2024 Martin River Aquatic Studies Report

Bradley Lake Hydroelectric Project
Dixon Diversion

FERC No. P-8221

Prepared for:
Alaska Energy Authority

Prepared by:
Kleinschmidt Associates

January 2025

Kleinschmidt

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

A

AEA	Alaska Energy Authority
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AVCT	autonomous video counting tower

B

BFW	bankfull width
BLVD	Bradley Lake Vertical Datum

C

°C	degrees Celsius
cfs	cubic feet per second
cm	centimeter
CPUE	Catch per Unit Effort

D

DO	dissolved oxygen
DSP	Draft Study Plan

E

EFMR	East Fork Martin River

F

FERC	Federal Energy Regulatory Commission

G

GIS	Geographic Information System
GPS	Global Positioning System

I

ICD	Initial Consultation Document

K

km	kilometer

L

LiDAR	light detection and ranging

M

m	meter
m^2	square meters
mg/L	milligrams per liter
µS/cm	microsiemens per centimeter
mm	millimeter

N

NMFS	National Marine Fisheries Service
N/S	not sampled
NTU	nephelometric turbidity unit

O

OCH	off-channel habitat

P

pH	potential of hydrogen
Project	Dixon Diversion Project
PVC	polyvinyl chloride

Q

QA/QC	quality assurance/quality control

R

RM	River Mile

S

SS	side slough

U

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

W

WFMR	West Fork Martin River
WQ	Water Quality

1.0 INTRODUCTION

The Alaska Energy Authority (AEA), Licensee and owner of the 120-megawatt Bradley Lake Hydroelectric Project (Bradley Lake Project; Federal Energy Regulatory Commission [FERC] No. P-8221), is pursuing a FERC license amendment. The purpose of the proposed amendment is to gain authorization to divert seasonal meltwater coming from Dixon Glacier at the headwaters of the Martin River to Bradley Lake to increase power production, identified herein as the Dixon Diversion Project (Project).

AEA filed an Initial Consultation Document (ICD) (AEA 2022a) with FERC on April 27, 2022. The ICD describes existing facilities and current Bradley Lake Project operations; characterizes the affected environment; and describes two proposed Project alternatives for producing energy from Dixon Glacier meltwater. Following the ICD filing, AEA hosted Joint Agency and Public Meetings in Homer, Alaska on June 14, 2022, to discuss the ICD and receive stakeholder input. In November 2022, AEA filed a Draft Study Plan (DSP) (AEA 2022b) with FERC, which outlined ten studies based on the two alternatives. Stakeholders filed comments on the DSP in December 2022. AEA briefly paused the FERC amendment process while it conducted additional feasibility studies and narrowed down the proposed Project alternatives.

Based on further investigations, AEA decided to move forward with diverting Dixon Glacier meltwater to Bradley Lake. The proposed Dixon Diversion Project (Project) would include construction of a diversion dam near the toe of the Dixon Glacier; an approximately 4.7-mile-long diversion tunnel bored through the mountain extending from Dixon Glacier to Bradley Lake; diverting water from the Martin River basin to Bradley Lake; approximately 1 mile of new, 16-foot-wide, gravel-surfaced access road from the existing Upper Battle Creek diversion access road to the outlet of the proposed diversion tunnel; and modification of the existing Bradley Lake Dam to raise the maximum normal pool elevation currently at 1,180 feet Bradley Lake Vertical Datum (BLVD) by as much as 7, 14, or 28 feet (1,208 feet elevation BLVD). The entire proposed Project is located on State-owned land.

AEA re-initiated the amendment process in 2024 by hosting public meetings in March and April 2024 to review the selected Project alternative, stakeholder comments on the DSP, and AEA's proposed modifications to the DSP.

To develop a baseline understanding of the existing conditions within the Martin River related to water quality, fish habitat, and fish use of available habitat, AEA implemented three studies to be completed during the spring and fall seasons of 2024 and 2025. This report summarizes the objectives and methodologies detailed in the study plan, reports on the results of the 2024 field efforts, and provides a discussion of baseline Martin River conditions relative to priority fish species for the following studies:

- Water Quality Monitoring,
- Aquatic Habitat Characterization, and
- Martin River Fish Use.

2.0 WATER QUALITY MONITORING STUDY

2.1 Background

The proposed Dixon Diversion Project would divert water from the Dixon Glacier outflow from May through October (AEA 2022a), potentially impacting water temperature, dissolved oxygen (DO) concentrations, turbidity, potential of hydrogen (pH), and conductivity in the Martin River. This study provided baseline data to support the evaluation of the potential effects of the Dixon Diversion Project on water quality with respect to state standards (Table 2-1) and habitat for fish and aquatic life by measuring water quality parameters that have the potential to be impacted by the proposed Project. AEA began implementing the water quality monitoring study in 2023 as described in the DSP (AEA 2022b). The 2023 monitoring effort and results were summarized in a February 2024 report (Kleinschmidt 2024).

Table 2-1 Water quality standards for Alaska freshwater uses.

Pollutant	Criteria*
Dissolved Gas	DO must be greater than 7 milligrams per liter (mg/L) in waters used by anadromous or resident fish. In no case may DO be less than 5 mg/L to a depth of 20 centimeters (cm) in the interstitial waters of gravel used by anadromous or resident fish for spawning. For waters not used by anadromous or resident fish, DO must be greater than or equal to 5 mg/L. In no case may DO be greater than 17 mg/L. The concentration of total dissolved gas may not exceed 110 percent of saturation at any point of sample collection.
pH	May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions.
Temperature	May not exceed 20°C at any time. The following maximum temperatures may not be exceeded where applicable: Migration routes 15°C Spawning areas 13°C Rearing areas 15°C Egg and fry incubation 13°C For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent the appearance of nuisance organisms.

Pollutant	Criteria*
Turbidity	May not exceed 25 nephelometric turbidity units (NTUs) above natural conditions. For all lake waters, may not exceed 5 NTUs above natural conditions.

*The water quality standards listed in this table include the criteria for the growth and propagation of fish, shellfish, other aquatic life, and wildlife.
Source: Alaska Department of Environmental Conservation (ADEC) (2020).

2.2 Goals and Objectives

The goal of the Water Quality Monitoring Study is to characterize water quality in the Martin River basin. Waters potentially affected by the proposed Dixon Diversion Project are identified as Class C waters by the State of Alaska intended to protect the designated use of growth and propagation of fish, shellfish, other aquatic life, and wildlife. Characterization of current water quality conditions will support the evaluation of compliance with water quality criteria under current conditions and under the proposed Project operation.

Study objectives included collection of water quality data (temperature, pH, DO, turbidity) in the East Fork Martin River (EFMR) near the canyon outlet (EFMR River Mile [RM] 0.1), in the West Fork Martin River (WFMR) downstream of the Red Lake outlet (WFMR RM 0.1), in the outlet from the Martin River off-channel habitat (OCH) complex on river-right at RM 4.2 (OCH4.2 outlet), and the mainstem Martin River downstream of these sources as measured at the constriction near RM 1.9.

2.3 Study Area

The study area included the mainstem Martin River and associated OCH from the constriction near RM 1.9 upstream to the confluence of the EFMR and WFMR, the mouth of the EFMR, and WFMR downstream from the outlet of Red Lake. Water quality monitoring locations are shown in Figure 2-1.

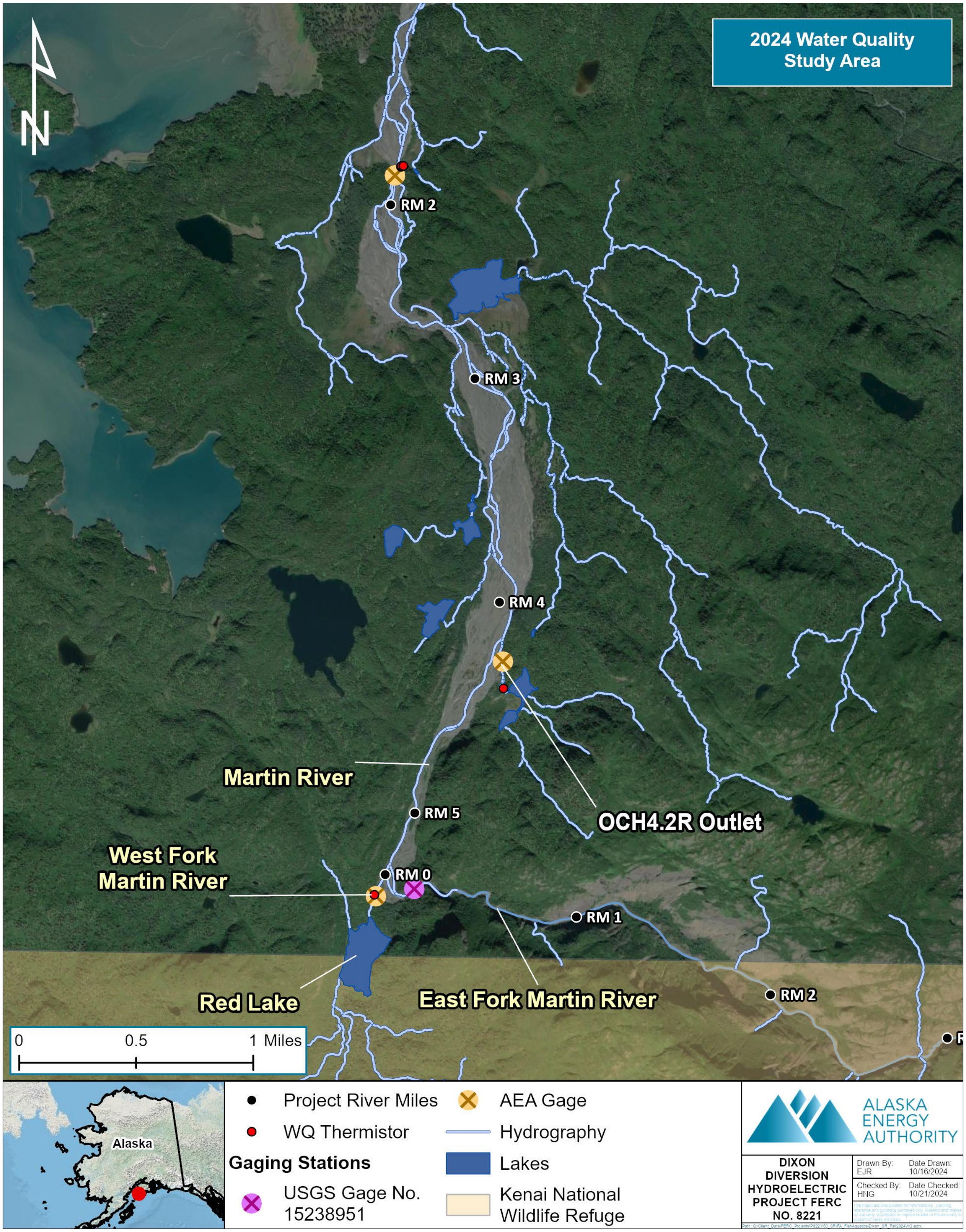

Figure 2-1 Martin River water quality monitoring sites.

2.4 Methods

Study activities included the collection of baseline field data and analysis with respect to state water quality standards. Field and analytical methods are summarized below.

2.4.1 Monitoring Locations

Water quality monitoring was conducted at the four stream flow monitoring locations (Figure 2-1):

- EFMR at the canyon outlet near EFMR RM 0.1 (United States Geological Survey [USGS] Gage No. 15238951 location),
- WFMR downstream of the Red Lake outlet (WFMR RM 0.1),
- Right bank Martin River off-channel site (OCH4.2R Outlet) in its outlet near RM 4.2, and
- Mainstem Martin River at the downstream constriction near RM 1.9.

This configuration of monitoring locations allowed the characterization of Martin River temperature dynamics in reaches potentially affected by the proposed Dixon Diversion Project.

The Martin River basin is a complex glacial river system that experiences periods of high stream discharge and velocities which can cause rapid channel migration, debris flows, and gravel deposition which affected some sampling locations and monitoring equipment in 2023 and 2024.

2.4.2 Monitoring Schedule

Water quality monitoring was conducted in 2023 and 2024 throughout the period of proposed water diversion (May through October). Temperature was monitored continuously during this period. Temperature and other water quality parameters including DO, turbidity, conductivity, and pH were measured as single-point data monthly, with no less than 3 weeks and no more than 6 weeks between sampling events. Continuous temperature data was corroborated by point measurements taken at each site monthly.

In 2023, monthly synoptic or "snapshot" sampling was conducted at all four sites; continuous temperature monitors were installed at three of the sites (Table 2-2). Monitoring began on April 24, 2023, at three of the sites and was completed on November 17, 2023 (Table 2-2). Water quality monitoring at the EFMR site began on June 23, 2023.

Due to concerns about the risk of logger damage under high flow conditions in the mainstem Martin River, a redundant second logger was placed at the Martin River RM 1.9 site. Both loggers installed at Martin River RM 1.9 were not accessible during the monthly site visits due to high flows and both loggers were lost during high flow conditions before it was safe to retrieve them and download the data. Monthly data collection was the only effective approach for temperature data collection at the Martin River mainstem site during 2023.

The logger installed at the OCH4.2R Outlet location was found transported downstream and partially exposed during the September 19, 2023, site visit. It appeared that a high flow event in late August provided an upstream connection to the Martin River, which inundated the OCH and dislodged the duckbill anchor from the channel. Fortunately, the logger was retrieved, and stored temperature data were recovered during the September site visit when the logger was reinstalled. Due to the uncertainty around the timing that this logger was out of water and which habitats the temperature data may have represented, the data between site visits on August 24 and September 19 were removed from analysis. Continuous temperature data were collected in the WFMR near WFMR RM 0.1 throughout the monitoring period, although the logger was found to be missing during the final site visit on November 17, 2023.

Table 2-2 Martin River basin 2023 water quality (WQ) monitoring locations.

Date	EFMR RM 0.1	WFMR RM 0.1		OCH4.2R Outlet		Martin River RM 1.9	
	Monthly WQ	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature
4/24/23		x	x	x	x	x	*
5/26/23		x	x	x	x	x	*
6/23/23	x	x	x	x	x	x	*
7/20/23	x	x	x	x	x	x	*
8/24/23	x	x	x	x	x	x	*
9/19/23	x	x	x	x	x	x	*
10/20/23	x	x	x	x	x	x	*
11/17/23	x	x	*	x	x	x	*

*Installed but not able to be retrieved.

In 2024, continuous temperature monitors were installed at three monitoring sites (Table 2-3). To provide redundancy and reduce the risk of data loss, backup temperature loggers were installed in 2024 at three of the water quality monitoring study sites on April 29, 2024, and May 4, 2024 (Table 2-3). Due to the challenges of maintaining equipment at the Martin River RM 1.9 site during high flows, redundant thermistors were installed in a dry side channel downstream of the constriction near RM 1.8. Data from this site was intended to be used as a backup only during high flows when the flow through the side channel would be representative of the mainstem Martin River. No redundant temperature loggers were installed at the EFMR site because the stream temperature recorded at the USGS Gage No. 15238951 provided the necessary backup. Stream flow and channel conditions were ideal for completing thermistor installation in the Martin River. Low, clearwater conditions enabled the team to access and cross the Martin River channel within all target sampling areas.

Table 2-3 Martin River basin 2024 water quality (WQ) monitoring locations.

Date	EFMR RM 0.1		WFMR RM 0.1		OCH4.2R Outlet		Martin River RM 1.9		Martin River RM 1.8 Side Channel	
	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature	Monthly WQ	Continuous Temperature
4/18/24	X	X	X		X					
5/12/24	X	X	X	X	X	X	X	X		
6/12/24	X	X	X	X	X	X	X	X	X	X
7/19/24	X	X	X	X	X	X	X	X	X	X
8/21/24	X	X	X	X	X	X	X	X	X	X
9/28/24	X	X	X	X	X	X	X	X		
10/30/24	X	X	X	X	X	X	X			

2.4.3 Monitoring Equipment and Procedures

Continuous temperature monitoring was conducted at 30-minute (2023) or 15-minute (2024) intervals following the data standards outlined in Mauger et al. (2015) using calibrated, continuous temperature loggers. Temperature loggers (thermistors) were capable of an accuracy of ±0.25 degrees Celsius (°C) and had a range of −4°C to 37°C; Onset Hobo U22-001 loggers were used. Pre- and post-deployment accuracy checks were performed to screen for defective equipment and qualify data reporting if measurement drift occurred. Accuracy checks were conducted at a minimum of two temperatures (0°C and 20°C). During monthly field visits, the thermistors were audited by taking an independent measure of water temperature.

Point measurements of water temperature, conductivity, DO, pH, and turbidity were taken monthly with a YSI Pro DSS water quality meter, professionally calibrated and field calibrated as needed after transport to Homer, Alaska. All parameters were calibrated successfully.

Given the prevalence of glacial inputs and high turbidity levels expected during the monitoring period, a transparency tube was used to estimate turbidity in NTUs when probe readings exceeded 5 NTUs. Transparency tubes, also called turbidity tubes, use a small Secchi disk at the bottom of a clear, narrow plastic tube to allow an observer to estimate the depth of water sufficient to obscure the Secchi; this measurement quantifies water transparency and can be used to estimate NTUs (Dahlgren et al. 2004).

Field data were recorded on datasheets which were photographed in the field and checked for completeness before daily crew departure from the site. Records of accuracy checks and calibration events were maintained. Metadata for field water quality measurements included a unique site identifier, datum, latitude and longitude, date, and time. Data were entered and managed in Microsoft Excel. Field data collection followed the Dixon Diversion Project data quality assurance/quality control (QA/QC) protocol (see Section 2.4.5).

2.4.4 Equipment Installation

Each logger installed at a monitoring site was placed within a PVC casing to protect the logger from sunlight temperature differences and anchored to the bank (bedrock or stable tree) with vinyl coated cable.

At the EFMR USGS Gage, temperature logging equipment was installed at a bedrock-bank constriction (Photo 2-1). At the WFMR RM 0.1 site, the backup thermistor was attached to an anchor in bedrock. At the Martin River off-channel site OCH4.2R (Photo 2-2), thermistors were anchored to stable trees at two locations (Photo 2-2), one immediately downstream of the lake and another closer to the confluence between OCH4.2R and the mainstem Martin River. This monitoring site was intended to determine the temperature of outflow from two source lakes and their inflowing streams. The lake is shallow, encroached with grasses, sedges, and aquatic vegetation, has dark, tannic water, and full sun exposure (Photo 2-1).

Thermistors in a side channel near mainstem Martin River RM 1.9 were anchored to stable trees in a dry side channel (Photo 2-4) to prevent loss of data for the Martin River mainstem if the thermistors installed at the stream gage near the constriction at RM 1.9 were lost during high flows, as occurred in 2023. At high flows, this channel had flowing water, and data recorded in this side channel was representative of the mainstem Martin River.

Photo 2-1 EFMR temperature logger installation location.

Photo 2-2 WFMR temperature logger installation location at WFMR RM 0.1 (red circle).

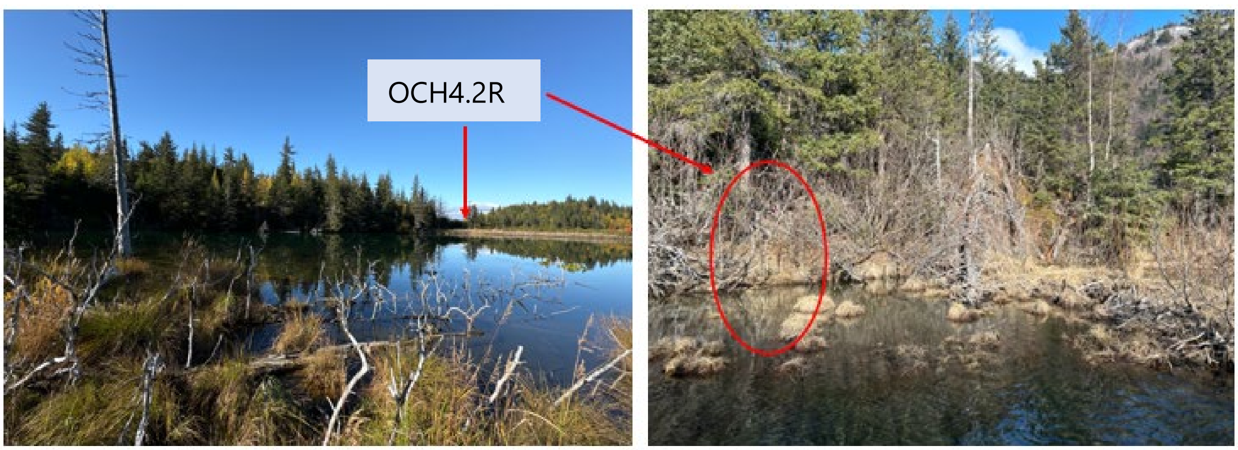

Photo 2-3 Temperature logger installation location at the OCH4.2R outlet on April 29, 2024 (right, red circle). The lake that feeds OCH4.2R is pictured on the left on September 29, 2024.

Photo 2-4 Temperature logger installation locations at the Martin River RM 1.8 river right side channel downstream from the constriction stream gage at RM 1.9. Photo taken on May 4, 2024.

2.4.5 Field Data Quality Assurance and Quality Control

Studies under this program included the collection of field data. The goals of data management were to establish a data QA/QC protocol to be applied at logical stages of data collection and processing, and to create a database of all QC data collected for the Dixon Diversion Project. Five levels of QC (QC1 to QC5) were completed to govern data collection efforts and ensure a rigorous and high-quality product. Each QC level was tracked either within tabular datasets (Microsoft Excel and database tables) or within file path names (as for raw field data files). This allowed for quick determination of the QC status of all data. A data dictionary describing the database entities and attributes was compiled to accompany the database and to provide an understanding of data elements and their use by anyone querying or analyzing the data.

Data QC was ensured by implementing three levels of data quality review:

- QC1: Field data was checked for accuracy and completeness by a team member other than the recorder prior to site departure.

- QC2: All data were checked following entry to identify entry errors.
- QC3: Before data analysis, data were inspected for completeness, outliers, or inconsistencies by field staff familiar with the sampling events and site conditions.
- QC4: Database Validation: Tabular data files were verified to meet project database standards. Data are verified for completeness, project standards (codes, field name conventions, date formats, units, etc.), calculated and derived fields, and QC fields.
- QC5: Technical Review: Data revision or qualification by senior professionals when analyzing data for reports. Data calculations may be stored with the data. Some data items may have been corrected or qualified within the database, while others have only been addressed in report text. QC5 may be iterative, as data are analyzed in multiple years.

All data quality measures were documented with the reviewer's initials and date.

2.4.6 Analytical Methods

For continuous temperature sampling, data included daily summaries of minimum, maximum, and mean stream temperatures for days within the monitoring period that contain at least 90 percent of the incremental data recorded for that day (e.g., 44 of the 48 30-minute measurements).

Monthly data meeting QC review was reported in summary tables. Transparency tube readings were converted to NTUs using the conversion in Table 2-4. Water quality data was evaluated relative to state water quality criteria.

Table 2-4 Turbidity conversion chart from centimeters to NTUs.

Distance from Bottom of Tube (cm)	NTUs	Distance from Bottom of Tube (cm)	NTUs
≤6.25	>240	31.25-33.75	21
6.25-7	240	33.75-36.25	19
7-8	185	36.25-38.75	17
8-9.5	150	38.75-41.25	15
9.5-10.5	120	41.25-43.75	14
10.5-12	100	43.75-46.25	13
12-13.75	84	46.25-48.75	12
13.75-16.25	60	48.75-51.25	11
16.25-18.75	48	51.25-53.75	10
18.75-21.25	40	53.75-57.5	9
21.25-23.75	35	57.5-60	8

Distance from Bottom of Tube (cm)	NTUs	Distance from Bottom of Tube (cm)	NTUs
23.75-26.25	30	60-70	7
26.25-28.75	27	70-85	6
28.75-31.25	24	>85	≤5

Source: Utah State University (2022).

2.5 Results

2.5.1 2023 Results

In 2023, the general pattern of temperature increases between the upstream and downstream sites over approximately 3.6 RMs were influenced by both season and river flows. When the WFMR and Martin River OCHs cooled in the fall, the longitudinal difference between the mainstem sites decreased. Similarly, when river flows were high and the Dixon Glacier contributed the highest proportion of total Martin River flow, as represented by conditions on August 24, 2023, the difference between the East Fork and lower mainstem Martin River sites also decreased.

In April of 2023, both the WFMR and Martin River OCH sites consisted of open water outlet channels of water bodies covered by ice and snow. Water quality monitoring documented low DO and low pH, consistent with light-limited conditions. DO and pH were low enough at the WFMR Red Lake outlet in April that they failed to meet water quality standards.

2.5.1.1 Point Measurements of Water Quality

Martin River water temperatures, as recorded during monthly site visits to the outlet of the EFMR near EFMR RM 0.1 and the mainstem Martin River at the downstream constriction near RM 1.9 were low throughout the monitoring period in 2023. Snapshot monthly temperature measurements at the EFMR RM 0.1 site ranged from 0 to 2°C and the mainstem Martin River RM 1.9 site at the downstream constriction ranged from 0.3 to 5.3°C (Figure 2-2).

The monthly snapshot monitoring of the WFMR and Martin River OCH site OCH4.2R outlet documented water temperatures notably warmer than the EFMR or lower Martin River mainstem sites (Figure 2-2). Monthly snapshot measurements at the WFMR site near WFMR RM 0.1 ranged from 2.0 to 15.6°C and from 1.4 to 16.2°C at the Martin River OCH site OCH4.2R outlet. The monitoring period captured conditions in April and November, when temperatures were low and differences among the sites were relatively small (less than 2.5°C) as well as mid-summer conditions in July and August when these sites were considerably warmer than the glacially influenced East Fork and mainstem Martin River (more than 9.5°C warmer).

