/22/23
11:10:12
LOG
-02.3°
-17.4°
247° S67W 4391mils TRUE
SHOW EXTRAS...
WHAT'S NEW...
ZERO
A-B
CAL
COLOR
0.5X


PREFS
+037.765617° / -119.120689°
MAIL
MAP
09/22/23
11:12:52
LOG
-00.3°
-15.9°
247° S67W 4391mils TRUE
SHOW EXTRAS...
WHAT'S NEW...
ZERO
A-B
CAL
COLOR
0.5X


PREFS
-037.766000° / -119.120640°
↑7248ft
MAIL
MAP
09/22/23
11:09:31
LOG
-03.1°
-08.5°
SHOW EXTRAS
180° S00W 3200mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
150
210
COLOR
0.5 X


PREFS
-037.765798° / -119.120765°
↑7242ft
MAIL
MAP
09/22/23
11:10:59
LOG
-01.3°
-23.3°
SHOW EXTRAS
041° N41E 0729mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
030
060
COLOR
0.5 X


PREFS
-037.765853° / -119.120637°
MAIL
MAP
09/22/23
11:10:02
LOG
-01.4°
-20.3°
310° N50W 5511mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
300
330
COLOR
0.5 X


PREFS
-037.765687° / -119.120784°
MAIL
MAP
09/22/23
11:12:27
LOG
-01.1°
-22.2°
324° N36W 5760mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
300
330
COLOR
0.5 X


PREFS
+037.766297° / -119.120597°
↑7246ft
MAIL
MAP
09/22/23
11:07:43
LOG
-00.3°
-13.2°
285° N75W 5067mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
W
300
COLOR
0.5X


PREFS
+037.765924° / -119.120674°
↑7244ft
MAIL
MAP
09/22/23
11:09:47
LOG
+03.2°
-13.6°
159° S21E 2827mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
150
S
COLOR
0.5X


+037.766190° / -119.120557° ↑7233ft
09/22/23
11:08:16
216° S36W 3840mils TRUE
210
240

SRWD_9

RUSH CREEK UPSTREAM OF CONFLUENCE WITH REVERSED CREEK

RCWD_1

RCWD_2

RUSH CREEK DOWNSTREAM OF CONFLUENCE WITH REVERSED CREEK

RCDSR_1

RCDSR_2


PREFS
+037.766945° / -119.120948°
↑7238ft
MAIL
MAP
09/22/23
N
14:42:10
LOG
00
+01.1°
-08.2°
-10
-05
+05
SHOW EXTRAS
326° N34W 5796mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
300
330
N
COLOR
0.5 X

RCDSR_3


PREFS
+037.767018° / -119.121584°
↑7241ft
MAIL
MAP
09/22/23
N
14:53:35
LOG
-05
00
+00.6°
-09.1°
-10
-05
+05
SHOW EXTRAS
098° S82E 1742mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
0
E
120
COLOR
0.5 X


PREFS
+037.767005° / -119.121569°
MAIL
MAP
09/22/23
14:53:14
LOG
+05.7°
-15.8°
SHOW EXTRAS
334° N26W 5938mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
COLOR
0.5 X


PREFS
+037.767028° / -119.121343°
↑ 7235ft
MAIL
MAP
09/22/23
14:52:19
LOG
+01.1°
-03.0°
SHOW EXTRAS
278° N82W 4942mils TRUE
WHAT'S NEW
ZERO
A-B
COLOR
0.5 X


PREFS
+037.767018° / -119.121584°
↑7241ft
MAP
09/22/23
14:53:35
LOG
+00.6°
-09.1°
SHOW EXTRAS
098° S82E 1742mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
COLOR
0.5 X


PREFS
+037.766971° / -119.121428°
↑7239ft
MAIL
MAP
09/22/23
14:52:43
LOG
+03.0°
-07.8°
SHOW EXTRAS
305° N55W 5422mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
300
330
COLOR
0.5 X

RCDSR_4


PREFS
-037.767795° / -119.122503°
↑7237ft
MAIL
MAP
09/22/23
N
15:14:36
LOG
+00.5°
-09.8°
SHOW EXTRAS
039° N39E 0693mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
030
060
COLOR
0.5 X


PREFS
-037.767767° / -119.122316°
↑7248ft
MAIL
MAP
09/22/23
N
15:13:45
LOG
+00.5°
-09.8°
SHOW EXTRAS
303° N57W 5387mils TRUE
WHAT'S NEW
ZERO
A-B
CAL
W
300
330
COLOR
0.5 X


PREFS
+037.767386° / -119.122124°
↑7241ft
MAIL
MAP
09/22/23
15:03:00
LOG
+07.5°
-19.5°
024° N24E 0427mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
COLOR
0.5 X


PREFS
+037.767747° / -119.122444°
↑7234ft
MAIL
MAP
09/22/23
15:14:15
LOG
-02.0°
-10.7°
000° N00E 0000mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
COLOR
0.5 X


-037.767417° / -119.122182°
7241 ft
09/22/23
15:03:14
+00.7°
-29.1°
074° N74E 1316mils TRUE


-037.767800° / -119.122265°
7257ft
09/22/23
15:13:32
+00.7°
-06.8°
293° N67W 5209mils TRUE


PREFS
037.767543° / -119.122091°
7242ft
MAIL
MAP
09/22/23
15:04:03
LOG
+02.8°
-23.7°
037° N37E 0658mils TRUE
SHOW EXTRAS
WHAT'S NEW
ZERO
A-B
CAL
030
060
COLOR
0.5 X

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