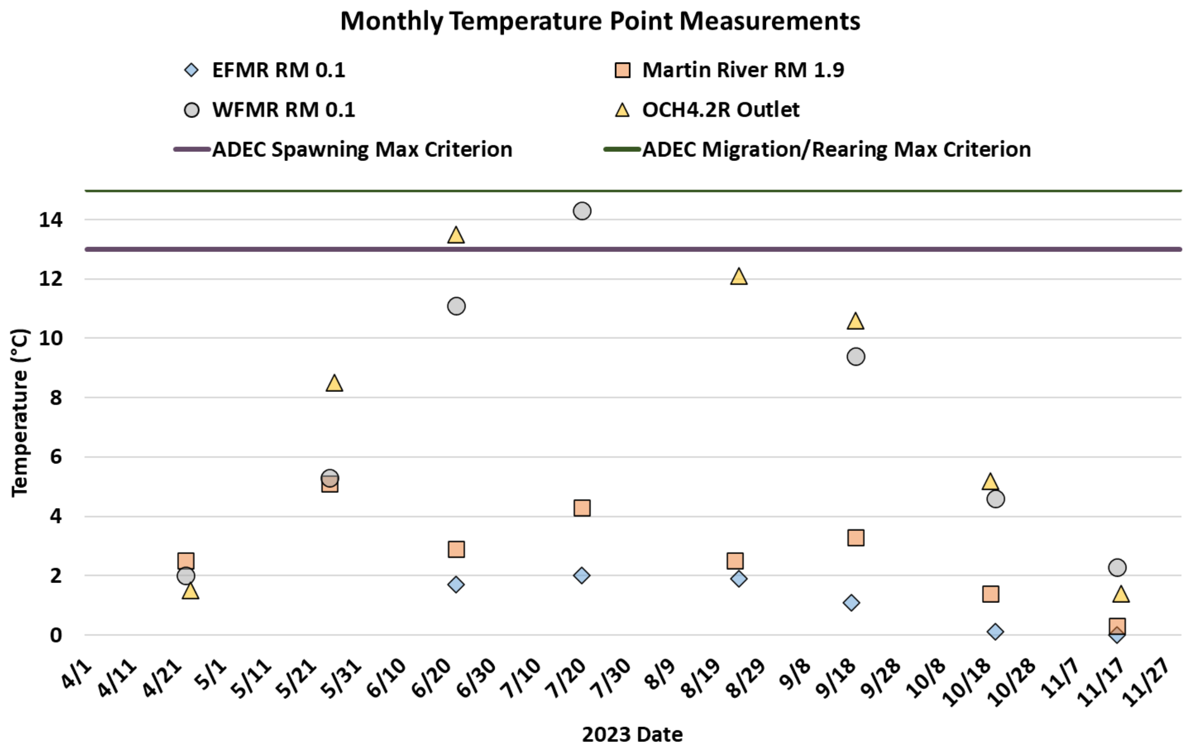

Figure 2-2 2023 monthly water temperature point measurements at Martin River main channel and off-channel monitoring sites.

Both DO metrics (concentration and saturation) characterized DO levels as relatively high in May through October of 2023 across all monitoring sites. DO concentrations (mg/L) were slightly lower in the warmer WFMR and Martin River OCH sites (Figure 2-3). However, all sites were similar in percent saturation (Figure 2-4) in May through October, ranging from 88 to 113 percent. In contrast, DO levels were lower in habitats under ice and snow. The lowest DO concentrations were observed at non-glacial sites in late April and concentrations started to drop again in November.

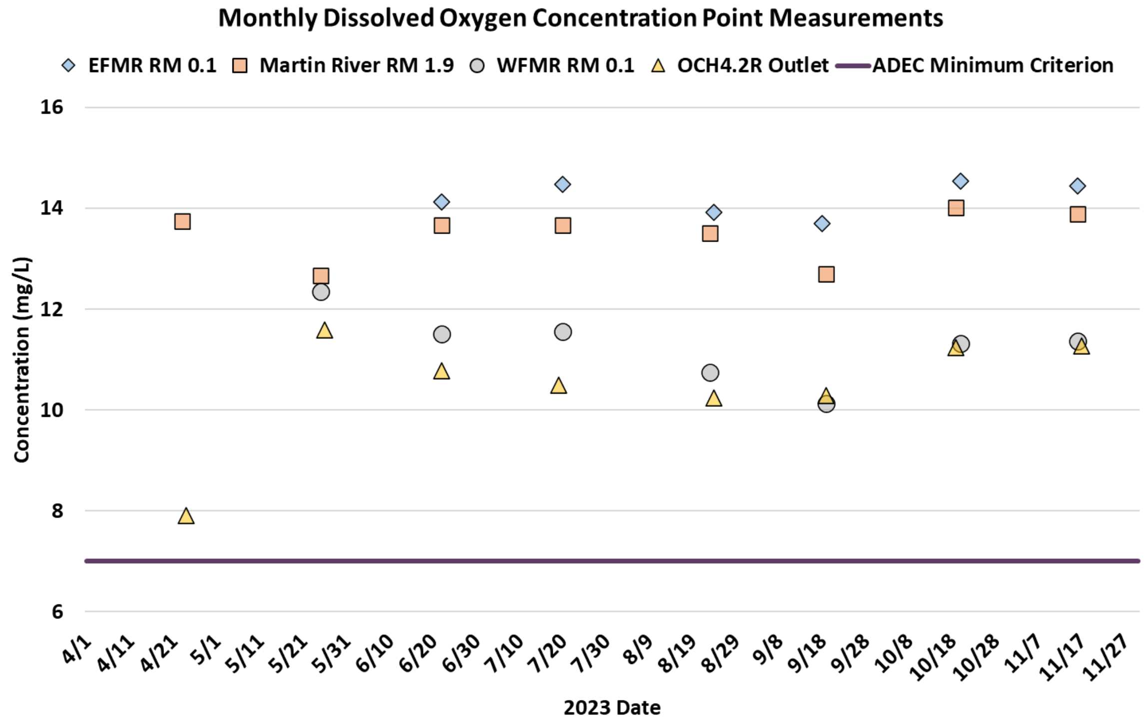

Figure 2-3 2023 monthly point measurements of DO concentration at Martin River main channel and off-channel monitoring sites.

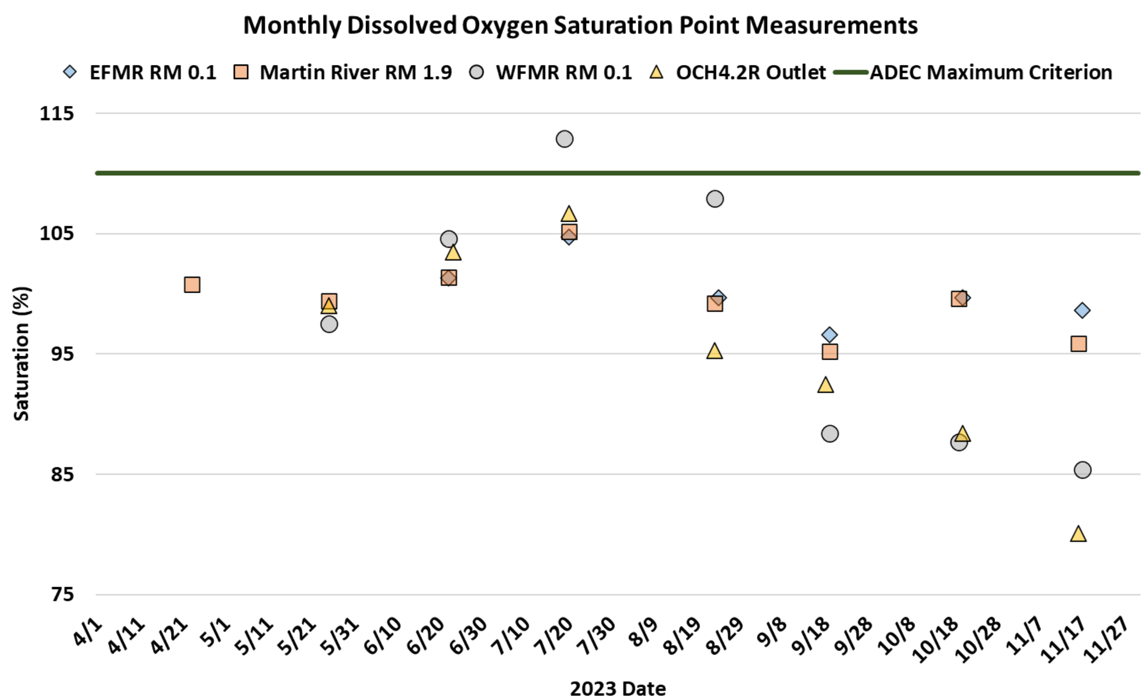

Figure 2-4 2023 monthly point measurements of DO saturation at Martin River main channel and off-channel monitoring sites.

Monthly monitoring of the East Fork and mainstem Martin River sites documented turbidity levels notably higher than the WFMR and off-channel sites from June through October of 2023 (Figure 2-5). Turbidity levels were highest (438 NTUs) on August 24, 2023, at the Martin River RM 1.9 monitoring site. Monthly measurements at the Red Lake outlet site near WFMR RM 0.1 and the Martin River off-channel OCH4.2R outlet site ranged from 0 to 4.0 NTUs. The monitoring period also captured conditions in April through May and November when turbidity levels were relatively low (less than 2.5 NTUs) across all monitoring sites.

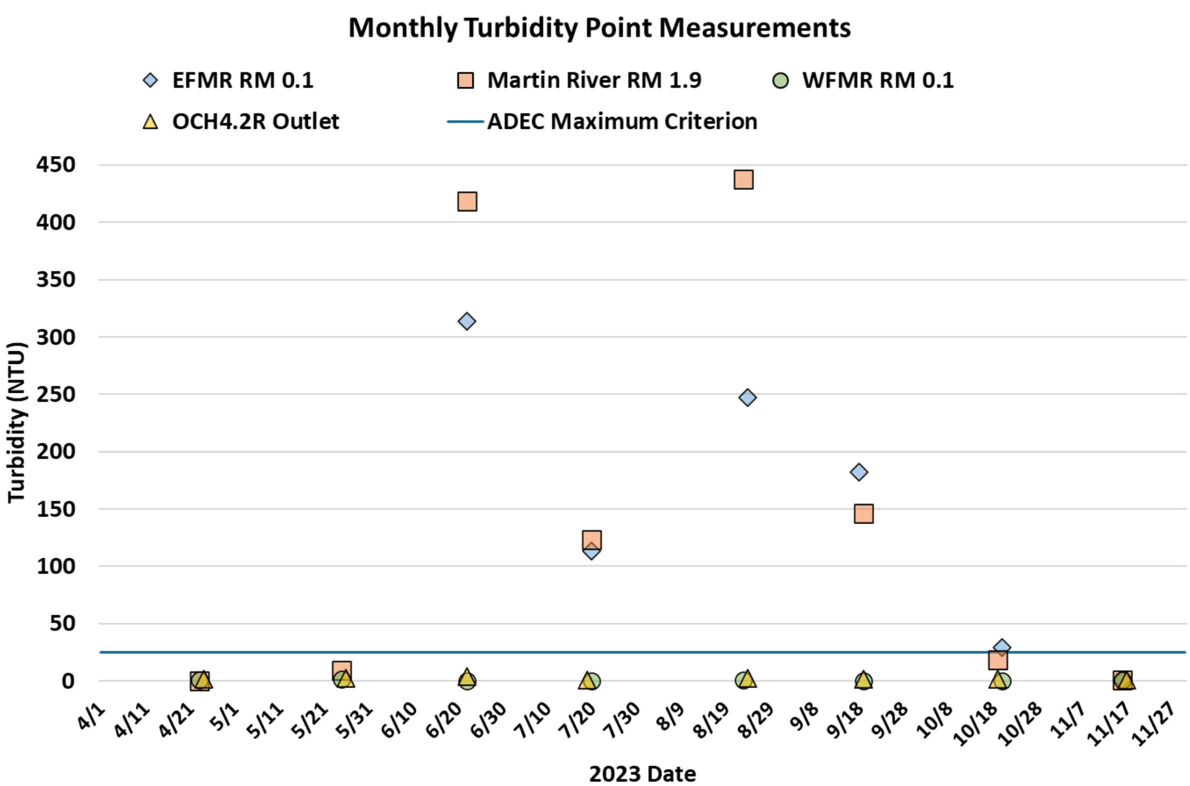

Figure 2-5 2023 monthly point measurements of turbidity (NTUs) at Martin River main channel and off-channel monitoring sites.

In 2023, specific conductance ranged between 21 and 124 microsiemens per centimeter (µS/cm) across sites and monitoring events (Figure 2-6). In general sites and events with higher proportions of glacial water sources had lower specific conductance levels.

Monitoring in 2023 documented pH levels ranging from 5.9 to 7.9 across sites over the monitoring period (Figure 2-7). No consistent differences in pH among the monitoring sites were observed.

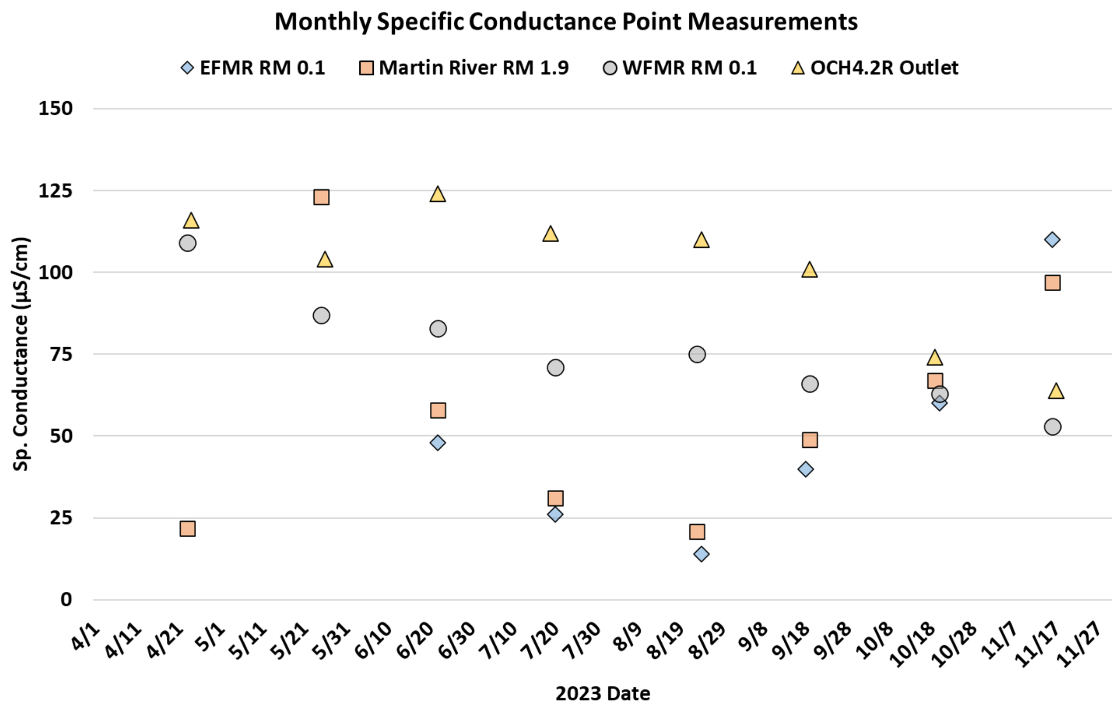

Figure 2-6 2023 monthly point measurements of specific conductance at Martin River main channel and off-channel monitoring sites.

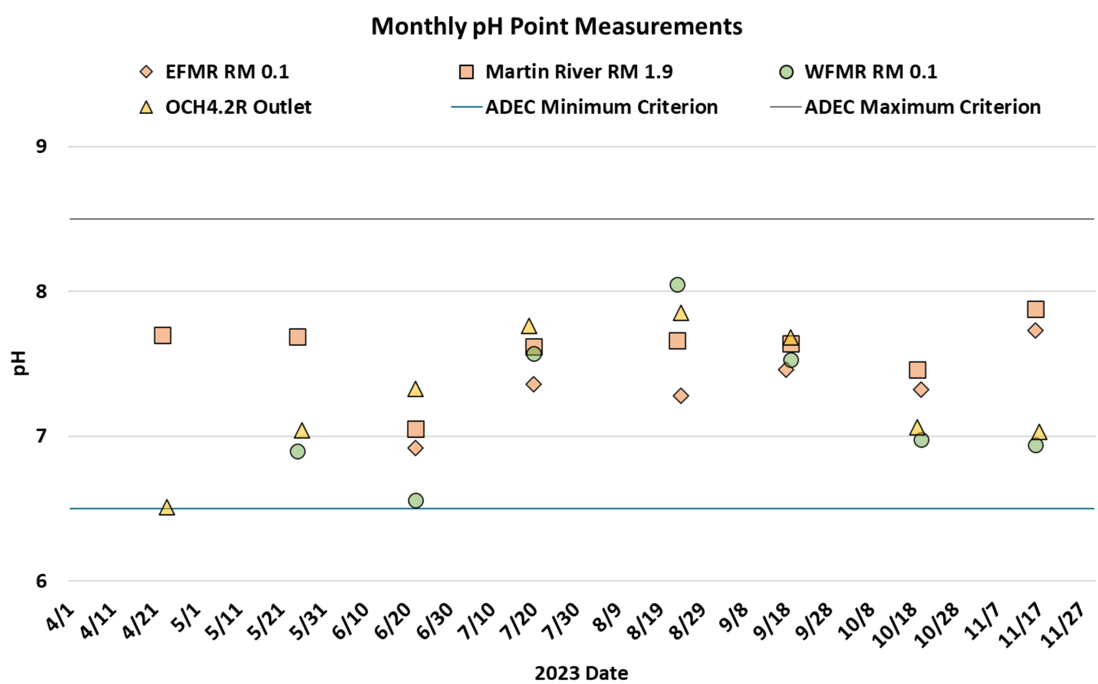

Figure 2-7 2023 monthly point measurements of pH at Martin River main channel and off-channel monitoring sites.

2.5.1.2 Continuous Temperature Data

The USGS Gage at EFMR RM 0.1 recorded water temperature data in 2023 between June 1 and November 1. Within the available temperature record, stream temperatures were highest in early June (4.3°C) following runoff, and remained between 1.5-2.5°C during the summer months as flow was dominated by meltwater from the Dixon Glacier (Figure 2-8).

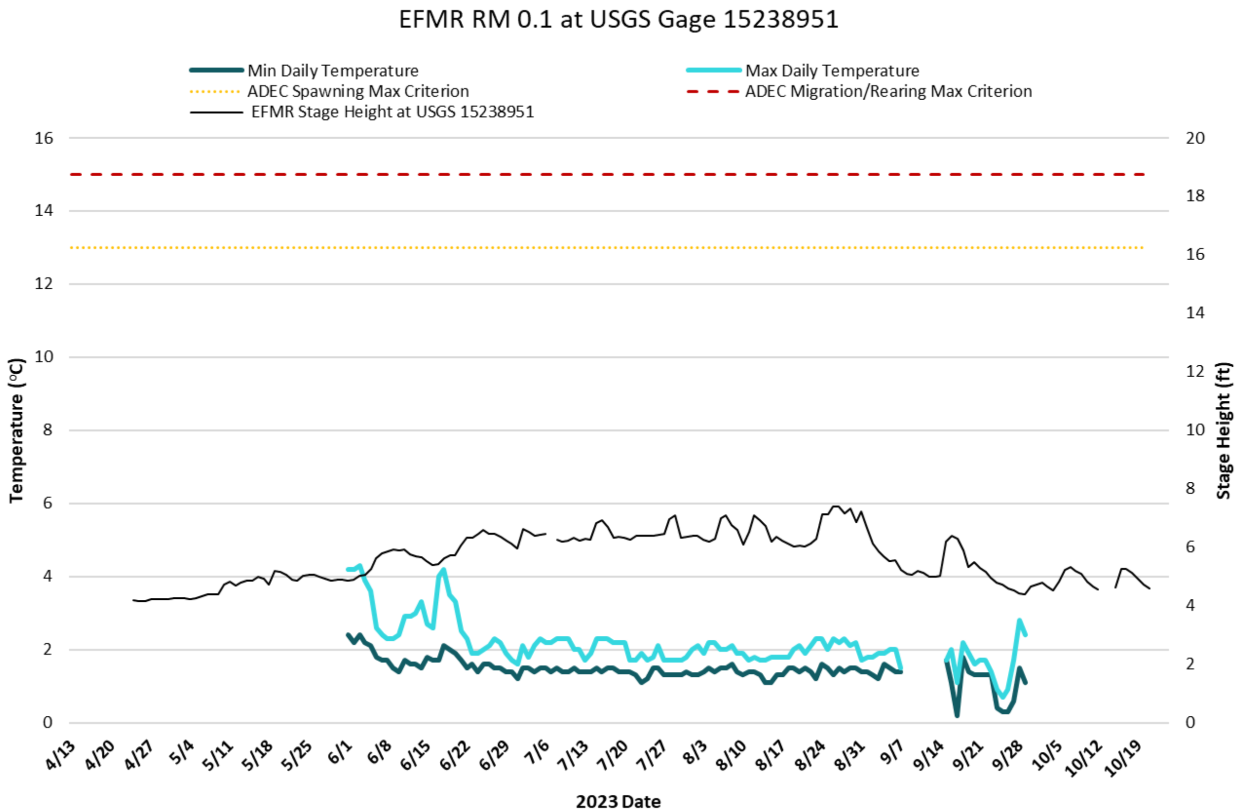

Figure 2-8 2023 minimum and maximum daily water temperature measured at the EFMR USGS Gage No. 15238951 at RM 0.1.

The WFMR monitoring site downstream from the Red Lake outlet characterized 178 complete days of water temperature in 2023 at 30-minute intervals. Water temperatures ranged between 1.9 and 19.2°C (Figure 2-9). Peak water temperatures were observed on August 2, 2023.

The Martin River off-channel OCH4.2R outlet monitoring characterized 151 complete days of water temperature in 2023 at 30-minute intervals. Water temperatures ranged between 0.4 and 18.2°C, with peak water temperatures also observed on August 2, 2023 (Figure 2-10). Although the temperature logger was not functional for a month in late August and early September, the pattern of monthly snapshot temperature decline over that period were consistent with the Red Lake outlet data (Figure 2-9). Minimum temperatures at this site demonstrated dips of more than 5°C on July 6 and August 13, 2023. Based on site conditions, these short (less than one day) drops in temperature may represent Martin River mainstem inflows into this OCH complex under high flow conditions.

Comparison of WFMR RM 0.1 temperature and OCH4.2R with that of the mainstem at EFMR clearly demonstrate that different source water (glacial vs. lake) affect stream temperatures at these sites (Figure 2-11).

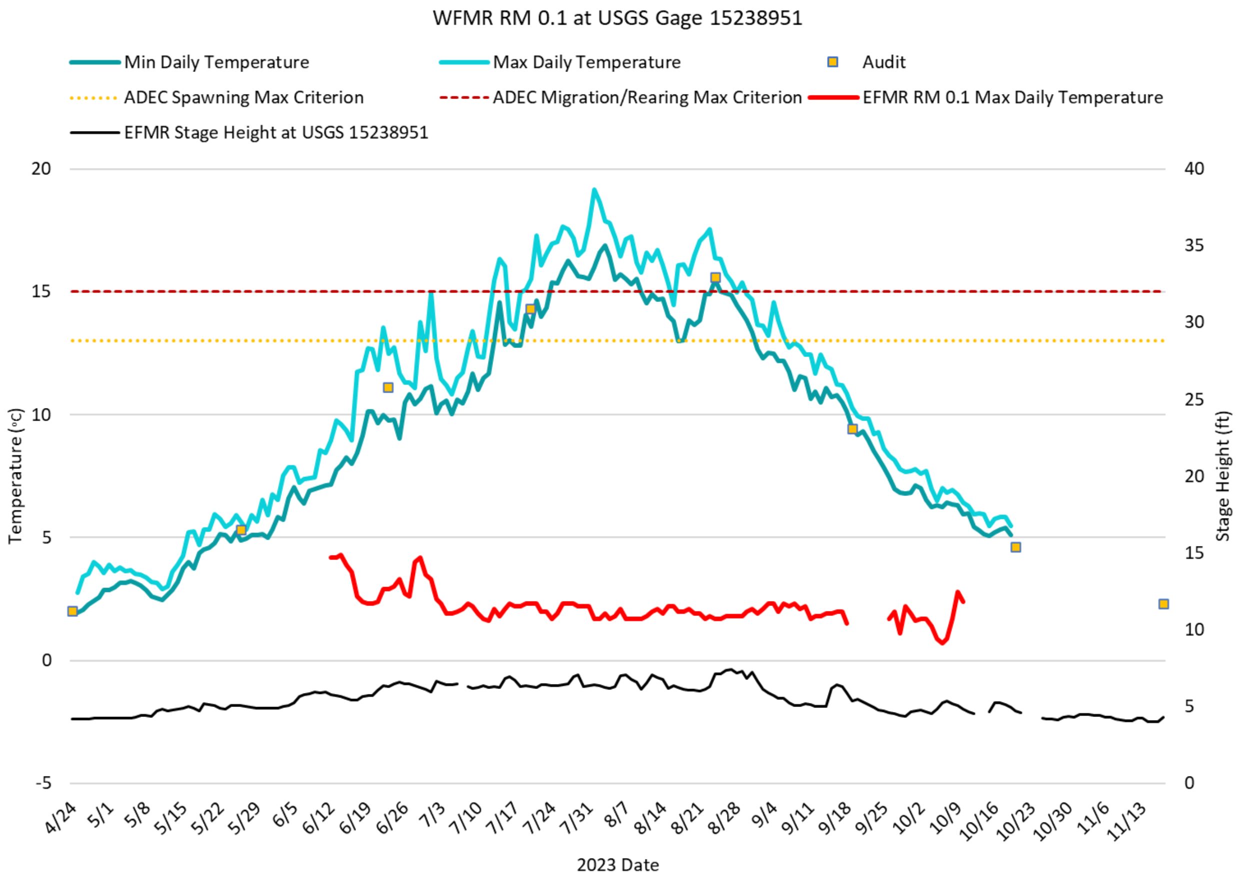

Figure 2-9 2023 minimum and maximum daily water temperature measured at the WFMR site WFMR RM 0.1.

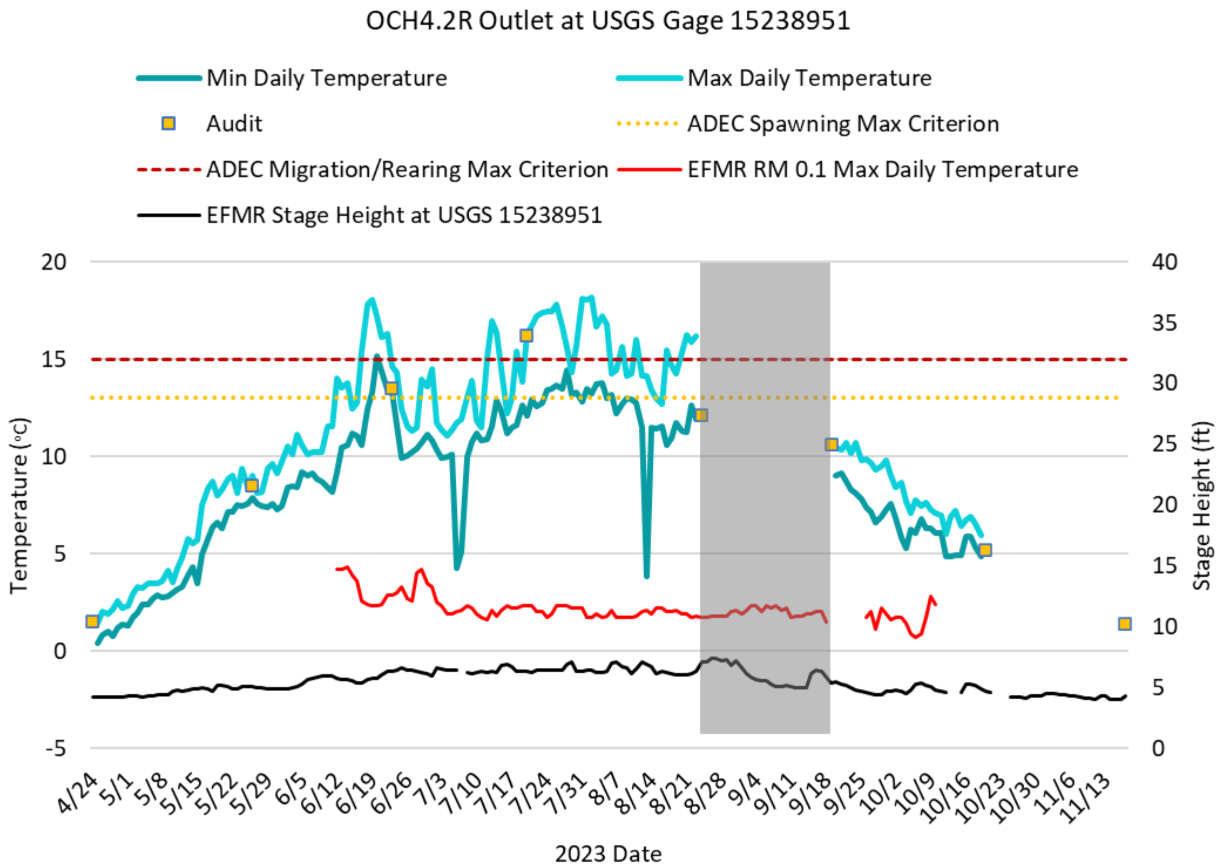

Figure 2-10 2023 minimum and maximum daily water temperature measured at Martin River off-channel site OCH4.2R.

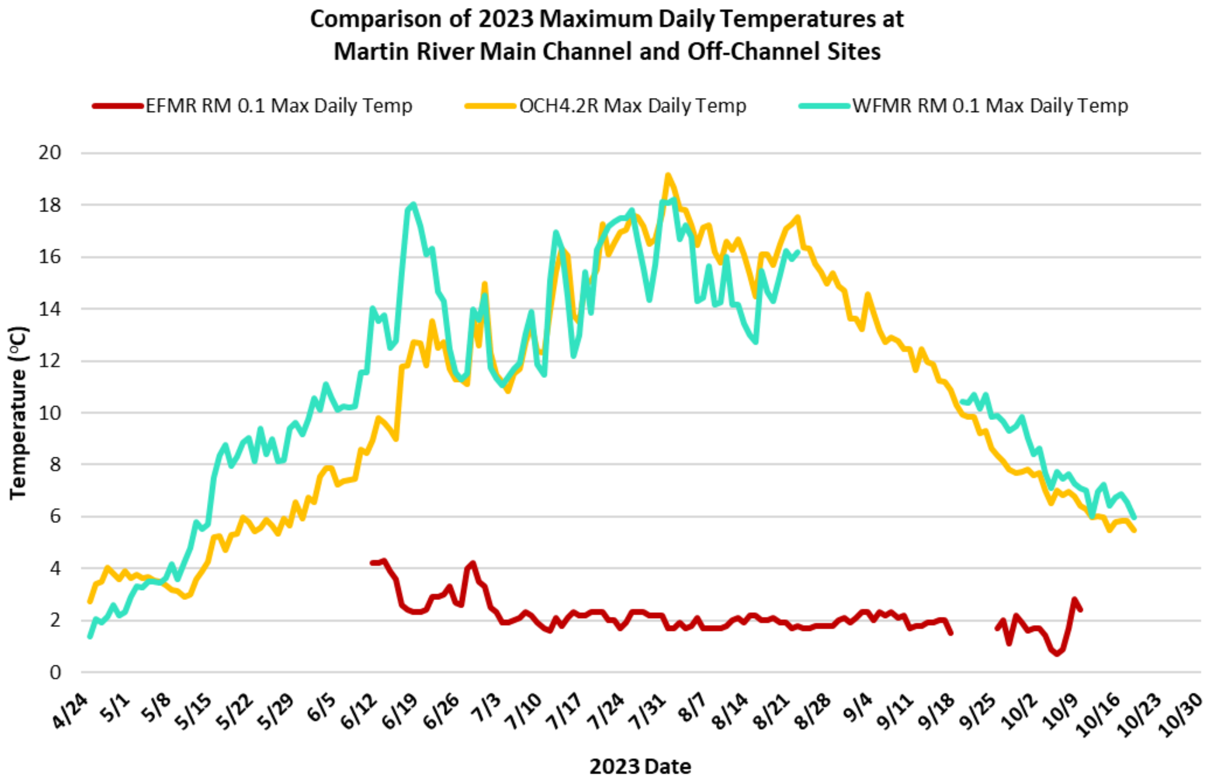

Figure 2-11 Comparison of 2023 maximum daily temperatures at Martin River main channel and off-channel sites.

2.5.2 2024 Results

Martin River hydrology in 2024 influenced water quality parameters in the Martin River as well as other metrics such as habitat characterization, fish use, and geomorphologic changes that resulted from an atmospheric river precipitation event on August 6 and 7, 2024. The USGS gages at the EFMR (USGS Gage No. 15238951) and nearby Battle Creek (USGS Gage No. 15238986) both recorded peak annual gage height on August 7 (Figure 2-12). The EFMR gage does not report discharge, but the storm event resulted in an increase at Battle Creek from 45.5 cubic feet per second (cfs) on August 4 to 1,520.0 cfs on August 7, 2024, though the flow was likely higher than that as the USGS gage has a maximum reading of 1,520 cfs. The storm event resulted in significant changes to local geomorphology including avulsions, channel changes, gravel deposition, and large wood recruitment and deposition. These changes are described more fully in the Geomorphology Report (Watershed GeoDynamics 2025).

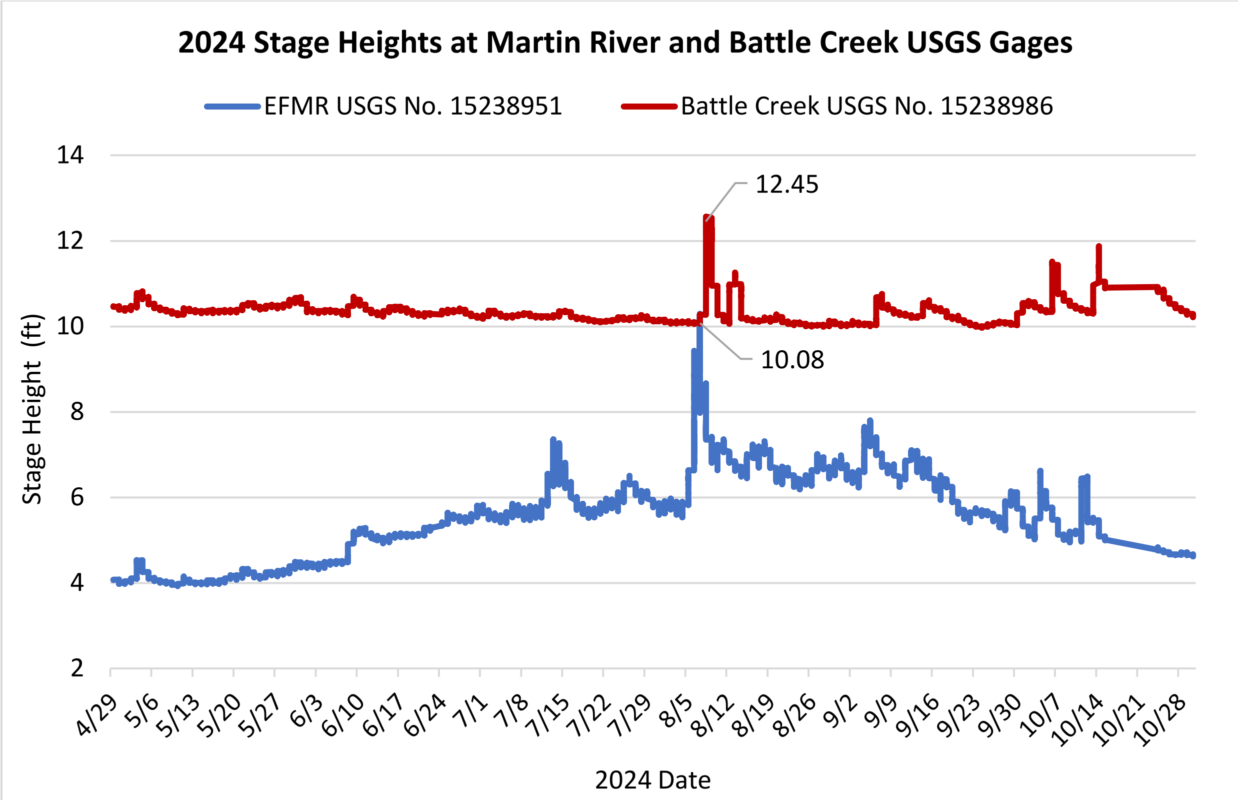

Figure 2-12 2024 stage height data for the EFMR (USGS Gage No. 15238951) and nearby Battle Creek (USGS Gage No. 15238986).

2.5.2.1 Point Measurements of Water Quality

Water temperature measurements were similar for EFMR RM 0.1 and Martin River RM 1.9, both main channel sites, with low summer temperatures (<4°C) influenced by glacial meltwater while the off-channel site (OCH4.2R) and the outlet of Red Lake (WFMR RM 0.1) had considerably warmer summer temperatures ranging from 8 to 12°C, indicative of storage and warming in the small, silty or tannic lakes that flow into the mainstem (Figure 2-13). The mainstem at RM 1.9 was consistently slightly warmer than the EFMR, as there are several inputs from off-channel/tributary complexes draining hillslopes and lakes without glacial influence downstream of the EFMR and WFMR confluence, but the site did remain colder than all OCHs by 2 to 10°C. The differences in temperatures across sites were greatest in July and August. There were no point-measurement exceedances of ADEC Water Quality Standards for Alaska Fresh Water Uses which specifies that waters shall not be greater than 13°C during spawning and 15°C during migration and rearing of fishes (ADEC 2020).

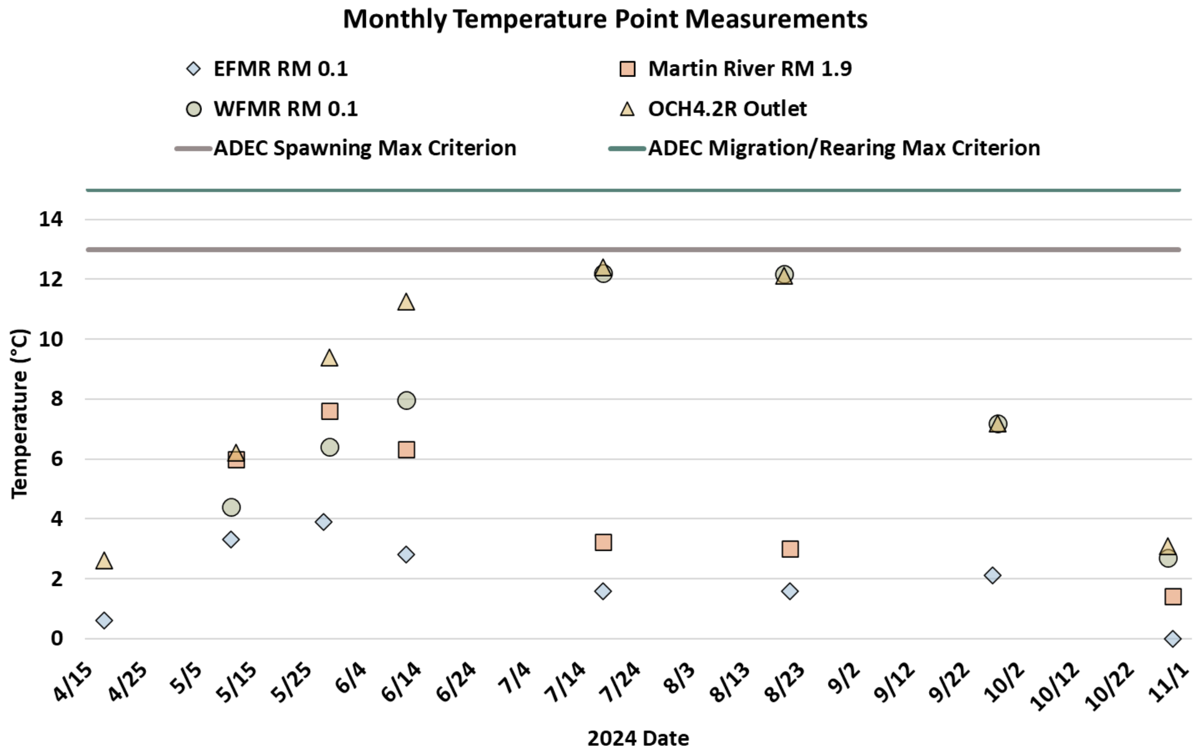

Figure 2-13 Monthly temperature data measured at the four Martin River basin water quality monitoring locations.

In 2024, the summer temperatures measured at the WFMR RM 0.1 and OCH4.2R outlet sites were lower than point measurements taken in 2023 by nearly 4°C. The maximum recorded temperature at these sites was 15.6°C (August 24, 2023, WFMR RM 0.1) and 16.2°C (July 20, 2023, OCH4.2R) (Kleinschmidt 2024). The significant flood event on August 6 and 7, 2024 may have altered the summer thermal regime in the basin, particularly as low elevation lake habitats including Red Lake were inundated with Martin River floodwater. The highest point measurements of water temperature at the EFMR RM 0.1 and Martin River RM 1.9 sites were similar between years, not exceeding 4.5°C in 2023 and 7.5°C in 2024.

DO concentrations (percent and mg/L) were highest during the period of spring snowmelt run-off and high seasonal flows, which occurred in June of 2024, and during mid-August at mainstem sites EFMR RM 0.1 and Martin River RM 1.9 following a high flow event. During warm summer months, DO concentrations diverged between mainstem sites influenced by cold glacial runoff, and off-channel sites (OCH4.2R and WFMR RM 0.1) which are fed by warm water lakes (OCH4.2R) and glacially turbid lakes with low light penetration (Red Lake), both generally associated with lower DO concentration than cold flowing water. DO concentration did not exceed the Water Quality Standards for Alaska Fresh Water Uses (ADEC 2020) for maximum saturation criteria of DO of 110 percent (Figure 2-14), or fall below the minimum standards of 7.0 mg/L (Figure 2-15).

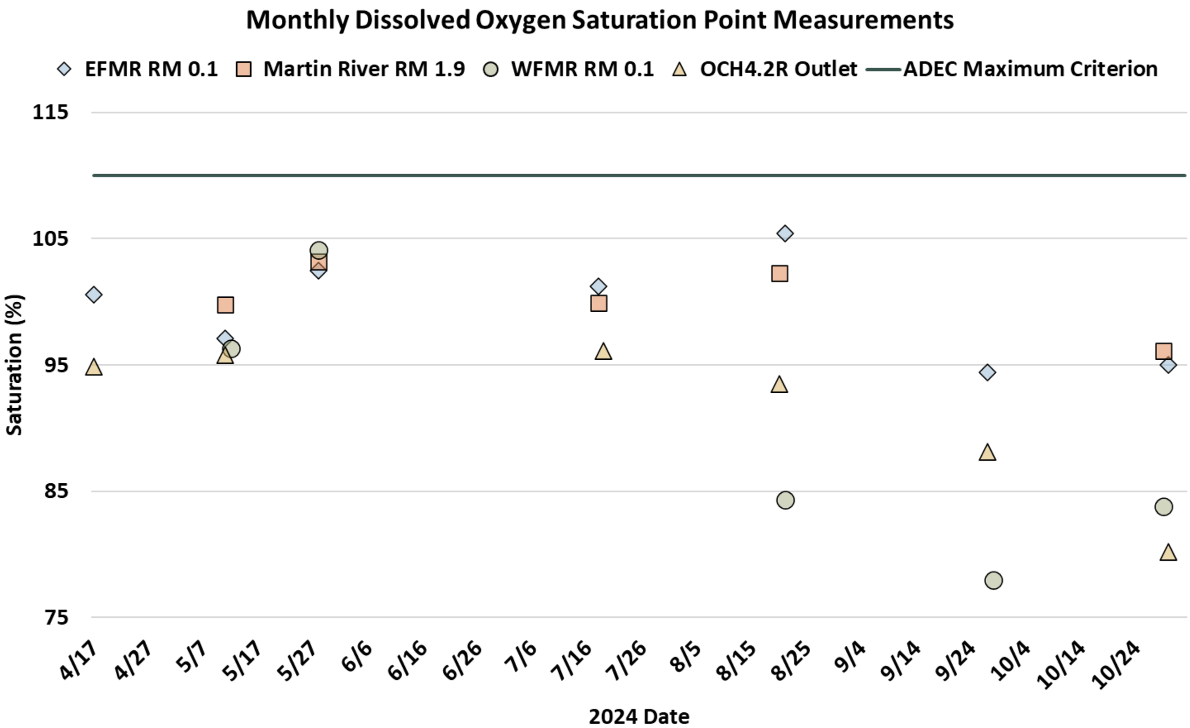

Figure 2-14 2024 monthly point measurements of DO (percent saturation) at water quality monitoring sites in the Martin River basin.

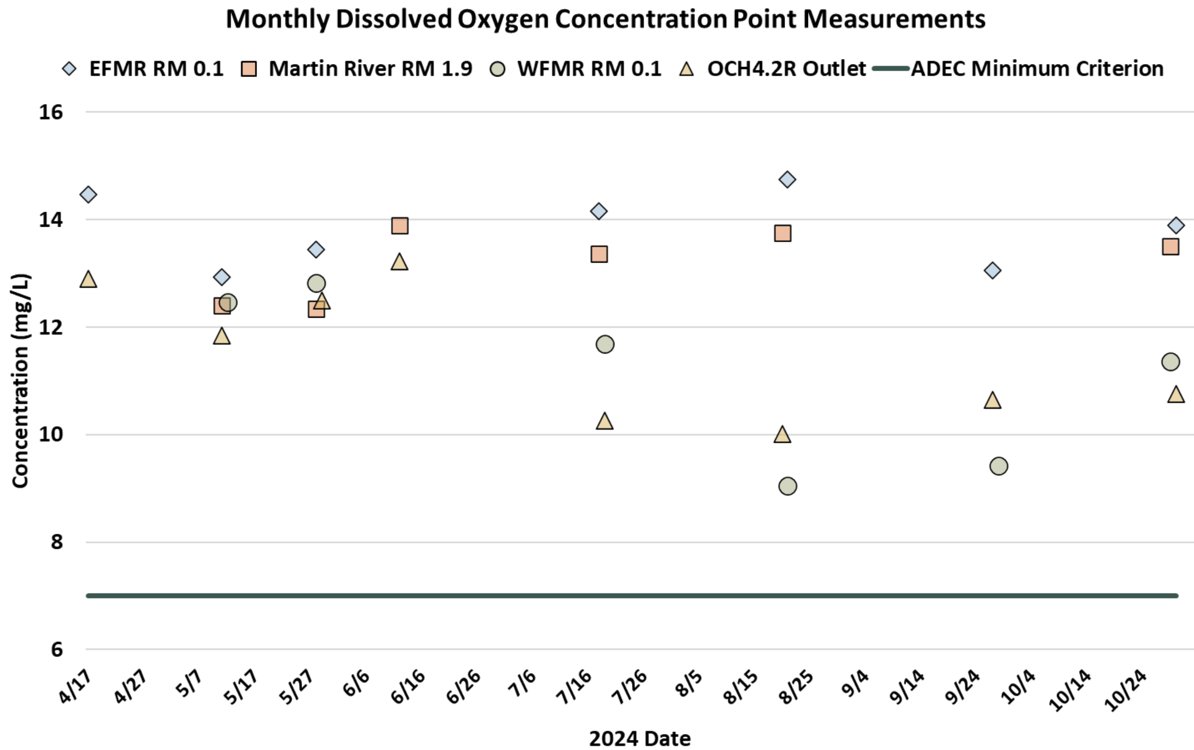

Figure 2-15 2024 monthly point measurements of DO (mg/L) at water quality monitoring sites in the Martin River basin.

As observed in 2023, turbidity in mainstem sites increased with warming weather in June as glacial runoff influenced mainstem flows more than snowmelt from the surrounding hillslopes, peaking above 240 NTUs which was the maximum turbidity measurable by the turbidity tube. Prior to glacial melt, turbidity was under 10 NTUs at all locations. Turbidity at OCH4.2R, which is fed by a clear, tannic lake, remained below 50 NTUs except during August following a flood event that inundated the low-elevation lake with turbid mainstem floodwater, increasing turbidity to 75 NTUs for the August measurement. Despite the turbid nature of Red Lake from the August 2024 event, turbidity in the outlet (WFMR RM 0.1) was low throughout the season (NTUs <10), suggesting that glacial silt may settle out in the lake resulting in relatively clearwater runoff. During October when glacial re-freezing was expected to have occurred, turbidity at all sites returned to near zero (NTUs <5) (Figure 2-16).

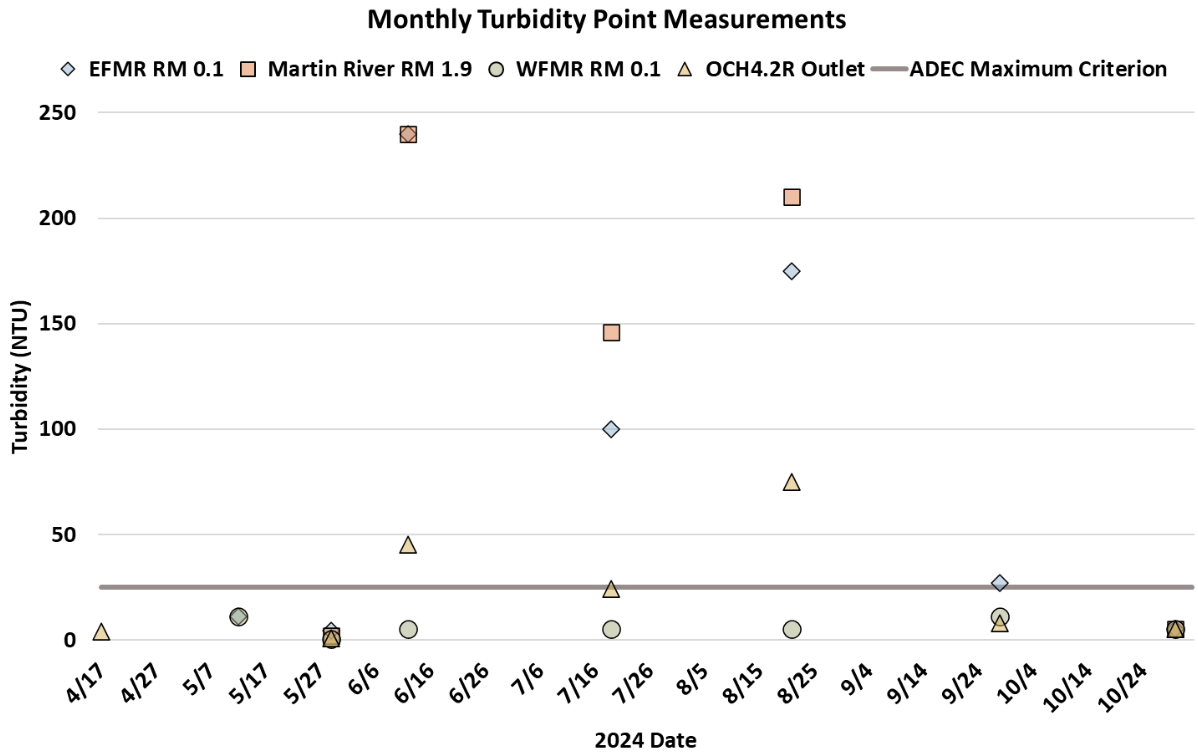

Figure 2-16 2024 monthly point measurements of turbidity (NTUs) at water quality monitoring sites in the Martin River basin.

Specific conductance and pH measurements were taken at water quality monitoring sites. Unlike other water quality metrics, there was less variation between sites for specific conductance (Figure 2-17) for which there are no standards identified in Water Quality Standards for Alaska Fresh Water Uses (ADEC 2020). Specific conductance was highest across all sites (200-400 µS/cm) during spring measurements in May and decreased precipitously to under 100 µS/cm by mid-June. Specific conductance remained low across all sites throughout the warm months, and then increased with the onset of colder weather and increased frequency of rain events in the fall during September and October measurements.

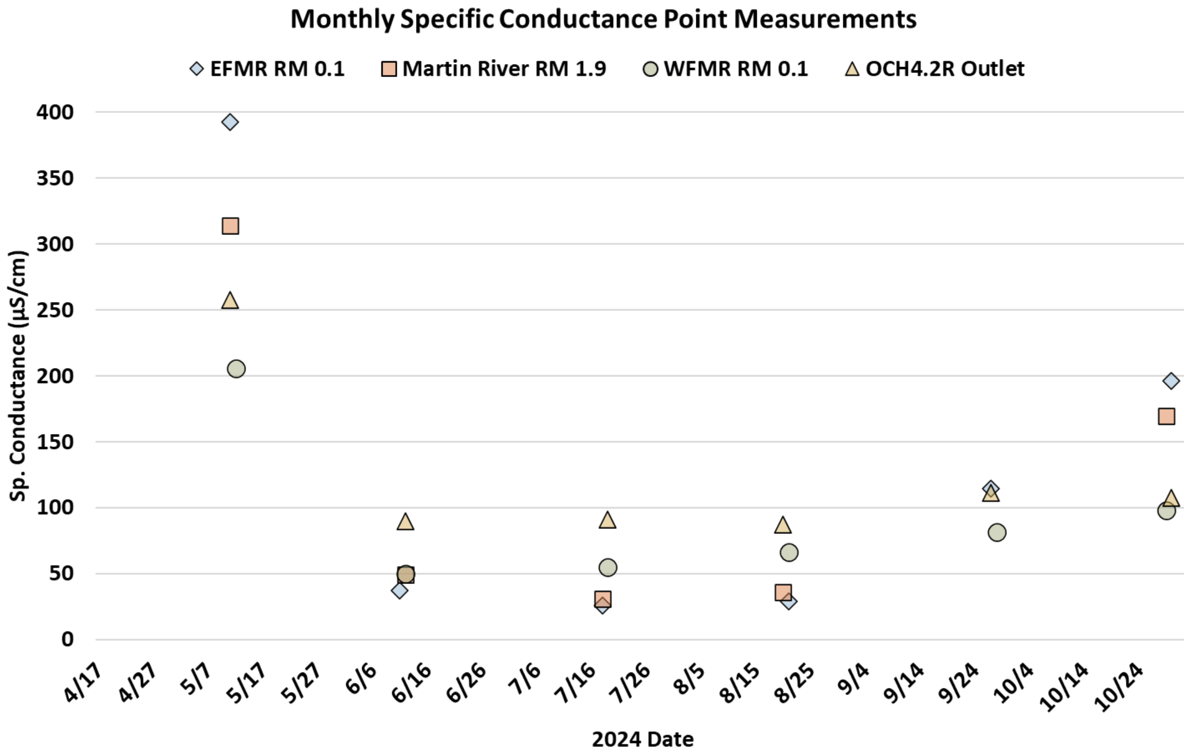

Figure 2-17 2024 monthly point measurements of specific conductance at water quality monitoring sites in the Martin River basin.

Water Quality Standards for Alaska Fresh Water Uses (ADEC 2020) specify that pH must be between 6.5 and 8.5. There were slight variances in pH between sites, likely due to changing source water (snow melt vs. glacial melt, mainstem vs. lake or groundwater), however, there were no exceedances of criteria for pH in 2024 (Figure 2-18).

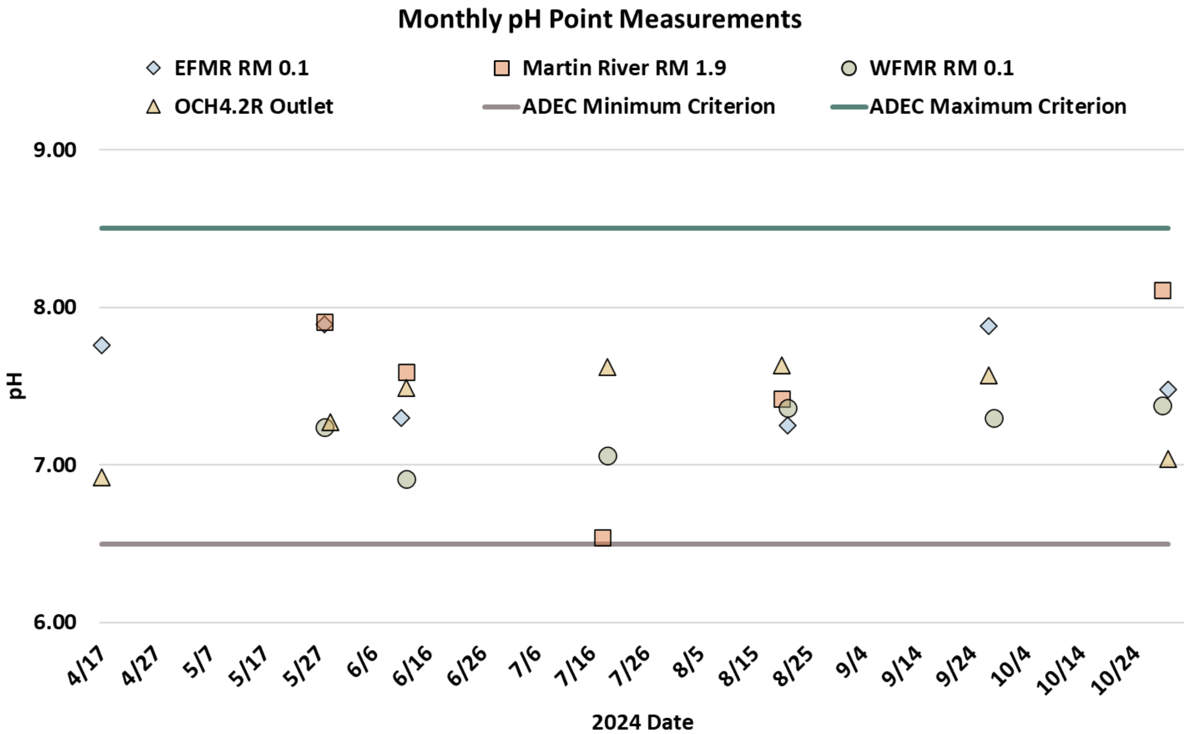

Figure 2-18 2024 monthly point measurements of pH at water quality monitoring sites in the Martin River basin.

2.5.2.2 Continuous Temperature Data

The WFMR water quality monitoring site measures the temperature of water flowing out of Red Lake and into the Martin River and was positioned near the Alaska Department of Fish and Game (ADF&G) fish counting videography equipment. Due to the longer residence time in the lake and anticipated lack of glacial influence relative to riverine locations, water flowing from the surface of the lake was expected to be higher in temperature, especially in summer months, which is reflected in similar daily maximum temperatures to estimates of daily maximum air temperature, as measured by the nearby barologger installed at the side slough (SS) at RM 2.8 on the right bank (OCH2.8R-SS-1).

The water temperature at WFMR RM 0.1 exceeded the Water Quality Standards for Alaska Fresh Water Uses (ADEC 2020) for temperature. Summer water temperatures in June, July, and August included over 77 days of maximum temperature over 13°C. Although two sets of thermistors were installed in WFMR RM 0.1, temperature data were not recorded for the period from July 19 to August 23, 2024 by either instrument, likely related to large flow events in early August or wildlife tampering, resulting in a data gap (Figure 2-19).

Water temperature during this period was likely similar to the period before and after the data gap as the air temperature and flow conditions were not sufficiently different and would be primary drivers of water temperature. During the migration period of fall-spawning Coho (*Oncorhynchus kisutch*) and Sockeye (*O. nerka*) salmon, water temperatures were within criteria for spawning (13°C) and rearing (15°C) at this location.

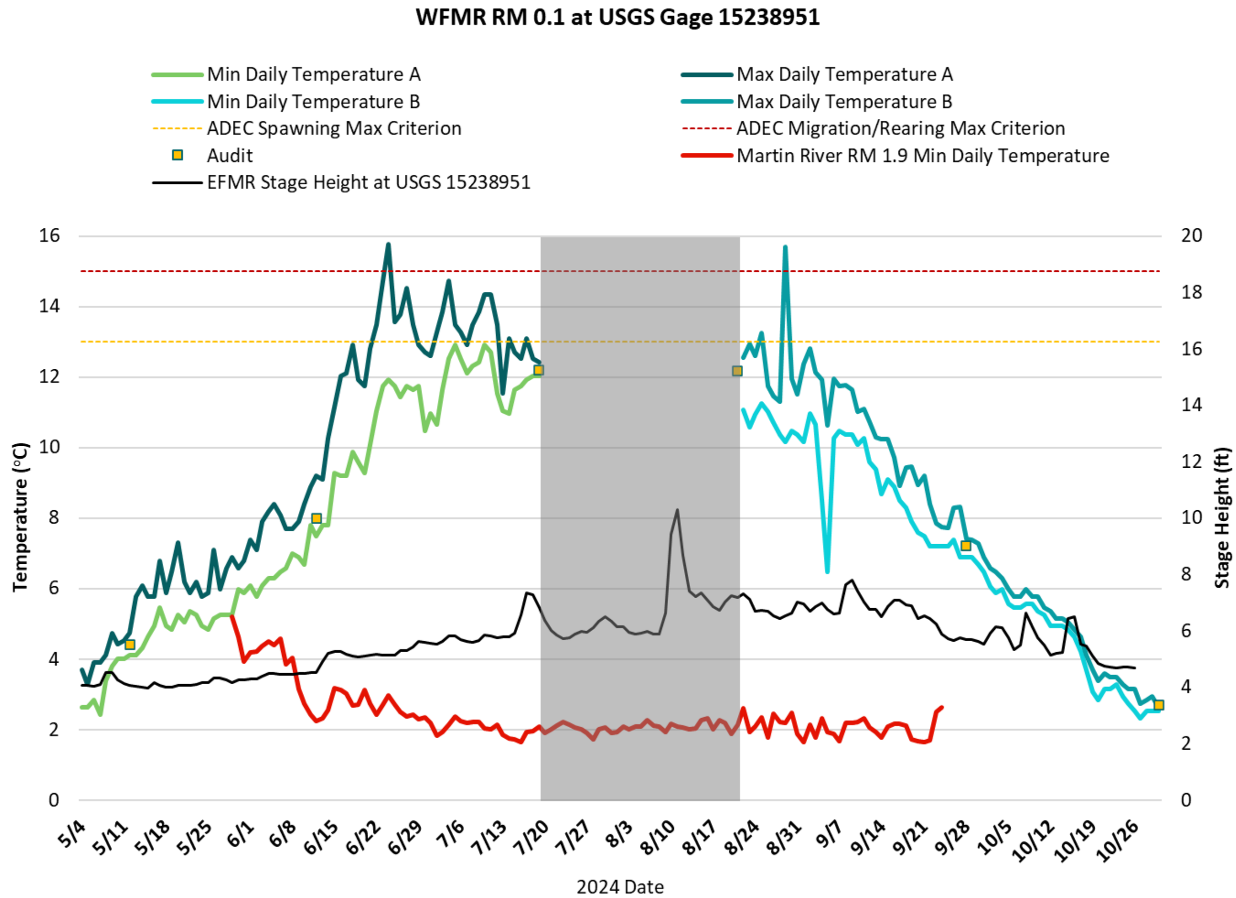

Figure 2-19 2024 minimum and maximum daily water temperature measured at the outlet of Red Lake, site WFMR RM 0.1.

The water quality monitoring location at the OCH4.2R side slough was intended to determine the temperature of outflow from two source lakes and their inflowing streams. The lake is shallow, encroached with grasses, sedges, and aquatic vegetation, has dark, tannic water, and full sun exposure. The conditions in the lake resulted in elevated water temperatures (>20°C) in the outflowing OCH4.2R immediately downstream of the lake where the instrument was installed. The additional thermistor installed closer to the confluence between OCH4.2R and the mainstem recorded slightly cooler temperatures during warm weather when this OCH was influenced by flow from the mainstem rather than the lake.

During this period, the daily maximum water temperature in OCH4.2R both upstream and at the confluence locations were greater than 13°C for 30 days and greater than 15°C for more than 22 days (Figure 2-20), exceeding the Water Quality Standards for Alaska Stream Uses for spawning and migration/rearing, respectively (ADEC 2020). During the high flow event on August 6-7, 2024, the entire area was inundated with water from the mainstem, possibly even overflowing the lake which is evident by the influence of cold water at both instruments beginning on that date. When Coho and Sockeye salmon were observed spawning and migrating in September and October of 2024, water temperatures at this site were well below the criteria for both life-history stages though none were observed to use this habitat for spawning.

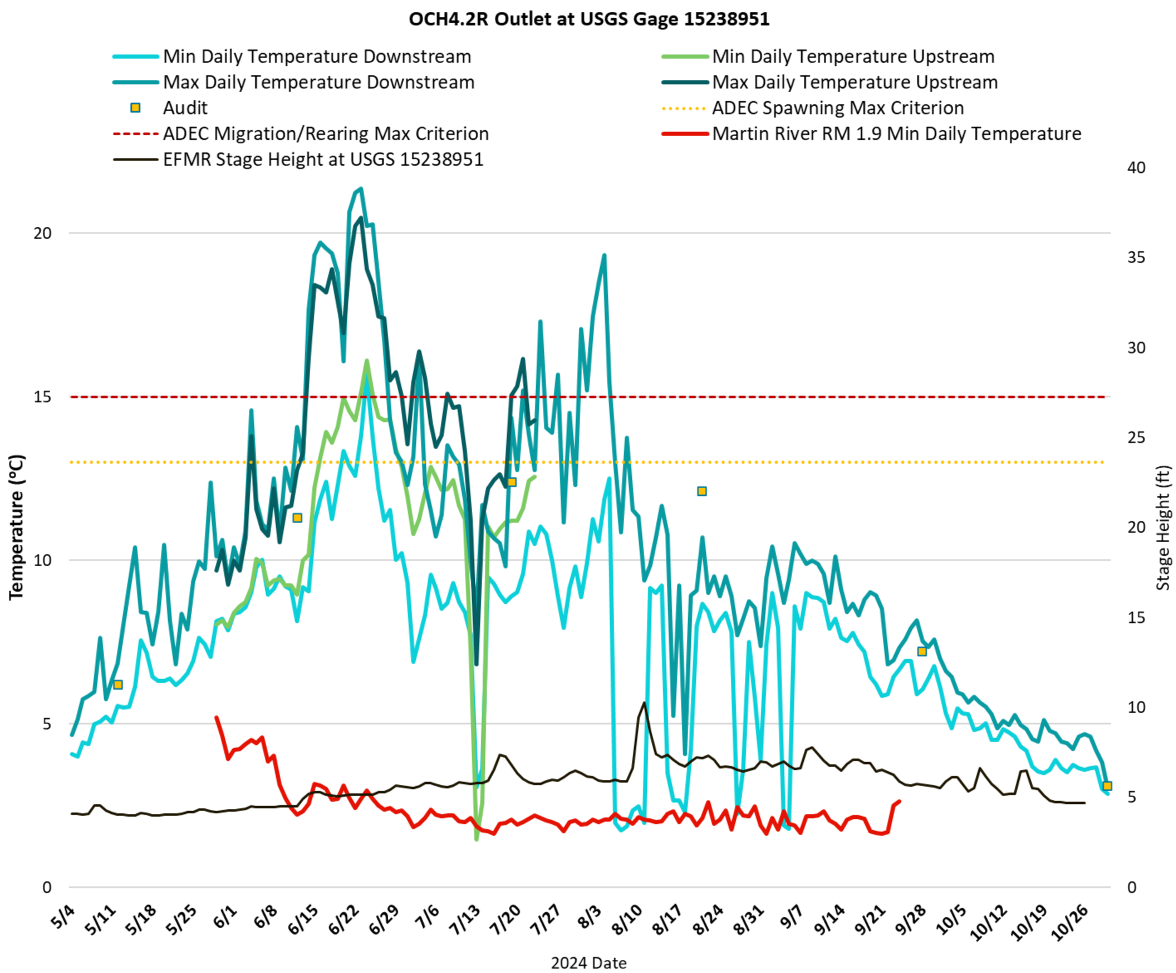

Figure 2-20 2024 minimum and maximum daily water temperature measured at the Martin River off-channel OCH4.2R outlet.

Data for the EFMR immediately upstream of the confluence with the West Fork (Red Lake) outlet was collected by the USGS at Gage No. 15238951 and is reported here for comparison to other sites. Glacial meltwater from the Dixon Glacier flows through the EFMR to the downstream mainstem Martin River RM 1.9 site where summer water temperatures were below 5°C during the low flow period of the summer when the EFMR was below 3°C for the hottest months of the year when glacial inputs were present (Figure 2-21).

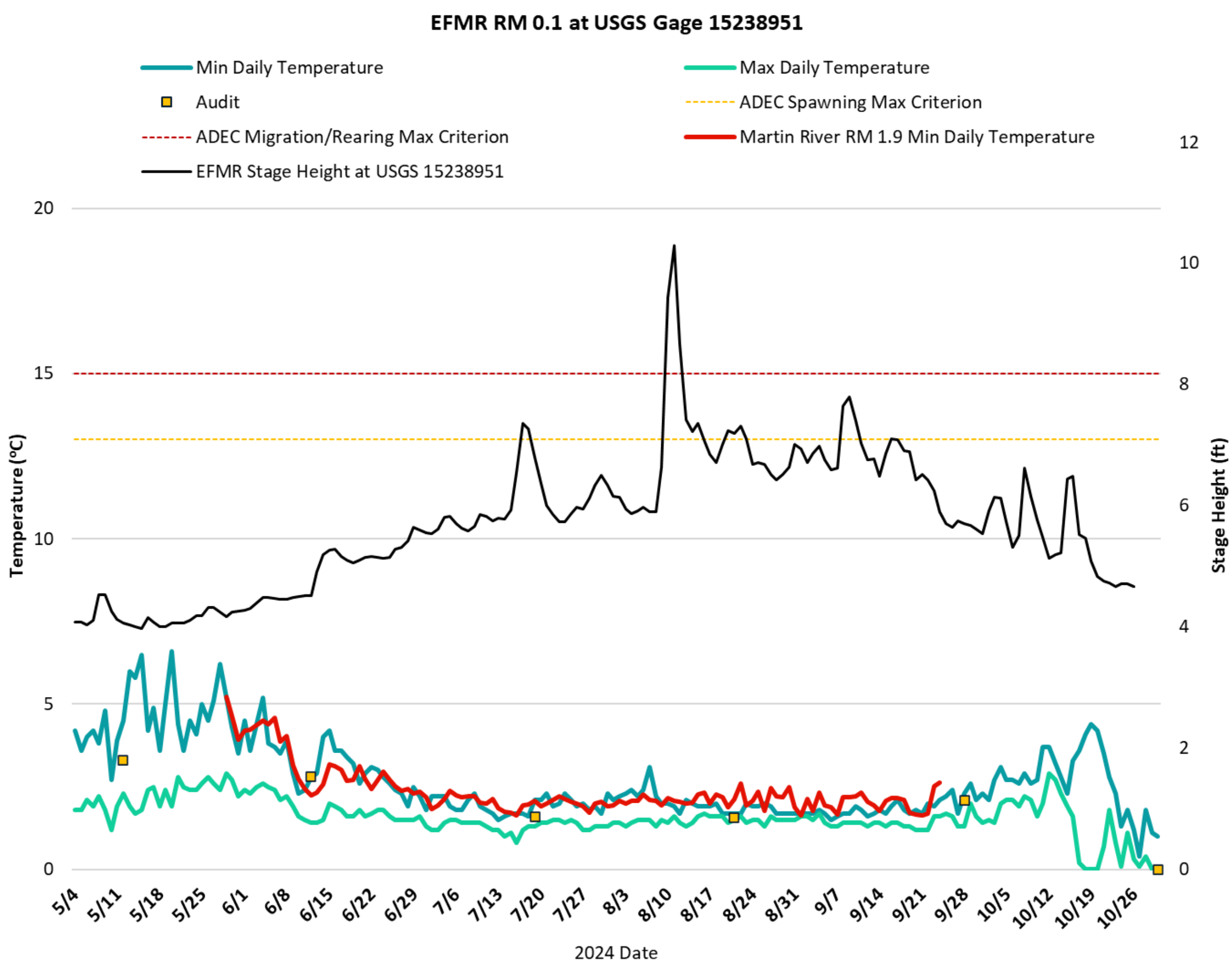

Figure 2-21 2024 minimum and maximum daily water temperature data at the mouth of the EFMR USGS Gage No. 15238951.

Data for the mainstem Martin River at the constriction near RM 1.9 was collected from May 28th to September 24th and recorded peak temperatures during late May of 6-8°C and became colder as glacier meltwater influenced mainstem flow, resulting in low summer temperatures of less than 5°C. The Water Quality Standards for Alaska Fresh

Water Uses (ADEC 2020) were not exceeded for temperature (Figure 2-22). In fact, the mainstem (and adjacent side channel when inundated) indicate that there was little temperature difference between this main channel site and the EFMR. During low flow, the mainstem at RM 1.9 ranged from 2 to 5°C while the EFMR ranged from 1 to 3°C. There was a slight response in daily maximum temperature following the August flood event where mainstem temperature increased from 4-5°C to over 6°C.

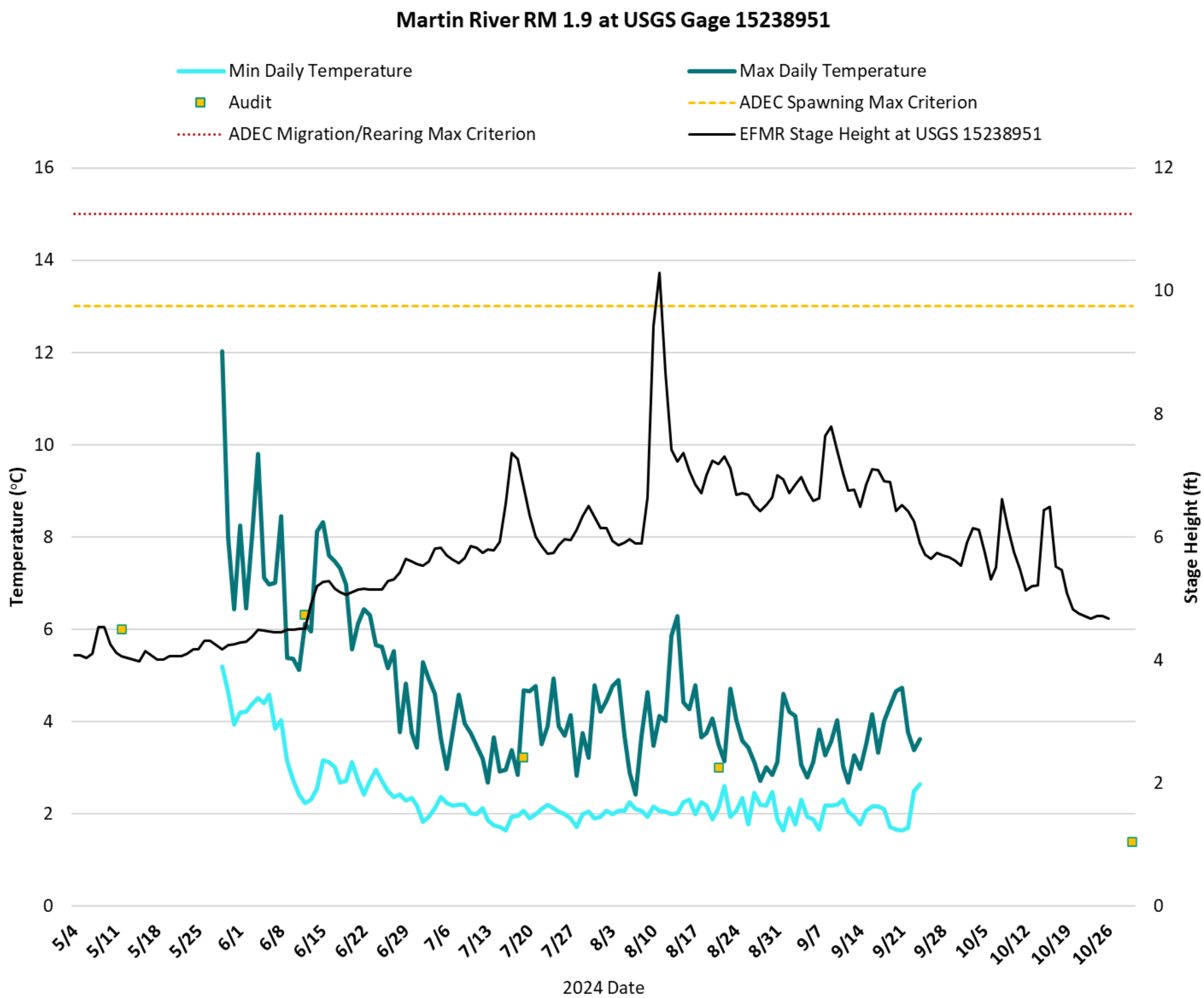

Figure 2-22 2024 minimum and maximum daily water temperature measured at the mainstem Martin River RM 1.9 site.

A comparison of maximum daily temperature at all four monitoring sites together clearly indicates where cold water influence from the main channel Martin River dictates the thermal regime of instream habitats, and where warmer source water from either runoff, groundwater, or lakes influence temperature. Figure 2-23 depicts these trends, with cold summer temperatures at the USGS Gage on EFMR and the mainstem at RM 1.9 where glacial meltwater results in cold summer temperatures in contrast to the warmer temperatures documented at the outlet to Red Lake at WFMR, and at OCH4.2R which are fed by warm water lakes on the floodplain.

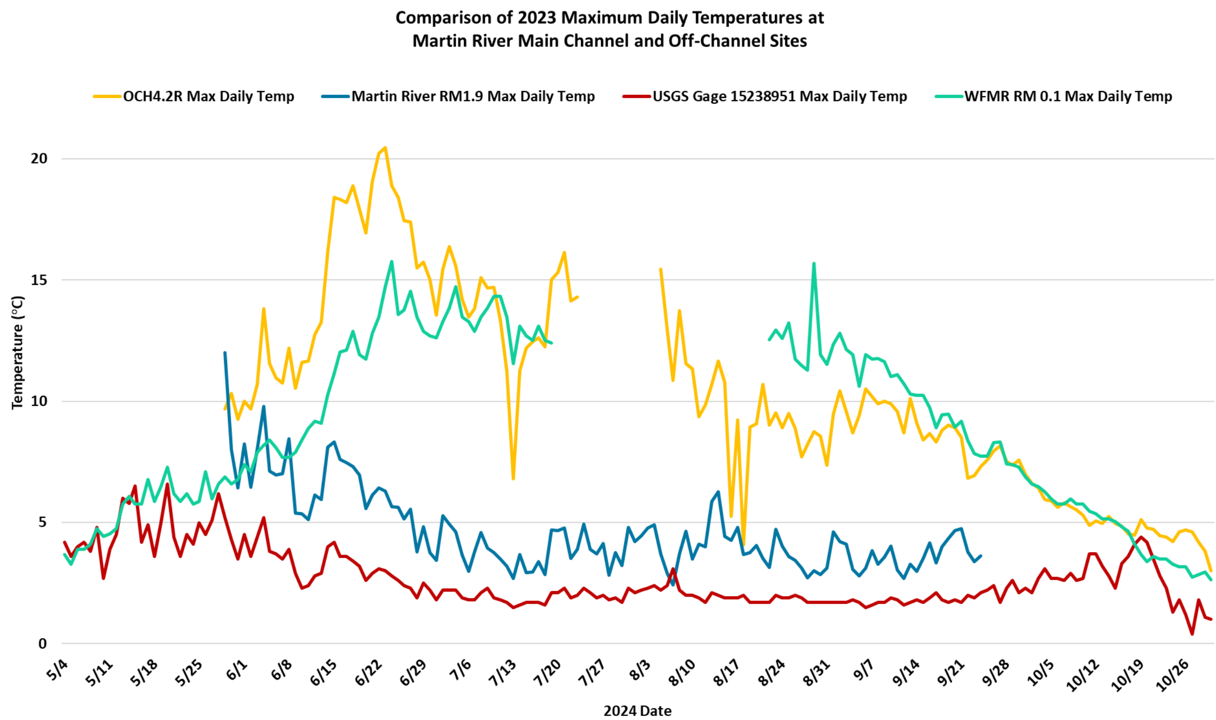

Figure 2-23 Comparison of 2024 maximum daily temperature measured at Martin River main channel and off-channel sites.

2.5.3 Multi-Year Compliance with Water Quality Standards

Water temperature criteria for the growth and propagation of fish, shellfish, other aquatic life, and wildlife include criteria for various uses at temperature thresholds of 13°C, 15°C, and 20°C (ADEC 2020). Water temperature monitoring over 2023 and 2024 identified several exceedances of these water quality standards at the WFMR and OCH4.2R sites. The EFMR and mainstem Martin River constriction at RM 1.9 remained less than 6°C throughout the monitoring period in both years.

In 2023, at the Red Lake outlet monitoring site (WFMR RM 0.1), daily maximum water temperatures exceeded the criteria for spawning areas and egg and fry incubation (13°C) for 61 days between June 22 and September 6. Daily maximum water temperatures exceeded the criteria for rearing areas and migration routes (15°C) for 43 days between

July 13 and August 29, 2023. Water temperatures at the Red Lake outlet monitoring site did not exceed 20°C during the monitoring period. In 2024, there was a gap in the data record from July 19 to August 20 because the temperature logger was out of the water, so the 21 days of 13°C exceedance and 2 days of 15°C exceedance likely underestimates actual exceedance days in 2024.

In 2023, daily maximum water temperatures at the Martin River off-channel monitoring site OCH4.2R exceeded the criteria for spawning areas and egg and fry incubation (13°C) earlier, starting on June 12, and first exceeded the criteria for rearing areas and migration routes (15°C) on June 17 (Table 2-5). The duration of these exceedances was truncated by a gap in daily maximum estimates between August 24 and September 19, 2023. In 2024, there was a continuous temperature record until July 20 at the OCH4.2R site which documented the first exceedance of the 13°C criteria for spawning and rearing areas from June 17 through June 28, 2024, with a single-day exceedance of the 15°C criteria on June 24 (16°C).

DO criteria applicable to these monitoring sites require concentrations greater than 7 mg/L in waters used by anadromous or resident fish and concentrations of total gas may not exceed 110 percent of saturation. The only site with values outside these criteria was the WFMR site, with concentrations greater than 110 percent on July 20, 2023.

Table 2-5 Water quality standards for temperature and 2023 and 2024 exceedances for Martin River monitoring stations at Red Lake outlet and OCH4.2R.

Criterion	Fish Use	Number of Days Exceeding Criteria			
		2023		2024	
		Red Lake Outlet	OCH4.2R Outlet	Red Lake Outlet	OCH4.2R Outlet
≤13°C	Spawning areas, egg, and fry incubation	61	37	21[1]	39
≤15°C	Migration routes, rearing areas	43	11	2[1]	24
≤20°C	Growth and propagation of fish, shellfish, other aquatic life, and wildlife	0	0	0	5

[1] Data gaps exist from July 19 to August 20, 2024, at the WFMR (Red Lake outlet) in 2024 which results in probable underestimation of exceedance days at this site.

2.6 Discussion

Water temperature data collection at the USGS Gage near the proposed diversion location (USGS Gage No. 15238950 EFMR below Dixon Glacier) began on November 9, 2021, and ended in June 2023 (USGS 2022). During 2022 monitoring, the maximum daily water temperature was 0.7°C on June 5, 2022. Water temperature data collection began at USGS Gage No. 15238951 located at the mouth of the EFMR on June 1, 2023, and is ongoing (USGS 2024) at this site.

In 2023, AEA implemented the water quality monitoring methods described in the DSP (AEA 2022b). Water quality data for the Martin River in 2023 were summarized in a February 2024 report (Kleinschmidt 2024). In general, mainstem Martin River water temperatures were very low (0.3-5.3°C) whereas water temperatures in non-glacial habitats varied seasonally and were occasionally more than 10°C warmer than the mainstem during July and August. DO concentration and percent saturation were relatively high in May through October across all monitoring sites, with exceptions at sites where source water included runoff from lakes. Specific conductance varied slightly between sites, but seasonal trends were more marked with peaks over 150 µS/cm before spring runoff when the dilution of minerals in source water was low and dropped to less than 50 µS/cm across all sites as run off and glacial melt diluted mineral concentration in surface water.

AEA monitoring documented pH levels ranging from 5.9 to 7.9 across sites over the monitoring period in 2023 and 2024 with minor seasonal variations associated with changes in the influence of source water at study locations. Turbidity levels in the glacially influenced EFMR and mainstem Martin River monitoring sites were consistently greater than 100 NTUs during monitoring events between June and September, peaking at 438 NTUs at the Martin River RM 1.9 monitoring site on August 24, 2023, and at over 240 NTUs during the same period of 2024. Monthly measurements of the Red Lake outlet at the WFMR RM 0.1 site and the Martin River off-channel OCH4.2R site ranged from 0 to 4 NTUs in 2023 and were slightly higher in 2024 following the inundation of these sites by floodwater following the August 6-7 flooding event. Despite the inundation, the turbidity response when measurements were taken about two weeks later had weakened to levels of about 10 NTUs. The monitoring period also captured conditions in April through May and November when turbidity levels were relatively low (less than 2.5 NTUs) across all monitoring sites.

The goal of this study was to characterize water quality in the Martin River to support the evaluation of compliance with water quality criteria under current conditions at established monitoring sites. To achieve this goal, continuous water temperature data and monthly measurements of water temperature, DO, turbidity, conductivity, and pH were collected in the EFMR, WFMR downstream of Red Lake, the outlet of Martin River OCH at RM 4.2 (OCH4.2R), and the mainstem Martin River at the constriction near RM 1.9 to characterize current water quality conditions.

In 2023, equipment losses in the mainstem due to flooding resulted in data gaps in the characterization of water quality parameters across all sites (see 2023 Water Quality Report, Kleinschmidt [2024]). Adjustments to equipment deployment in 2024 resulted in the successful addressing of some data gaps, while a significant flooding event associated with atmospheric river rainfall on August 6-7, 2024, created challenges for continuous monitoring at others (e.g., WFMR), as described above.

The general pattern of temperature increases between the upstream and downstream sites over approximately 3.6 RMs appeared to be influenced by both season and EFMR flows. When the non-glacial WFMR and Martin River OCHs cooled in the fall, the longitudinal difference between the mainstem site and the EFMR decreased. Similarly, when river flows were high and the Dixon Glacier contributed the highest proportion of total Martin River flow, as represented by conditions in late August, the difference between the EFMR and lower mainstem Martin River site also decreased.

Overall, the mainstem Martin River receives significant input from the EFMR which delivers glacial meltwater below 4°C throughout the year. The WFMR, which drains Red Lake, contributed warmer water that averaged 12-13°C in the summer months and exceeded 20°C when hot weather caused thermal loading on the lake surface. Despite the input of warmer water from the WFMR and other off-channel areas, temperatures at mainstem sites downstream were only 2-3°C warmer than EFMR during water temperature monitoring efforts in both 2023 and 2024.

Off-channel habitats monitored for water quality, including OCH4.2R, as well as many other off-channel sites included in the Aquatic Habitat Characterization Study (see Section 3.0), receive input from non-glacial sources including primarily feeder lakes perched above the valley floor, and possibly also groundwater sources which provide clear water flow that is visually distinct from turbid mainstem inputs. At off-channel sites, there were periodic water quality exceedances for maximum daily water temperature during periods when brown water source lakes received the most thermal loading and contributed warm water to OCHs, but the exceedances were mostly in maximum daily temperatures, not long periods of 24-hour exceedances. The presence of rearing Coho Salmon and Dolly Varden (*Salvelinus malma*) at all sites where these exceedances were observed indicates that the fish community persists despite occasional periods of warm water (see Fish Use Study, Section 4.0).

Other water quality parameters measured at the four monitoring stations in both years do not signify any concerns relative to Water Quality Standards for Alaska Fresh Water Uses (ADEC 2020) for the Martin River to support Pacific salmon and resident fish species. While the cold, turbid mainstem likely does not represent habitat that is suitable for Coho or Sockeye salmon spawning in the fall when water temperatures were below 2°C, the thermal and water quality conditions in off-channel and lake habitat, as represented by OCH4.2R and the WFMR, suggest that the Martin River is suitable to sustain spawning and other life history stages of fish species in clearwater off-channel portions of the watershed.

2.7 References

Alaska Department of Environmental Conservation (ADEC). 2020. Water Quality Standards. Amended March 5, 2020. Alaska Administrative Code Chapter 70 (18 AAC 70).

Alaska Energy Authority (AEA). 2022a. Initial Consultation Document. Amendment to Bradley Lake Hydroelectric Project, Proposed Dixon Diversion. (FERC No. 8221), April 27, 2022. Available online: https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2022.04.01%20Dixon%20Diversion%20ICD.pdf

Alaska Energy Authority (AEA). 2022b. Draft Study Plan. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Proposed Dixon Diversion. November 2, 2022. Available online: https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2022.11.02%20Dixon%20Diversion%20Draft%20Study%20Plan.pdf

Dahlgren, R., E. Nieuwenhuyse, and G. Litton. 2004. Transparency tube provides reliable water-quality measurements. California Agriculture, 58(3), pp.149-153.

Kleinschmidt Associates. 2024. Water Quality Monitoring. Amendment to Bradley Lake Hydroelectric Project, Proposed Dixon Diversion (FERC No. 8221). Prepared for Alaska Energy Authority. February 2024. Available online:

https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2024.02.01%20Dixon%20Diversion%20Water%20Quality%20Monitoring%20Report.pdf.

Mauger, S., R. Shaftel, E.J. Trammell, M. Geist, and D. Bogan. 2015. Stream temperature data collection standards for Alaska: Minimum standards to generate data useful for regional-scale analyses. Journal of Hydrology: Regional Studies, 4, pp.431-438.

United States Geological Survey (USGS). 2022. NWIS Site Information for Alaska: Site Inventory for USGS 15238950 Dixon Creek Near Homer, AK. Online: https://nwis.waterdata.usgs.gov/ak/nwis/inventory/?site_no=15238950&agency_cd=USGS.

United States Geological Survey (USGS). 2024. NWIS Site Information for Alaska: Site Inventory for USGS 15238951 East Fork Martin River at Mouth Near Homer, AK. Online at: https://nwis.waterdata.usgs.gov/nwis/inventory/?site_no=15238951&agency_cd=USGS

Utah State University. 2022. Utah Water Watch. Turbidity Tube Conversion Chart. Online: https://extension.usu.edu/utahwaterwatch/monitoring/field-instructions/turbidity/turbiditytube/turbiditytubeconversionchart.

Watershed GeoDynamics. 2025. 2024 Geomorphology Report. Amendment to Bradley Lake Hydroelectric Project, Proposed Dixon Diversion (FERC No. 8221). Prepared for Alaska Energy Authority. December 2024.

3.0 AQUATIC HABITAT CHARACTERIZATION STUDY

3.1 Background

The EFMR flows from Dixon Glacier through a high-gradient canyon to the confluence with the WFMR, where it forms the Martin River which flows through a lower-gradient, dynamic glacial outwash plain approximately 5 miles to Kachemak Bay. The Martin River displays a typical channel form of many glacial rivers of braided main channel reaches (interlacing network of branching and recombining channels separated by branch islands and channel bars) where the river flows through a glacial outwash plain comprised of relatively coarse grain deposits (Brittain and Milner 2001). High turbidity (typically >30 NTUs) from large loads of suspended sediment (typically above 20 mg/L with peaks over 2,000 mg/L) in glacial rivers limits instream primary productivity and has important implications for salmonids. Like many glacier-fed rivers in Alaska, the Martin River also contains a complexity of OCHs adjacent to the main channel including side channels, sloughs, backwaters, and channel edges of the active river channel as well as terrace tributaries, tributary mouths, beaver ponds, and upland sloughs of the glacial outwash plain (Wheaton 2002).

In addition to this spatial diversity of habitats, when the glacial component of river flows is reduced in the spring and autumn, improved water clarity and channel stability allow for some algal growth and benthic macroinvertebrate production assuming physical conditions are suitable. Thus, refugia may exist in space and time for aquatic organisms to avoid the harsher conditions of summer when glacier melt is at its maximum and both water temperatures and channel stability are low (Milner 2013).

Characterizing aquatic habitat in the Martin River basin will support resource management goals related to fish and wildlife habitat protection. The operation of the proposed Dixon Diversion Project will have the potential to impact aquatic habitat conditions of downstream waters which in turn can impact aquatic resources. The ADF&G, National Marine Fisheries Service (NMFS), and United States Fish and Wildlife Service (USFWS) have resource management goals directly related to the potentially affected resource.

3.2 Goals and Objectives

The proposed Dixon Diversion Project may impact aquatic habitat in the Martin River by diverting flows from the Dixon Glacier outflow from the EFMR to Bradley Lake. The goal of this study is to characterize the aquatic habitat in the Martin River basin that has the potential to be affected by the proposed Dixon Diversion Project.

Specific objectives are to:

- Provide baseline data to evaluate the potential loss or gain in accessible fluvial habitat that may result from flow diversion, and
- Inform other studies including Martin River Fish Use (see Section 4.0) and the Hydraulic Modeling, Geomorphology, and Aquatic Habitat Connectivity Study (Kleinschmidt Associates 2025; Watershed GeoDynamics 2025).

The purpose of the 2024 field effort under the Aquatic Habitat Characterization Study was to 1) create a GIS-based line map of the mainstem Martin River and its tributaries from the May 2024 aerial imagery; 2) survey the macrohabitats of the mainstem Martin River; 3) survey the mesohabitats of the clear off-channel areas and select tributaries; 4) install a barologger and pressure transducers to measure stream discharge at five off-channel and tributary sites, and 5) install temperatures loggers to measure stream temperatures at several off-channel and tributary sites; and 6) opportunistically document the accessibility of aquatic habitat to juvenile and adult fishes at off-channel and tributary confluences with the mainstem Martin River and/or other intermediary habitat (i.e., lakes, sloughs, backwaters, etc.), as well as identifying any potential fish passage barriers in the East Fork of the Martin River.

3.3 Study Area

The study area for the Aquatic Habitat Characterization Study includes the mainstem Martin River and associated off-channel, side-channel, and tributary habitats between the upper extent of tidewater at the downstream point and the lower portion of the EFMR and Red Lake outlet at the upper extent. Habitats within the watershed that were identified during GIS remote line mapping and were determined to be potentially assessable to fish were selected for ground-based habitat surveying (Figure 3-1).

Figure 3-1 Martin River aquatic habitat study area.

3.4 Methods

This study used remote mapping of macrohabitats in combination with ground-based habitat data collected in off-channel, clearwater habitats that may be of particular importance to fish. Remote mapping was the primary basis for quantifying turbid mainstem habitats, off-channel areas and tributary habitats to support the first study objective. Ground-based surveying provided the primary basis for supporting the second study objective of informing coordinated studies including the Martin River Fish Use Study and Hydraulic Modeling, Geomorphology, and Aquatic Habitat Connectivity Study (AEA 2022b). Ground-based habitat surveys of the mainstem Martin River and off-channel areas targeted low-flow conditions in the spring and were conducted concurrently or at similar flows as the 2024 aerial imagery and light detection and ranging (LiDAR) collection dates to capture the maximal extent of low-turbidity conditions in OCHs. Tributaries were predominately surveyed during the fall of 2024. No winter surveys were proposed as the Dixon Diversion Project would not operate during winter and Bradley Lake Project operations would not impact existing winter conditions. Both the remote mapping analysis and ground surveying data collection are described in the sections below.

3.4.1 Habitat Characterization

Methods to characterize the aquatic habitat at Martin River study sites included a Geographic Information System (GIS) desktop assessment of aerial imagery and LiDAR and remote line mapping to establish study sites followed by field-based surveys to verify remote mapping results and collect site-specific data on habitat available for fishes.

Data derived from aerial imagery and LiDAR were used to generate a geospatial database within a GIS framework. Remote line mapping of habitats in the study area was completed using a hierarchically nested habitat typing system. The habitat classification hierarchy was composed of three levels representing: 1) geomorphic reach; 2) macrohabitat type; and 3) mesohabitat type.

3.4.1.1 Geomorphic Reach Characterization

The Martin River was categorized into geomorphic reaches as part of the Hydraulic Modeling, Geomorphology, and Aquatic Habitat Connectivity Study (see Watershed GeoDynamics 2025). The geomorphic reach breaks were based in part on factors including: 1) planform type (single channel, island/side channel, braided); 2) confinement (approximate extent of floodplain, off-channel features); 3) gradient; 4) bed material/geology; and 5) river confluences.

In 2023, twelve geomorphic reaches were assigned using a combination of 2022 LiDAR and aerial photography supported by 2023 field observations (Watershed GeoDynamics 2024). The mitigation pond levee breach in August 2023 resulted in changes to the mouth of the river that required re-mapping of these areas with the updated spring 2024 remote sensing data (Watershed GeoDynamics 2025).

3.4.1.2 Macrohabitat Mapping

To characterize Martin River macrohabitats, a linear network was created in GIS by drawing segments along the stream channel centerline as viewed using aerial imagery or LiDAR shot in the spring of 2024, combined with 2022 LiDAR which covered a larger portion of the watershed (Figure 3-2). Each habitat feature was traced from the 2024 orthophotos, moving from upstream to downstream, based on the visual cues and macrohabitat classification outlined in Table 3-1. Accuracy was ensured by cross-referencing with additional spatial data layers, such as LiDAR hill shades and field survey data. Ground-based habitat data collection along the entire Martin River was impractical due to the complexity of channel plan form, the remoteness, and the flashy, high gradient and turbulent nature of the river. Thus, an arial survey was conducted by helicopter, delineating the predominate macrohabitat types in each geomorphic reach. A sample of macrohabitat classifications were ground-truthed during the spring. Attribute data was assigned to each digitized feature according to the definitions and field surveys.

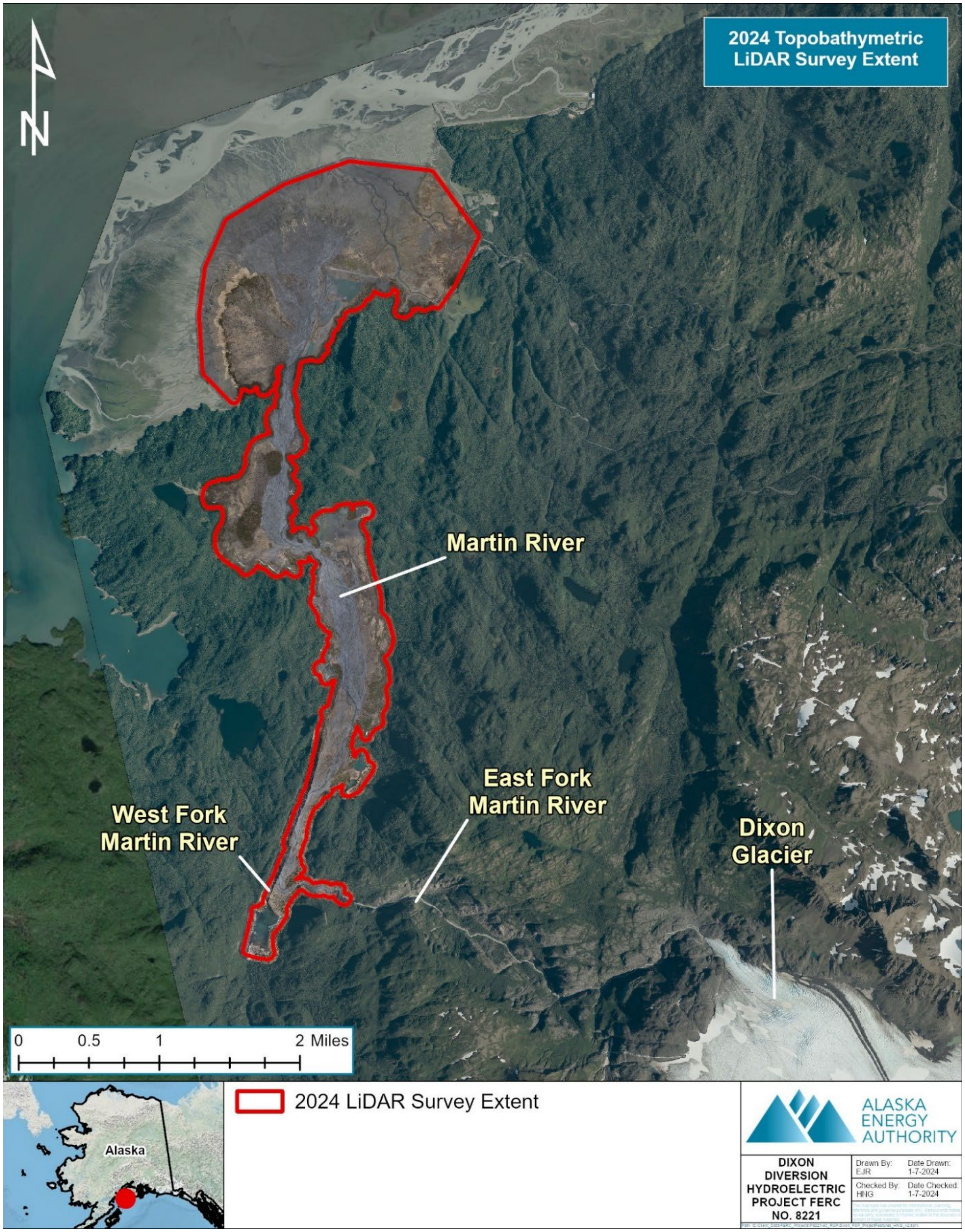

Figure 3-2 2024 LiDAR acquisition area including the Martin River from the estuary delta to the East and WFMR confluence.

Table 3-1 Macrohabitat classification definitions.

Categor	Macrohabitat Types and Definitions
Main Channel	Main Channel – Single dominant main channel. Split Main Channel – Two or fewer distributed dominant channels. Multiple Split Main Channel – Greater than three distributed dominant channels. Side Channel – Channel that is turbid and connected to the active main channel but represents a non–dominant proportion of flow. Tributary Mouth – Clearwater areas that exist where tributaries flow into the main channel or side channel habitats.
Off-Channel	Side Slough – Overflow channel contained in the floodplain but disconnected from the main channel. It has clear water. Upland Slough – Similar to a side slough but contains a vegetated bar at the head that is rarely overtopped by mainstem flow. Has clear water. Backwater – Found along channel margins and generally within the influence of the active main channel with no independent source of inflow. The water is not clear. Beaver Complex – Complex ponded water body created by beaver dams.
Tributary	Tributaries upstream of the upper limit of Martin River hydrological influence.
Lake/ Pond	Ponded waterbody formed naturally. Maybe within main, side, or OCHs

Main channel macrohabitats in the Martin River were classified as a single main channel when only a single dominant channel was present; split main channels when the flow was dispersed into two relatively evenly sized channels where the bar or island separating the channels was not vegetated; and multiple split main channels when the main channel split into three or more separate channels each carrying a significant portion of the flow.

Martin River side-channel macrohabitats were completely inundated under base-flow conditions, connected at both upstream and downstream ends to the main channel, and flowed around a permanently vegetated island. Any dry portions of the channel were delineated based on substrate and a lack of vegetation, indicating that water periodically inundated the channel during higher flow periods. The distance that a side-channel line segment extended into the main channel was determined by an estimation of the continuation of the vegetated or high-water shoreline on either side of the mouth of the side channel. The presence of clear versus turbid water under low flow conditions was used as an indicator to differentiate between sloughs and side channels.

Tributaries, off-channel areas, and ponds were also delineated in GIS from the aerial imagery. Tributaries were differentiated from side sloughs based on their gradient characteristics and whether they originated above the Martin River floodplain elevation. Tributary mouths were surveyed and ground-truthed using a single line segment showing the length of the wetted area of the tributary mouth that extended from the vegetation line out to the edge of the gravel bank.

Off-channel side sloughs had clear water at low flows and were only connected at the top of the channel to the main channel at high flows. These areas could be partially dry but showed evidence that they were inundated regularly during high flows by lack of vegetation. Off-channel upland sloughs had similar characteristics in that water was relatively clear, but they were not open to the main channel at both ends as indicated by the presence of vegetation in the area between the upstream end of the slough and the main channel.

Tributaries, off-channel macrohabitats, and lakes were assigned site names based on the following conventions.

Martin River tributary names began with an "MR1." and were sequentially assigned 3-digit stream codes from the mouth of the river upstream to the confluence of the East and West forks. For example, Tributary MR1.190 represents the 19th tributary flowing into the Martin River. Tributary MR1.190.10 represents the first tributary flowing into Tributary MR1.190. An "L" was added to the stream codes to designate lakes. For example, MR1.090.L1 represents the first lake flowing into Tributary MR1.090.

Off-channel sites were designated with an "OCH," followed by the Project RM at its downstream connection point to the mainstem, and an "R" or "L" to represent the side of the Martin River looking downstream. The macrohabitat was then included in the name followed by sequential numbering for primary and secondary channels. For example, OCH2.8R-SS-1 represents a primary side slough that enters the Martin River from the right bank at RM 2.8 and OCH2.8R-SS-1.010 represents a secondary channel contributing flow to the primary side slough.

3.4.1.3 Mesohabitat Characterization

The ground surveying effort was intended to provide mesohabitat classifications of clearwater off-channel areas and tributaries identified as survey targets during GIS remote line mapping intended for fish sampling as part of the Martin River Fish Use Study (AEA 2022b).

In the spring, mesohabitat surveying was focused on slough habitats within the floodplain of the Martin River that had the potential to be influenced by mainstem flows at some levels of mainstem discharge. Spring surveys were conducted at flows similar to those recorded during the capture of imagery and reference photographs. Fall surveys focused on tributary habitats not influenced by mainstem discharge under most Martin River flows.

Field surveys were conducted by two- or three-person survey crews. Each survey crew consisted of a qualified lead biologist and field technician(s). Habitat data collected in this study used the hierarchical habitat classification described above as well as standard protocols outlined in the U.S. Forest Service (USFS) Aquatic Habitat Surveys Protocol developed for Alaska (USFS 2001). The mesohabitat types are defined in Table 3-2 below. Habitat metrics were collected using a USFS Tier I through Tier II stream habitat survey protocol (USFS 2001). Some of the habitat metrics listed in the USFS protocol assumed that the stream being surveyed is wadable; however, some of the habitat units selected for ground surveys were only wadable along stream or pond/lake margins. Modifications were made to accommodate non-wadable stream reaches.

Table 3-2 Mesohabitat classification definitions.

Category	Mesohabitat Types and Definitions
Pools	Pool – Slow water habitat with minimal turbulence and deeper due to a strong hydraulic control.
Fast water	Glide – An area with generally uniform depth and flow with no surface turbulence. Low gradient; 0-2 percent slope. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. Generally deeper than riffles with few major flow obstructions and low habitat complexity. Riffle – A fast water habitat with turbulent, shallow flow over submerged or partially submerged gravel and cobble substrates.

Category	Mesohabitat Types and Definitions
	Generally broad, uniform cross-section. Gradient; usually 2.0-4.0 percent slope. Cascade – A fast water habitat with turbulent flow; many hydraulic jumps, strong chutes, and eddies and between 30-80 percent white water. High gradient; usually greater than 4 percent slope. Much of the exposed substrate composed of boulders organized into clusters, partial bars, or step-pool sequences.
Beaver Pond	Beaver Pond – Water impounded by the creation of a beaver dam. Maybe within main, side, or OCHs.

3.4.1.3.1 Habitat Metrics

The following habitat metrics were collected for each selected geomorphic reach, and for each clearwater macrohabitat unit:

- Mesohabitat unit type.
- Global Positioning System (GPS) location of channel measurements.
- Measured or estimated gradient.
- Measured unit length (range finder or remote using GPS waypoints).
- Measured or estimated bankfull width (BFW) (three measurements per riffle unit).
- Measured average wetted width (three measurements per unit).
- Measured bankfull depth of unit (three measurements per riffle unit).
- Measured or estimated wetted maximum depth (thalweg) (three measurements per unit).
- Estimated percent substrate composition within the wetted width of the unit.
- If pool, estimated or measured maximum depth.
- If pool, estimated or measured pool crest depth.
- If pool, identified structural features forming the pool.
- Large woody debris count within the wetted width of the unit.
- Estimated percent undercut, each bank in the unit.
- Estimated percent erosion, each bank in the unit.
- Type and percent in-stream cover in the unit.
- Estimated percent riparian vegetation cover in the unit.

- Dominant riparian vegetation type for each unit.
- Photograph of each unit.

3.4.2 Flow Monitoring

Flow monitoring sites were established at five locations (Figure 3-3) to help characterize aquatic habitat in inflowing tributaries and to provide additional resolution to the existing flow monitoring network established as part of the Martin River Stream Gaging Study (AEA 2022b). The establishment of flow monitoring sites included the installation of pressure transducers and opportunistic discharge measurements.

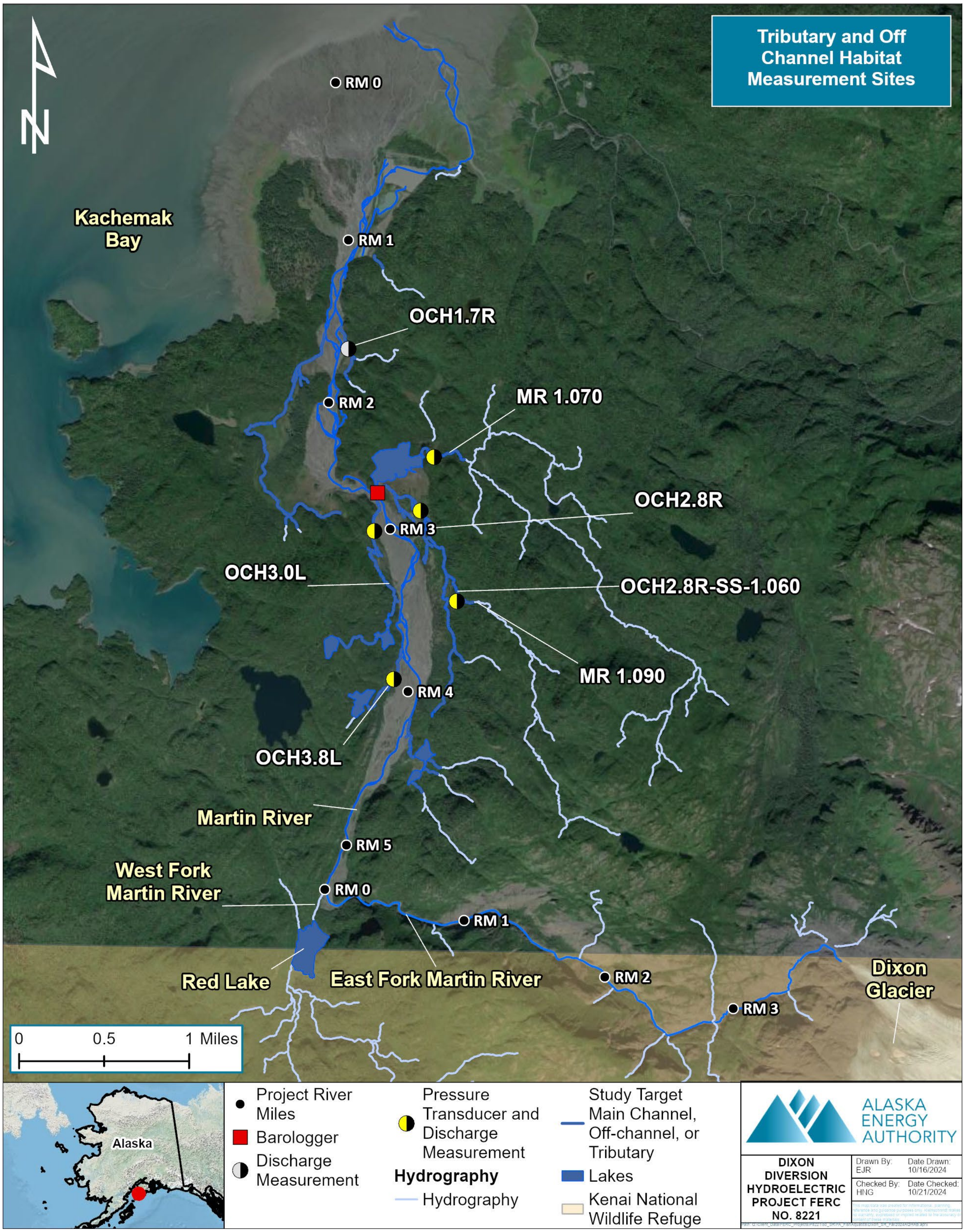

Figure 3-3 2024 stream flow monitoring sites.

3.4.2.1 Installation of Pressure Transducers and Barologger

Pressure transducers (Solinst Levelogger Model 3001) were selected to measure absolute pressure (water pressure + atmospheric pressure), and a single Barologger (Solinst Barologger 5) was used to detect variations in atmospheric pressure.

Before installation, all units (Leveloggers and Barologger) were launched and synchronized to record data at 30-minute intervals. The installation of each pressure transducer followed a standardized procedure, including:

1. Establish a staff gauge (metal yardstick) attached to a T-post or half-inch rebar in a pool/deep water area near the pressure transducer install location.
2. Secure the pressure transducer within a precut section of polyvinyl chloride (PVC) pipe to shield the sensor from direct sunlight and protect it from the surrounding substrate.
3. Attach the PVC pipe to a weight (fishing weight or small cobble).
4. Identify a location near the water’s edge with a stable channel bottom, relatively calm/non-turbulent water surface, water depth of approximately 1.5-2 feet, low velocity (<2.0 feet/second), and near a secure anchor point (tree or large boulder).
5. Place the unit (weighted pressure transducer) on the channel bottom and tether the unit to the shoreline using a 3/8-inch steel cable and fasteners.
6. Note installation time.
7. Record staff gauge elevation to the nearest ¼ inch.
8. Record installation notes and observations in a field notebook.
9. Collect position coordinates for pressure transducer installation points using a handheld GPS unit.
10. Document site conditions with representative photographs.

The most accurate method of obtaining changes in water level using the non-vented Leveloggers was to compensate for atmospheric pressure fluctuations using a barologger. One barologger was used to compensate all Leveloggers in a 30-kilometer (20-mile) radius and/or with every 300-meter (1,000-foot) change in elevation. Installation of pressure transducers (Solinst Levelogger Model 3001) and the barologger (to measure ambient atmospheric pressure and air temperature) occurred from April 30 to May 3, 2024 (Figure 3-3, Table 3-3, Photo 3-1).

Table 3-3 2024 Martin River off-channel and tributary flow monitoring and pressure transducer sites.

Site	Transducer Serial #	Transducer Type	Install Date	Recovery Date
Tributary MR1.070	22001541	Water Level	5/03/24	10/1/24
RM 2.75	1201719	Barometric Pressure	4/30/24	10/4/24
OCH2.8R-SS-1	22017421	Water Level	5/1/24	Buried
Tributary MR1.090	22017423	Water Level	4/30/24	10/1/24
OCH3.0L-SS-1	22001559	Water Level	4/30/24	Lost
OCH3.8L-SS-1	22017431	Water Level	4/30/24	10/1/24

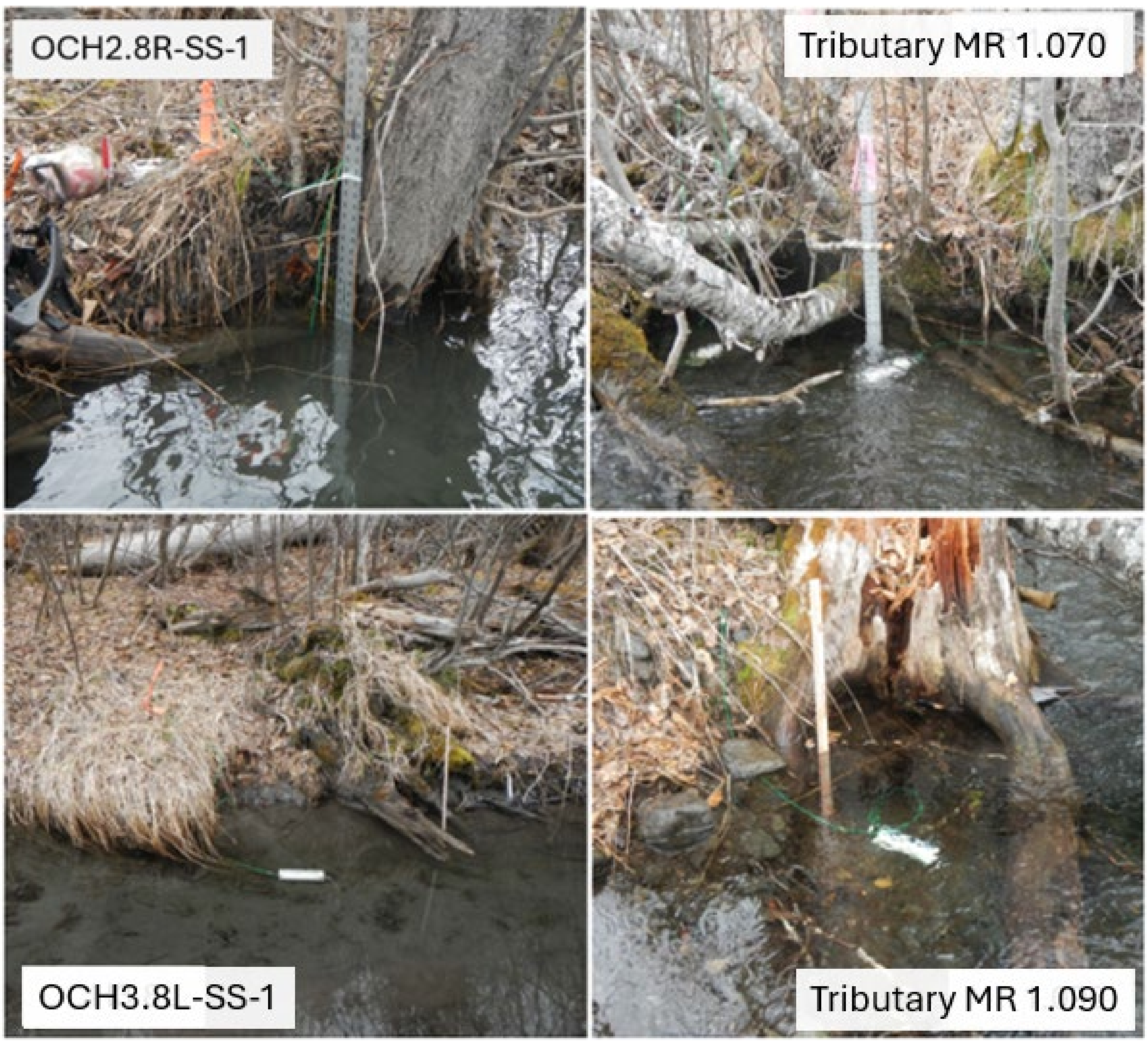

Photo 3-1 Flow monitoring stations installed in tributary and OCHs April 30 to May 3, 2024.

3.4.2.2 Discharge Measurements

Discharge measurements were completed concurrently with installation at each of the flow monitoring sites during the period April 30 to May 7, 2024, and again during equipment retrieval on October 2 and 3, 2024. Discharge measurements were completed using a Model 2100 Swoffer Meter set to display a 20-second average of water velocity. The selection of each discharge measurement site (cross-section) was based on proximity to the pressure transducer, perceived channel stability, streambed uniformity, and minimal backwater, boulders, or excessive turbulence. Temporary wood hubs were established to define the endpoints of the discharge cross-section (Photo 3-2). Completion of each discharge measurement followed the same general steps:

1. Extend a 50-foot measuring tape (using the wood hubs as tie-off points) across the stream perpendicular to its flow, with the "zero" end of the tape tied to the left bank wood hub, as viewed when looking downstream.
2. Record the water level on the staff gauge (feet in inches).
3. Divide the total wetted stream width into approximately 20 equal-sized intervals.
4. Record the water's edge station (left water's edge) and move to the first wetted station.
5. At each wetted station/interval, record the distance from the left bank (feet in tenths) and the depth indicated on the topsetting wading rod (feet in tenths) on the Discharge Measurement Form.
6. Stand downstream of the measuring tape and adjust the position of the velocity sensor/propeller on the wading rod so it is at 0.6 of the measured depth.
7. With the velocity meter set in Display Averaging mode proceed with the measurement and record the velocity value on the Discharge Measurement Form.
8. Move to the next interval and repeat the measurements for all wet intervals.
9. Record the water's edge station (right water's edge).
10. Document sampling conditions by taking representative photographs of the site including upstream, downstream, and across channel views.
11. Review the staff gauge (feet in inches) and note any change.

Photo 3-2 Position of barologger installed on a tree, and discharge measurements underway at OCH2.8R-SS-1 in May 2024.

3.4.3 Temperature and Water Quality Monitoring

In addition to continuous temperature monitoring equipment that was installed at water quality monitoring sites (see Section 2.0), an additional 28 thermistors were installed at 14 macrohabitat sites in Martin River OCHs and selected tributaries to characterize thermal environment for fishes (Figure 3-4). Temperature sampling was conducted at 15-minute intervals following the data standards outlined in Mauger et al. (2015) using calibrated, continuous temperature thermistors. Temperature loggers were capable of an accuracy of ±0.25°C and a range of −4°C to 37°C; Onset Hobo U22-001 loggers were used. Pre- and post-deployment accuracy checks were performed to screen for defective equipment and qualify data reporting if measurement drift occurred. Accuracy checks were conducted at a minimum of two temperatures (0°C and approximately 20°C).

Additional water quality parameters measured at aquatic habitat survey sites included pH, DO saturation (percent and mg/l), specific conductance (µS/cm), and turbidity. These measurements were made with a YSI Pro DSS multimeter.

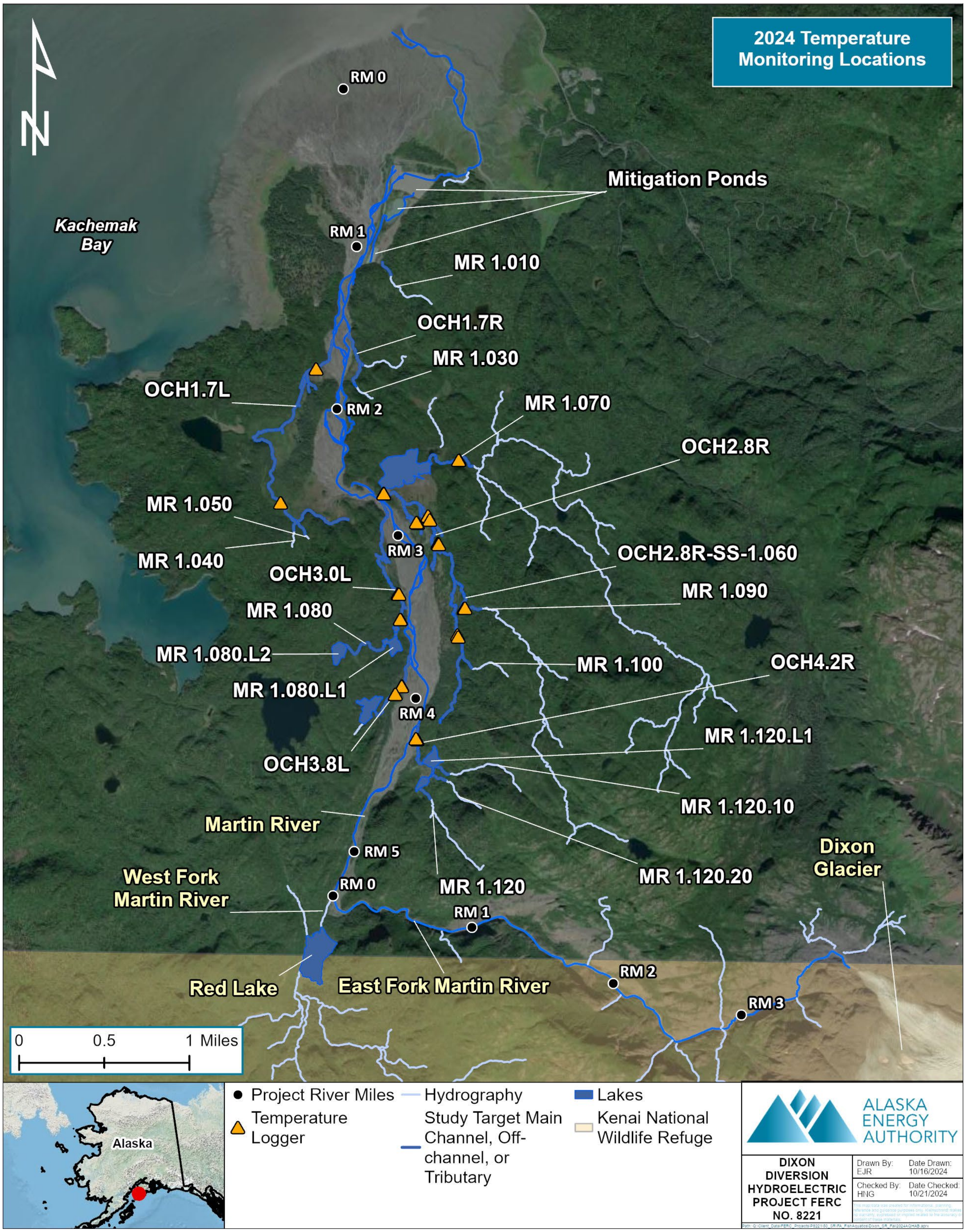

Figure 3-4 Aquatic habitat characterization water temperature and water quality monitoring locations.

3.4.4 East Fork Martin River Potential Fish Barriers

Fish passage barrier evaluation in the EFMR required ground access to measure feature dimensions. The confined canyon limited wading access during higher flows and limited landing areas for helicopter access. High-flow conditions in June 2022, during the site visit associated with the scoping meetings, prevented wading access to the EFMR. During a late May 2023 site visit, flows were much lower and although safe wading access was still not possible, access appeared possible at lower flow conditions. AEA targeted a foot survey of the lower EFMR in 2024 under extremely low flow conditions to evaluate potential barriers following the methods of Powers and Orsborn (1985) and using the leaping ability by species listed in Table 3-4. A field surveyor walked upstream until conditions became unwadable approximately 1.35 miles from the mouth of the EFMR to evaluate physical barriers to Pacific salmon.

Table 3-4 Pacific salmon leaping height capabilities.

Species	Leaping Height (feet)	
	Powers and Orsborn (1985)[1]	USFS (2001)
Chinook Salmon (*O. tshawytscha*)	7.5	11.0
Coho Salmon	7.5	11.0
Sockeye Salmon	7.5	10.0
Pink Salmon	3.5	4.0
Chum Salmon	3.5	4.0

Note: [1] assumes a trajectory of 80° with a condition factor of 1.0.

3.4.5 Field Data Quality Assurance and Quality Control

Many of the planned studies included the collection of field data. The goals of data management were to establish a data QA/QC protocol to be applied at logical stages of data collection and processing and to ultimately create a database of all QC data collected for the Dixon Diversion Project. Five levels of QC (QC1 to QC5) were completed to govern data collection efforts and ensure a rigorous and high-quality product. Each QC level was tracked either within tabular datasets (Microsoft Excel and database tables), or within file path names (as for raw field data files). This allowed for quick determination of the QC status of all data. A data dictionary describing the database entities and attributes was compiled to accompany the database and to provide an understanding of data elements and their use by anyone querying or analyzing the data.

Data QC was ensured by implementing five levels of data quality review:

- QC1: Field data was checked for accuracy and completeness by a team member other than the recorder prior to site departure.
- QC2: All data were checked following entry to identify entry errors.
- QC3: Before data analysis, data were inspected for completeness, outliers, or inconsistencies by field staff familiar with the sampling events and site conditions.
- QC4: Database Validation: Tabular data files were verified to meet project database standards. Data are verified for completeness, project standards (codes, field name conventions, date formats, units, etc.), calculated and derived fields, QC fields, etc.
- QC5: Technical Review: Data revision or qualification by senior professionals when analyzing data for reports. Data calculations may be stored with the data. Some data items may have been corrected or qualified within the database, while others have only been addressed in report text. QC5 may be iterative, as data are analyzed in multiple years.

All data quality measures were documented with the reviewer’s initials and date.

3.5 Results

Martin River aquatic habitat characterization in the basin is presented at three levels of scale: geomorphic reach, macrohabitat, and mesohabitat. Geomorphic reach characterization, described in Section 3.5.1, represents the largest scale of aquatic habitat characterization. Within geomorphic reaches, habitat was characterized by macrohabitat type. Finer-scale mesohabitat surveying was completed at clear-water off-channel areas and tributaries expected to be accessible and used by Martin River fish species, especially Pacific salmon. Water quality, continuous water temperature and discharge data was collected at select macrohabitat sites.

3.5.1 Geomorphic Reach Characterization

Geomorphic reach characterization was completed and is fully presented in the Geomorphology and Sediment Transport Study Report (Watershed GeoDynamics 2025). The analysis resulted in the identification of twelve geomorphic reaches in the study area (Table 3-5, Figure 3-5).

Reaches that are constricted/confined by bedrock or steep valley walls generally had one or two channels; unconfined areas generally had multiple channels. The number of wetted channels in each unconfined reach varied depending on flow conditions; at higher flows, more channels are wetted while at lower flows only one or two channels may be wetted.

Note that Geomorphic Reach 8, while unconfined by valley walls, was subdivided into two distinct sub-reaches; a downstream unconfined sub-reach with multiple channels and an upstream sub-reach that was confined by a high terrace. Average channel gradients in the other geomorphic reaches were relatively consistent (0.6 to 0.8 percent) between the delta (Geomorphic Reach 1) and Geomorphic Reach 7 except for the slightly steeper Geomorphic Reach 5 constriction. Channel gradients gradually increased in the upstream direction from Geomorphic Reach 7 (0.8 percent) through Geomorphic Reach 9 (1.5 percent). The EFMR canyon (Geomorphic Reach 10) had an average gradient of 6.7 percent, with the gradient increasing closer to the Dixon Glacier (Table 3-5).

Table 3-5 Martin River 2024 geomorphic reach characterization.

Reach No.	Reach Characteristics	Length (ft)	Length (m)	Average Gradient
0	Tidewater	--	--	--
1	Delta	3,145	959	0.7%
2	Levee	2,447	746	0.7%
3	Constriction	1,365	416	0.6%
4	Unconfined, left bank off-channel enters	2,114	644	0.8%
5	Constriction	283	86	1.1%
6	Unconfined; left bank off-channel area at the upstream end	3,400	1,036	0.8%
7	Moderately confined; right bank side channel enters	1,537	468	0.8%
8a	Unconfined, multiple channels	5,536	1,687	1.2%
8b	Unconfined single channel (constrained by high terrace)	3,820	1,164	1.2%
9	Moderately confined single thread Red Lake outflow (WFMR) near upper end of reach	4,238	1,292	1.5%
10	EFMR Canyon	19,671	5,996	6.7%
11	Glacier	33,256	10,136	9.8%

Figure 3-5 Martin River 2024 geomorphic reaches.

3.5.2 Martin River Macrohabitats

The results of the line-mapping of macrohabitats are provided in Table 3-6 and displayed in Figure 3-6. A close-up of the macrohabitats in the area between Martin River RM 2.7 and 4.2 are presented in Figure 3-7. The macrohabitats were ground-truthed during spring 2024 at flows similar to when the aerial imagery and LiDAR was acquired. Many of the macrohabitats identified, especially in off-channel areas, were very complex and included multiple connected and unconnected channels and tributaries. The major flooding event that occurred in the region following heavy rains on about August 7, 2024 resulted in changes to many of these habitats, underscoring the baseline condition in this watershed of a shifting mosaic of dynamic habitats across the landscape.

Table 3-6 Macrohabitats in the Martin River by geomorphic reach based on line mapping of the May 2024 aerial imagery and LiDAR.

Macrohabitat Type	Site Name	Feature Length (m)	Martin River Connection (RM)
Geomorphic Reach 0 (Tidewater)			
Main Channel		971	--
Split Main Channel		1,616	--
Geomorphic Reach 1 (Delta)			
Main Channel		494	--
Split Main Channel		547	--
Multiple Split Side Channel		222	--
Side Channel		36	--
OCH Upland Slough		347	--
Geomorphic Reach 2 (Levee)			
Main Channel		160	--
Multiple Split Side Channel		1,361	--
Tributary	Tributary MR1.010	712	Upper Mitigation Pond
Geomorphic Reach 3 (Constriction)			
Multiple Split Main Channel		1,096	--
Geomorphic Reach 4 (Unconfined)			
Main Channel		155	--
Multiple Split Main Channel		1,464	--
OCH Side Slough	OCH1.7R-SS-1	572	RM 1.7
OCH Side Slough	OCH1.7R-SS-1.010	37	RM 1.7 (OCH1.7R-SS-1)
Tributary	Tributary MR1.020	532	RM 1.7 (OCH1.7R-SS-1)
Tributary	Tributary MR1.030	198	RM 1.7 (OCH1.7R-SS-1)
OCH Side Slough	OCH1.7L-SS-1	3,141	RM 1.7
OCH Side Slough	OCH1.7L-SS-1.010	186	
OCH Side Slough	OCH1.7L-SS-1.010.10	89	
OCH Side Slough	OCH1.7L-SS-1.020	103	
OCH Side Slough	OCH1.7L-SS-1.030	24	

Macrohabitat Type	Site Name	Feature Length (m)	Martin River Connection (RM)
OCH Side Slough	OCH1.7L-SS-1.040	18	
OCH Side Slough	OCH1.7L-SS-1.050	43	
Tributary	Tributary MR1.040	317	RM 1.7 (OCH1.7L-SS-1)
Tributary	Tributary MR1.050	207	RM 1.7 (OCH1.7L-SS-1)
Geomorphic Reach 5 (Constriction)			
Main Channel		40	--
Multiple Split Main Channel		87	--
Geomorphic Reach 6 (Unconfined)			
Main Channel		388	--
Split Main Channel		221	--
Multiple Split Main Channel		2,325	--
Geomorphic Reach 7 (Moderately Confined)			
Main Channel		425	--
Split Main Channel		187	--
Side Channel		262	--
Lake/Pond	Swan Lake	--	RM 2.7
Tributary	Tributary MR1.070	5,307	RM 2.7 (Swan Lake)
OCH Side Slough	OCH2.8R-SS-1	2,928	RM 2.8
OCH Side Slough	OCH2.8R-SS-1.010	383	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.010.10	34	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.010.20	82	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.020	98	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.030	140	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.040	9	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.050	98	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.050.10	192	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.050.20	52	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.060	343	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH2.8R-SS-1.060.10	77	RM 2.8 (OCH2.8R-SS-1)
Tributary	Tributary MR1.090	2,001	RM 2.8 (OCH2.8R-SS-1)

Macrohabitat Type	Site Name	Feature Length (m)	Martin River Connection (RM)
Geomorphic Reach 7 (Moderately Confined) continued			
Tributary	Tributary MR1.100	573	RM 2.8 (OCH2.8R-SS-1)
OCH Side Slough	OCH3.0L-SS-1	1,350	RM 3.0
OCH Side Slough	OCH3.0L-SS-1.010	98	RM 3.0 (OCH3.0L-SS-1)
OCH Side Slough	OCH3.0L-SS-1.020	55	RM 3.0 (OCH3.0L-SS-1)
OCH Side Slough	OCH3.0L-SS-1.030	24	RM 3.0 (OCH3.0L-SS-1)
OCH Side Slough	OCH3.0L-SS-1.040	30	RM 3.0 (OCH3.0L-SS-1)
OCH Side Slough	OCH3.0L-SS-1.050	36	RM 3.0 (OCH3.0L-SS-1)
OCH Side Slough	OCH3.0L-SS-1.060	46	RM 3.0 (OCH3.0L-SS-1)
Lake/Pond	MR1.080. L1	--	RM 3.0 (OCH3.0L-SS-1)
Tributary	Tributary MR1.080	565	RM 3.0 (OCH3.0L-SS-1)
Lake/Pond	MR1.080. L2	--	RM 3.0 (OCH3.0L-SS-1)
Geomorphic Reach 8 (Unconfined)			
Main Channel		1,772	--
Split Main Channel		158	--
Multiple Split Main Channel		2,873	--
OCH Side Slough	OCH3.8L-SS-1	439	RM 3.8
Tributary	Tributary MR1.110	358	RM 3.8 (OCH3.8L-SS-1)
Lake/Pond	MR1.110. L1	--	RM 3.8 (OCH3.8L-SS-1)
OCH Side Slough	OCH4.2R-SS-1	356	RM 4.2
Lake/Pond	MR1.120. L1	--	RM 4.2 (OCH4.2R-SS-1)
Tributary	Tributary MR1.120	1,165	RM 4.2 (OCH4.2R-SS-1)
Tributary	Tributary MR1.120.10	612	RM 4.2 (OCH4.2R-SS-1)
Tributary	Tributary MR1.120.20	999	RM 4.2 (OCH4.2R-SS-1)
Geomorphic Reach 9 (Moderately Confined)			
Main Channel		1,052	--
Split Channel		417	--
Geomorphic Reach 10 (EFMR Canyon)			
Main Channel		6,065	--

Figure 3-6 Martin River aquatic macrohabitats based on May 2024 stream and channel conditions.

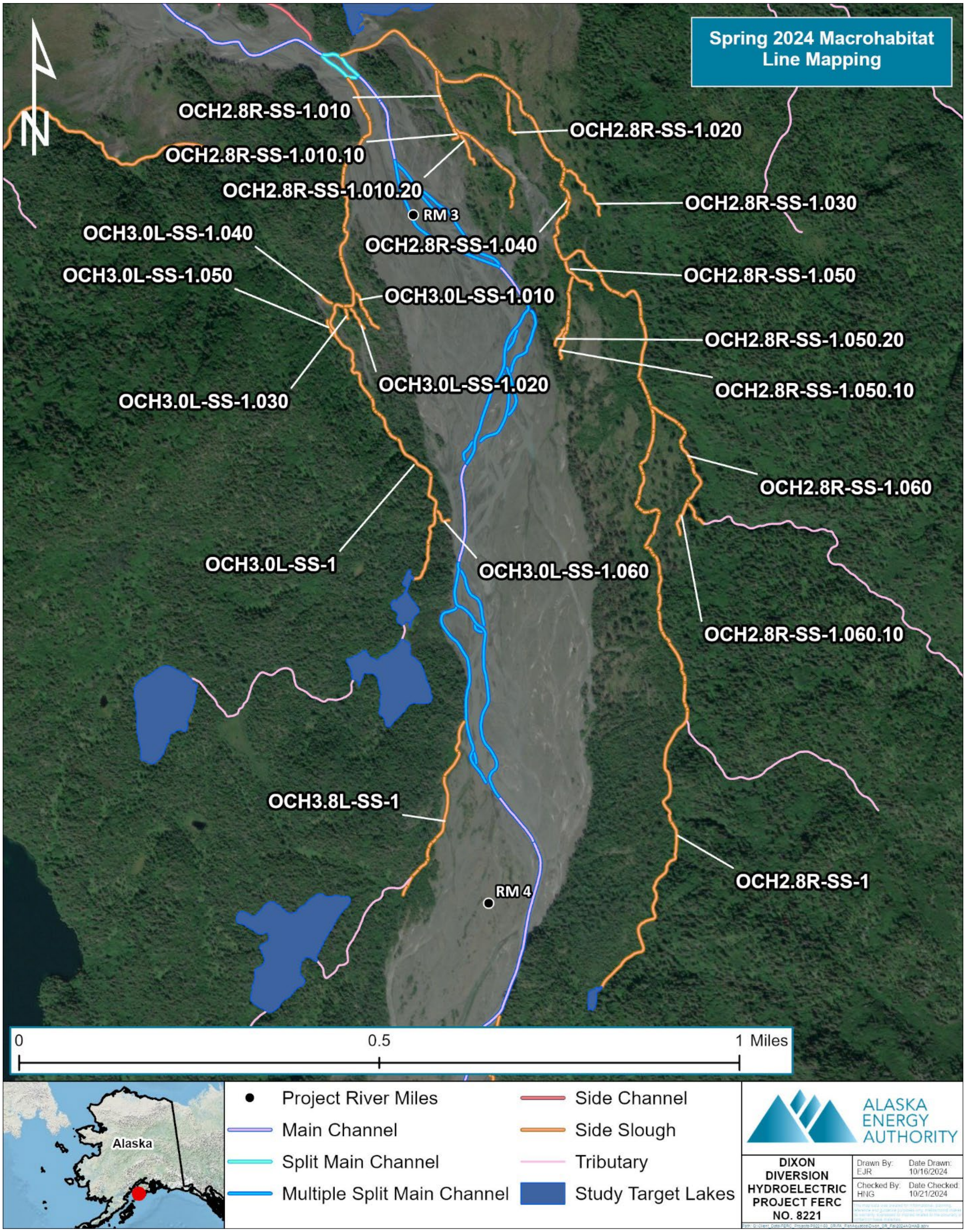

Figure 3-7 Martin River aquatic macrohabitats between RM 2.7 and RM 4.2 based on May 2024 stream and channel conditions.

3.5.3 Flow Monitoring

Discharge measurements at sites where pressure transducers and staff gages were installed were intended to help construct site-specific rating curves to link stage height to discharge at individual study sites. This analysis requires that the channel shape remain constant, and that there are multiple measurements of both stage and discharge to calibrate and audit a rating curve. However, it was not possible to develop a stage-discharge relationship for any of the monitored sites because there were significant changes in the shape of the channel, pressures transducers were not recoverable, or the number of discharge measurements were not sufficient to create a calibrating curve.

Channels at OCH3.0L-SS-1 and OCH3.8L-SS-1 received significant gravel deposition such that data were not comparable between discharge measurements. The pressure transducer at site OCH2.8R-SS-1 was buried under nearly 100 cm of gravel during the August 2024 storm event and was unrecoverable. It was initially deployed in about 30 cm of water, and its paired staff gage had nearly 50 cm of exposed metal, but after a major gravel deposition event at this location, only about 4 cm of the staff gage was visible (Photo 3-3). A second pressure transducer was lost in lower OCH3.0L-SS-1, due to a cable failure. The only site where a stage-discharge relationship could be derived was Tributary MR1.070, though enough data points were not available to create a calibrated rating curve.

Although stage-discharge relationships were not derived, point measurements of discharge were collected and are reported for spring and fall 2024 relative to the mainstem hydrograph from the EFMR USGS Gage which only reports stage height, not discharge (Figure 3-8). Spring discharge was highest at Tributary MR1.070 which drains a larger area and appeared influenced by snowmelt (>16 cfs) when its discharge was measured on April 29 relative to lower flow (6.2 cfs) in the late fall. This pattern was opposite the EFMR USGS Gage which was lower in May than in October. Discharge at other sites were similar between sampling events.

Photo 3-3 Pressure transducer at site OCH2.8R-SS-1 buried after August 7, 2024 flood event. Photo taken September 28, 2024.

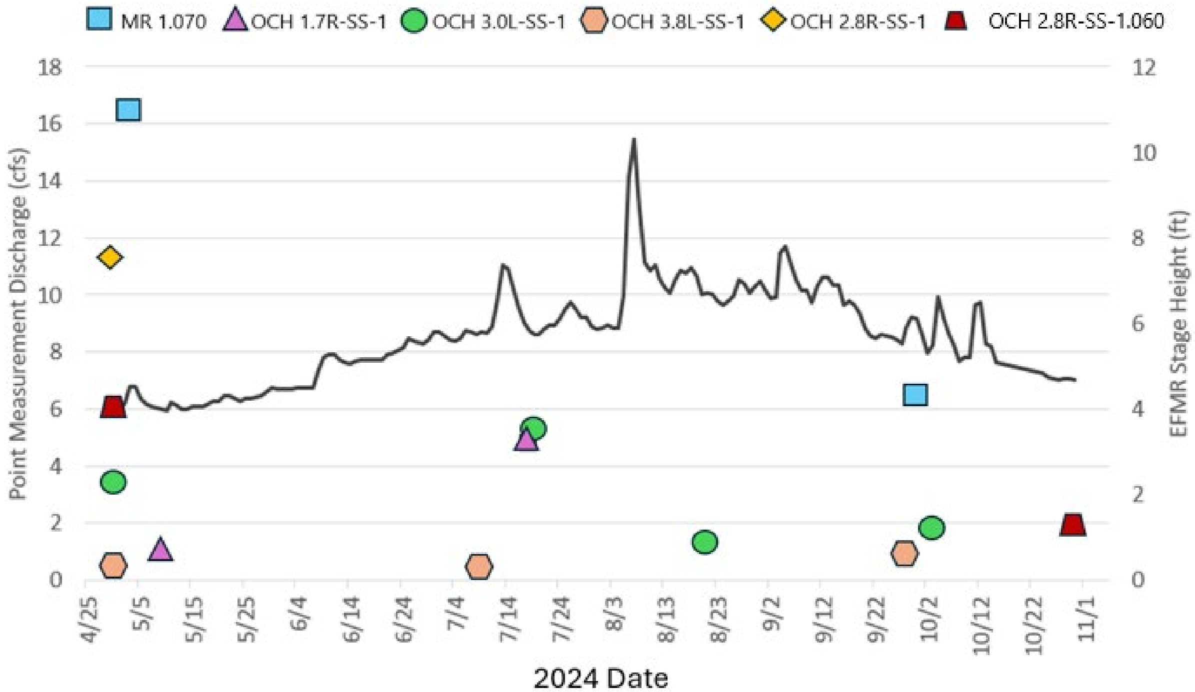

Figure 3-8 2024 discharge measurements at select sites. Data for discharge measurements (cfs) are provided as point data on the primary y-axis and the EFMR stage height (ft) data is provided on the secondary y-axis.

3.5.4 Temperature and Water Quality Monitoring

Part of macrohabitat characterization included continuous temperature monitoring to document trends in water temperature, but also to determine interaction between source water of different temperatures throughout the season to determine habitat connectivity dynamics. Macrohabitats equipped with temperature monitoring equipment are presented in Figure 3-9. Temperature loggers were recovered from 11 sites and were lost or buried with bed load at 3 sites as a result of the August 2024 high flow event. Temperature monitoring results are provided in context with the results of the macrohabitats where they were deployed, described in the following sections.

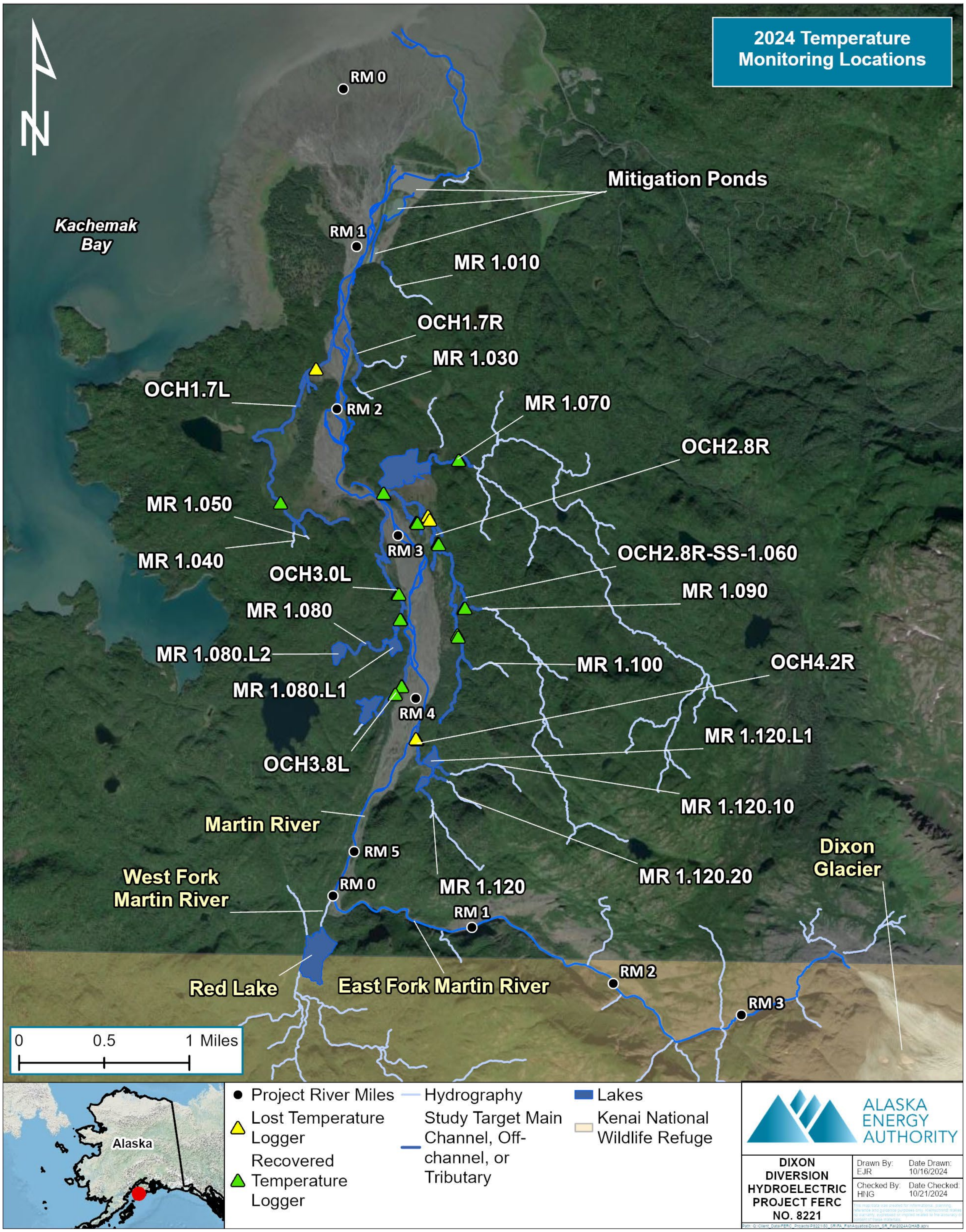

Figure 3-9 Temperature logger installations in the Martin River aquatic habitat characterization study area, May to October 2024.

Water quality measurements made during habitat surveying in fall 2024 are summarized in Table 3-7 for all macrohabitat units. As noted, point measurements of water quality were not collected in the spring due to equipment malfunction. Turbidity at Tributary MR1.070, Tributary 1.120, and all off-channel sites was less than 5 NTUs during the spring 2024 sampling, except at OCH1.7L-SS-1 where the turbidity exceeded 240 NTUs.

Table 3-7 Water quality parameters measured during mesohabitat surveying efforts between September 23 and September 30, 2024.

Site	Date	Temp (ºC)	DO (mg/L)	pH	Sp Cond (uS/cm)	Turbidity (NTUs)	Clarity
OCH1.7L-SS-1	05/02/24	-	-	-	-	>240	Turbid
OCH2.8R-SS-1	04/30/24	-	-	-	-	<5	Clear
OCH2.8R-SS-1.060	04/30/24	-	-	-	-	<5	Clear
OCH2.8R-SS-1	05/09/24	-	-	-	-	<5	Clear
OCH3.0L-SS-1	05/07/24	-	-	-	-	<5	Clear
OCH3.8L-SS-1	04/30/24	-	-	-	-	<5	Clear
OCH4.2R-SS-1	04/28/24	-	-	-	-	<5	Clear
OCH4.2R-SS-1.020	04/28/24	-	-	-	-	<5	Clear
Tributary MR1.070	05/03/24	-	-	-	-	<5	Clear
Tributary MR1.120	04/28/24	2	-	-	-	<5	Clear
OCH1.7R-SS-1	10/01/24	5.9	11.59	7.69	166.4	>240	Turbid
Tributary MR1.030	09/23/24	5.3	9.2	7.18	142	17	Turbid
Tributary MR1.070	10/01/24	4.8	12.7	7.71	100.9	<5	Clear
OCH2.8R-SS-1	09/24/24	4.2	11.81	7.7	136.5	24	Turbid
OCH3.0L-SS-1	09/27/24	3.9	10	7.7	161	<5	Clear
Tributary MR1.080.L1	09/27/24	11	9.18	7.47	115.8	12	Turbid
Tributary MR1.090	10/03/24	3.8	12.68	7.75	83.6	<5	Clear
Tributary MR1.110.L1	10/02/24	9.3	8.46	7.4	112.5	10	Turbid
Tributary MR1.120.L1	09/27/24	5.6	10.2	7.2	120.1	12	Turbid
Red Lake	10/05/24	6.2	9.6	7.39	-	40	Turbid

3.5.5 Mesohabitat Habitat Characterization of Off-channel Areas and Tributaries

Macrohabitat units surveyed for mesohabitat composition included off-channel side sloughs, secondary side sloughs and tributaries to OCHs, tributaries to the Martin River, and lakes. All off-channel and tributary surveying targets were identified from a GIS exercise using 2022 LiDAR. Mesohabitat surveying was conducted during the low flow period in spring (April 29 to May 15) and fall (September 23 to September 29) of 2024 (Figure 3-10). The spring surveying focused on the clear water off-channel areas, with opportunistic sampling of tributaries with difficult access. The fall surveying focused on the tributaries and any data gaps from the spring surveying effort. These areas were influenced by snow melt (spring) and precipitation (fall). During fall sampling, water levels in some off-channel and tributary habitats were low and many connection points between tributaries and off-channel or main channel habitats were dry or shallow enough that it appeared these habitat areas were not accessible to fish year-round and fish present in those habitats could become stranded under low-water conditions.

The USGS Gage No. 15238951 at the mouth of the EFMR recorded stage heights of 4.0 to 4.5 feet when spring ground surveys were completed in the Martin River mainstem and off-channel areas. The line mapping was based on the aerial imagery and LiDAR data collected May 2 to May 4, 2024, when the EFMR USGS Gage recorded 4.1 to 4.5 feet. During the fall surveys, the EFMR USGS Gage recorded stage heights of 5.5 to 6.2 feet.

In many cases, off-channel and tributary macrohabitats were complex, comprised of multiple secondary and tertiary side sloughs, with most tributaries flowing into the off-channel side sloughs without development of alluvial fans. Lakes were connected to side sloughs in a similar way (Table 3-8). Mesohabitat surveying results and habitat characterization are described below, organized by macrohabitat complex. Mesohabitat data collected at each macrohabitat site in 2024 is provided in Appendix A.

A total of 4,521 meters of off-channel side sloughs and 649 meters of tributaries were surveyed during 2024, totaling 37,362 square meters (m^2) of surveyed wetted OCH area potentially available for spawning and rearing fishes. A comparison of the total available wetted habitat by site indicated that off-channel complex OCH 2.8R comprised 46 percent of the total area surveyed, followed by off-channel complex OCH1.7L which comprised 19 percent (Figure 3-11). These two habitat complexes together comprised nearly three quarters of all wetted habitat accessible to fish and were accessible to fish at low flow conditions. The other macrohabitat units that contributed significant fish habitat included off-channel complex OCH3.0L (16 percent), Tributary MR1.070 (7 percent), and off-channel complex OCH 1.7R (5 percent). However, this is an underestimate of the amount of suitable habitat available to salmonids in Tributary MR1.070 as a relatively short length was mesohabitat surveyed (517 meters [m]) compared to that line-mapped (5.3 kilometer [km]).

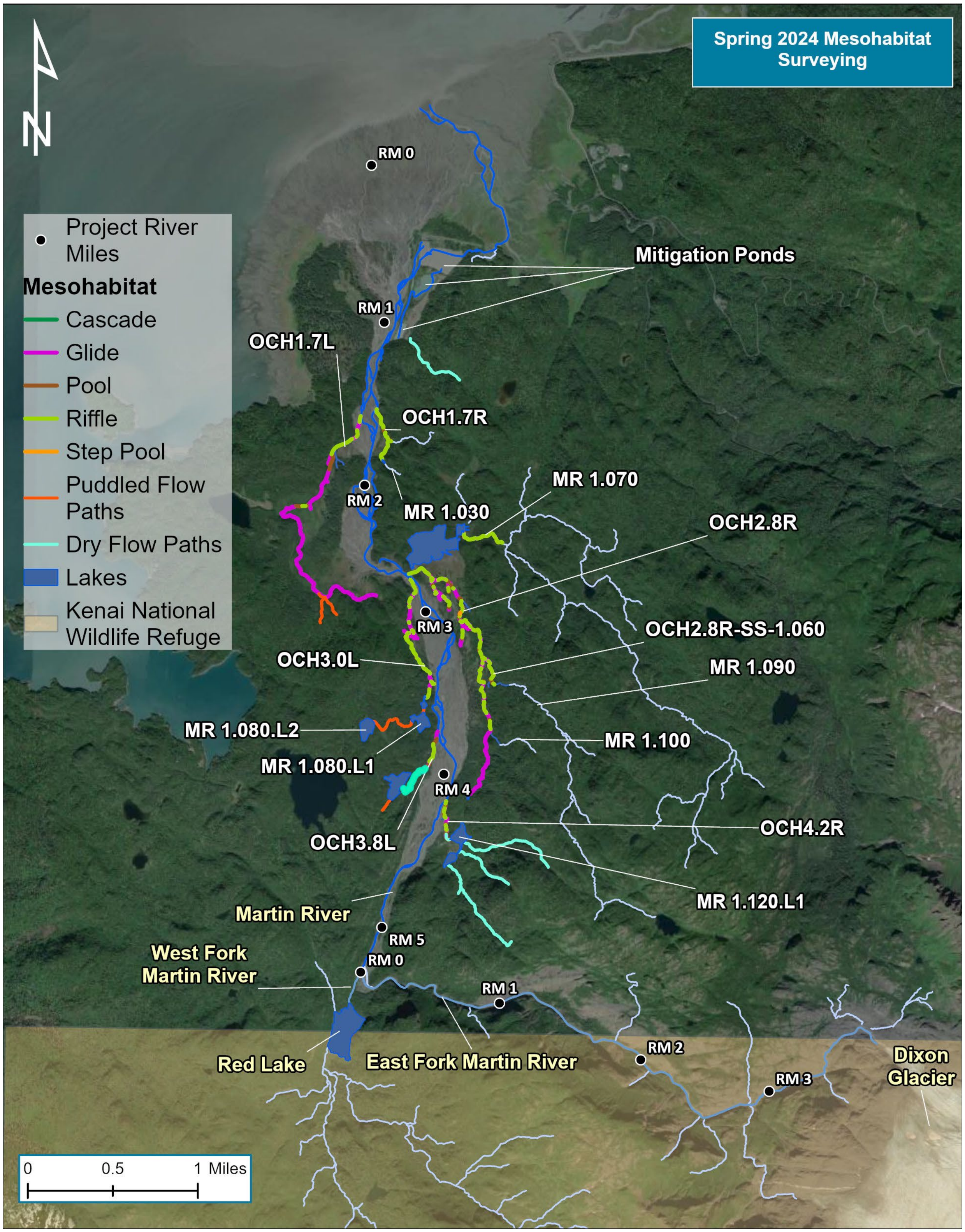

Figure 3-10 Martin River aquatic mesohabitats surveyed in the spring and fall 2024.

Table 3-8 Summary results of 2024 mesohabitat surveying of Martin River off-channel areas and select tributaries.

Site Name	Survey Date	Channel Type	Total Length Surveyed (m)	Mean Wetted Width (m)	Mean Bankfull Width (m)	Mean Pool Depth (m)	Mean Thalweg Depth (m)	Mesohabitat Type (area)					
								Glide	Riffle	Pool	Cascade	Beaver-pond	Dry
Geomorphic Reach 2 (Levee)													
Tributary MR1.010[1]	9/23/24	Tributary	--	0.00		--	0.00						100.0
Geomorphic Reach 4 (Unconfined)													
OCH1.7R-SS-1	9/23/24	Side Slough	19.0	0.85	1.90	0.28	1.26	>0.0	7.8	92.2			
OCH1.7R-SS-1.010	9/23/24	Side Slough	23.7	3.8	7.15	0.33	0.33			100.0			
Tributary MR1.020[2]	9/23/24	Tributary	--	--	--	--	--	--	--	--	--	--	
Tributary MR1.030	9/23/24	Tributary	99.0	13.50	3.80	--	--					100.0	
OCH1.7L-SS-1	5/3/24	Side Slough	883.1	6.02	15.93	0.68	0.46	84.3	11.1	4.5			
OCH1.7L-SS-1.010	5/3/24	Side Slough	--	33.62	--	--	0.34	100.0					
OCH1.7L-SS-1.010.10[3]	5/3/24	Side Slough	--	--	--	--	--	--	--	--	--	--	
OCH1.7L-SS-1.020[3]	5/3/24	Side Slough	--	--	--	--	--	--	--	--	--	--	
OCH1.7L-SS-1.030[3]	5/3/24	Side Slough	--	--	--	--	--	--	--	--	--	--	
OCH1.7L-SS-1.040	5/3/24	Side Slough	19.6	0.92	--	--	0.04	100.0					
OCH1.7L-SS-1.050	5/3/24	Side Slough	44.3	2.2	--	--	0.34	100.0					
Tributary MR1.040[4]	9/23/24	Tributary	--	--	--	--	--	--	--	--	--	--	
Tributary MR1.050[1]	9/23/24	Tributary	--	--	--	--	--						100.0
Geomorphic Reach 7 (Moderately Confined)													
Tributary MR1.070	5/3/24	Tributary	517.0	4.68	0.9	0.71	0.45	17.7	65.1	17.2			
OCH2.8R-SS-1	5/3/24	Side Slough	2,289.32	5.05	8.42	0.81	0.38	57.2	30.0	12.4	0.5		
OCH2.8R-SS-1.010	5/1/24	Side Slough	367.3	3.50	--	0.70	0.22	61.7	28.8	9.5			
OCH2.8R-SS-1.010.10	5/1/24	Side Slough	55.8	1.62	--	--	0.21	66.7	33.3				
OCH2.8R-SS-1.010.20	5/1/24	Side Slough	56.9	1.4	--	--	0.13	100.0					
OCH2.8R-SS-1.020	5/1/24	Side Slough	98.2	2.20	--	0.43	0.32	87.8	4.6	5.9			
OCH2.8R-SS-1.030	5/1/24	Side Slough	13.5	1.30	--	--	0.18	100.0					
OCH2.8R-SS-1.040[2]	5/1/24	Side Slough	8.0	0.93	--	--	0.08	--	--	--	--	--	
OCH2.8R-SS-1.050	5/2/24	Side Slough	85.0	1.00	--	--	--	100.0					
OCH2.8R-SS-1.050.10	5/2/24	Side Slough	182.7	2.31	4.68	0.33	0.22	62.1	29.8	8.1			
OCH2.8R-SS-1.050.20[5]	5/2/24	Side Slough	50.2	--	--	--	--	--	--	--	--	--	
OCH2.8R-SS-1.060	5/2/24	Side Slough	333.9	5.25	8.22	--	0.34	38.7	60.4	0.9			
OCH2.8R-SS-1.060.10	9/25/24	Side Slough	77.0	--	--	--	--	--	--	--	--	--	
Tributary MR1.090[2]	10/3/24	Tributary	--	--	--	--	--	--	--	--	--	--	
Tributary MR1.100[2]	9/28/24	Tributary	--	--	--	--	--	--	--	--	--	--	
OCH3.0L-SS-1	5/7/24	Side Slough	1,371	4.04	8.28	0.68	0.33	47.8	50.8	1.3			
OCH3.0L-SS-1.010	5/8/24	Side Slough	99.7	1.89			0.09	7.5	92.5				
OCH3.0L-SS-1.020[5]	5/8/24	Side Slough	53.9	--	--	--	--	--	--	--	--	--	
OCH3.0L-SS-1.030[5]	5/8/24	Side Slough	23.2	--	--	--	--	--	--	--	--	--	
OCH3.0L-SS-1.040[5]	5/8/24	Side Slough	35.7	--	--	--	--	--	--	--	--	--	
OCH3.0L-SS-1.050[5]	5/8/24	Side Slough	85.6	--	--	--	--	--	--	--	--	--	
OCH3.0L-SS-1.060[5]	5/8/24	Side Slough	46.7	--	--	--	--	--	--	--	--	--	
Tributary MR1.080[4]	9/27/24	Tributary	--	--	--	--	--	--	--	--	--	--	

Site Name	Survey Date	Channel Type	Total Length Surveyed (m)	Mean Wetted Width (m)	Mean Bankfull Width (m)	Mean Pool Depth (m)	Mean Thalweg Depth (m)	Mesohabitat Type (area)					
								Glide	Riffle	Pool	Cascade	Beaver-pond	Dry
Geomorphic Reach 8 (Unconfined)													
OCH3.8L-SS-1	4/30/24	Side Slough	378.9	2.90	6.28	0.54	0.25	53.7	37.0	9.3			
Tributary MR1.110[2,4]	4/30/24	Tributary		--	--	--	--	--	--	--	--	--	--
OCH4.2R-SS-1	4/29/24	Side Slough	394.5	4.19	6.14	0.55	0.31	35.7	45.7	18.5			
Tributary MR1.120	4/29/24	Tributary	32.8	5.63	8.93	--	0.43	100.0					
Tributary MR1.120.10[1]	9/28/24	Tributary	--	--	--	--	--						100.0
Tributary MR1.120.20[1]	9/28/24	Tributary	--	--	--	--	--						100.0

Notes:
1 Dry undefined channel designated as flow path
2 Not surveyed because fish barrier at mouth and high gradient
3 Wetland complex with many channels of glide habitat not surveyed
4 Defined channel but without surface flow or with isolated puddled water at time of survey
5 Depth too shallow to mesohabitat type

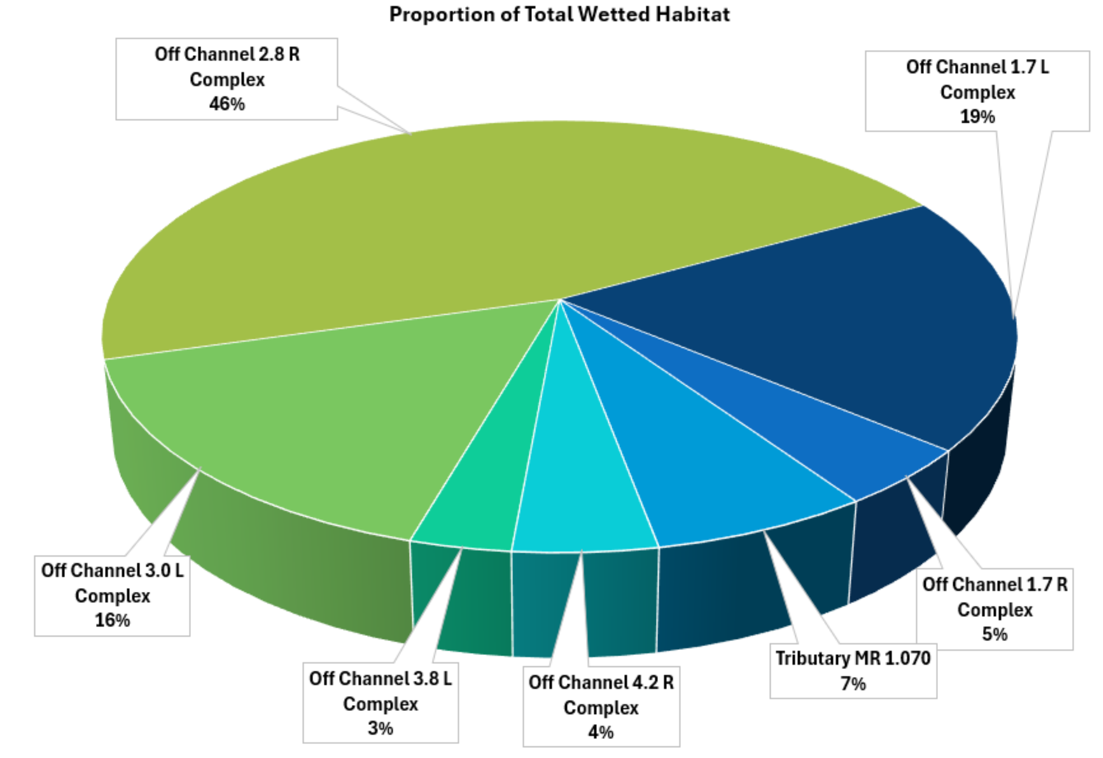

Figure 3-11 Composition of wetted off-channel and tributary habitats surveyed during 2024.

3.5.5.1 Tributary MR1.010

This macrohabitat was identified from aerial imagery as a potential tributary to the mainstem Martin River entering near RM 1.0. This site was visited on September 24, 2024, for mesohabitat and fish surveying. The field crew identified a shallow vegetated run-off gully on the east slope of the valley, but there was no defined channel that contained any habitat, wet or dry, that would be connected to the mainstem under higher flow conditions (Photo 3-4).

Photo 3-4 Tributary MR1.010 was identified as a flow path on September 24, 2024.

3.5.5.1.1 OCH1.7R-SS-1

This macrohabitat is an off-channel complex composed of a side slough with a short secondary side slough and two small tributaries: Tributary MR1.020, a steep tributary with shallow flow, and Tributary MR1.030 (Photo 3-5). The side slough was surveyed during the fall field events and was wetted at the time of the survey; however, neither Tributary MR1.030 nor the secondary side slough had sufficient water to support a surface connection to OCH1.7R-SS-1 that would allow access for fish year-round. Shallow riffles less than 0.02 m in depth separated OCH 1.7R-SS-1 from these smaller habitats (Photo 3-6 and Photo 3-7). Despite isolated conditions in late September, both areas contained rearing fish of multiple age classes (see Fish Use Study, Section 4.0) and provide accessible fish habitat at some time during the year.

Photo 3-5 Tributary MR1.020 on September 23, 2024.

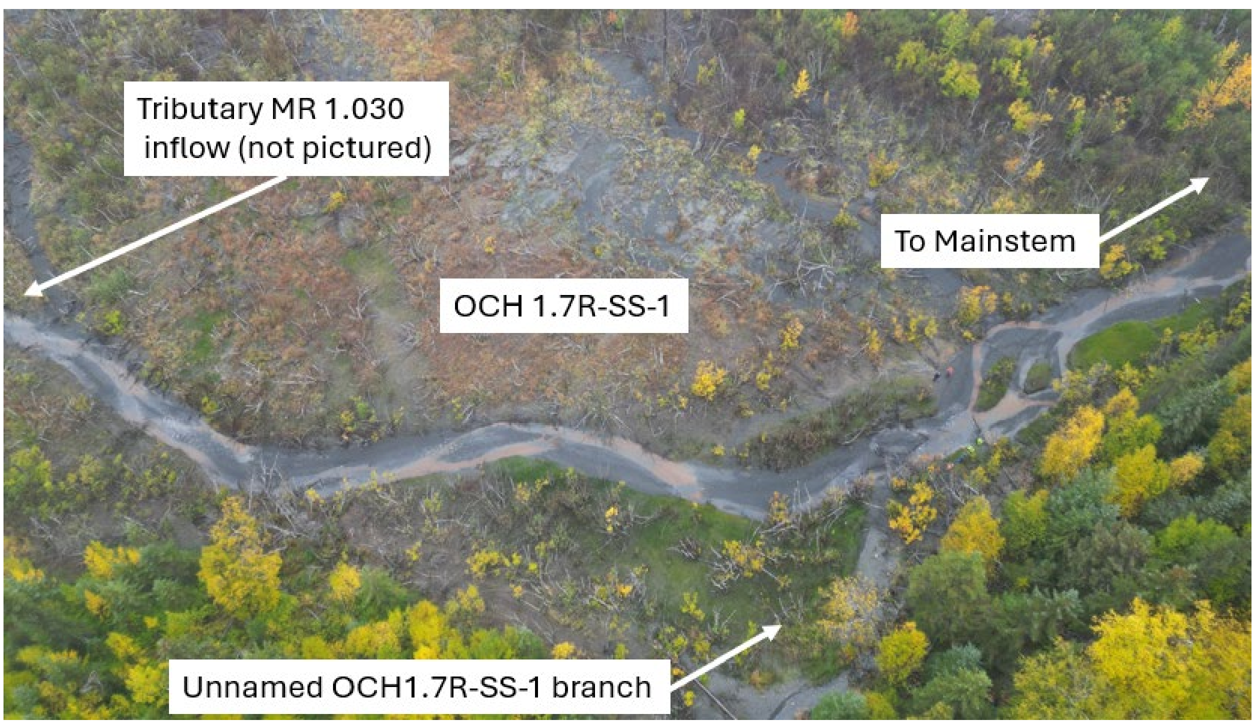

Photo 3-6 OCH1.7R-SS-1 on September 23, 2024 during low flow.

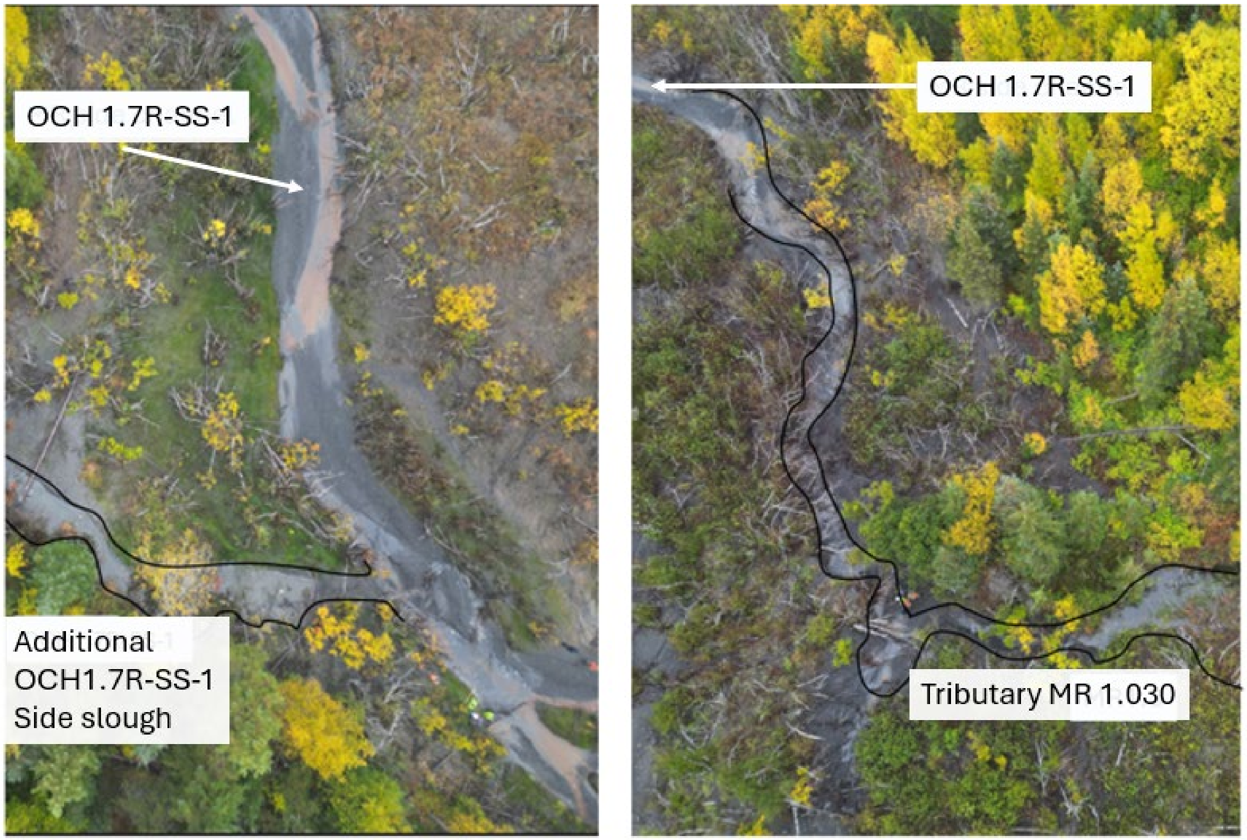

Photo 3-7 OCH1.7R-SS-1 and Tributary MR1.030 on September 23, 2024.

During the fall of 2024, 42.7 m of OCH 1.7R-SS-1 was surveyed. The mean wetted width was 2.03 m. The slough was composed of 5 mesohabitat units of predominantly pool habitat, estimated as 92.17 percent by area (Table 3-8). The three pools totaled 99.21 m^2 with a mean depth of 0.93 m, indicating a relatively small area of potential early-rearing salmon habitat. No salmon spawning habitat was evident in the two riffles as the substrate was 100 percent small gravel and fine sand; water depth was also insufficient in the riffles, averaging under 0.1 m.

The water flowing through the slough was turbid (>240 NTUs) during the fall, but other water quality parameters were compatible with healthy aquatic habitat criteria. The water temperature was cold at 5.9°C during the September 24, 2024, but was also the warmest of the three sloughs sampled at that time and similar to Red Lake which was 6.2°C during the same sampling event. No discharge data were available due to the displacement of the pressure transducer at this site.

At OCH1.7R-SS-1, the confluence between this slough and a nearly dry channel of the Martin River was a steep riffle (~6 percent gradient) less than 0.05 m deep which likely prevented any adult salmonids in the Martin River channel from accessing this OCH.

The tributary and slough draining into this slough were only wetted in the vicinity of the confluence with OCH1.7R-SS-1. Fall surveying showed a greater than 0.5 m drop over a log at the upstream end of the top pool in the secondary side slough which contained some isolated pool habitat. Upstream of the 0.5 m drop, the drainage channel gradient was greater than 20 percent and consisted of step pools and pours over large wood pieces. No fish habitat was present or accessible upstream of this drop.

3.5.5.1.2 Tributary MR1.030

This was a short tributary outflowing from a relict beaver pond perched above the valley grade into OCH 1.7R-SS-1 through a new sediment deposit at the downstream (Photo 3-8). The beaver pond which was at least 1.5 m in depth, backs up to the valley hillslope from which a vegetated gully drains. The beaver pond and outflowing pooled habitat was 99 m in length and measured 13.5 m at the widest point and 3.8 m at a constriction at the confluence with OCH 1.7R-SS-1. Pool habitat comprised the entirety of this habitat unit. A large wedge of fine gravel sediment was present at the mouth of the tributary and was in the process of being reshaped into a new channel by the outflowing water which was 0.2 m in depth. It was assumed that this sediment wedge was deposited by the flood event which occurred on August 6-7, 2024, and both the channel and tributary mouth were likely more established before this event.

Water quality parameters measured on September 23, 2024 included a temperature of 5.3°C, pH 7.18, and DO of 9.2 mg/L and 76 percent saturation. Specific conductance was 142 μS/cm, and turbidity was low at less than 5 NTUs. All parameters were within the criteria for healthy habitat for rearing juvenile fishes in Alaska.

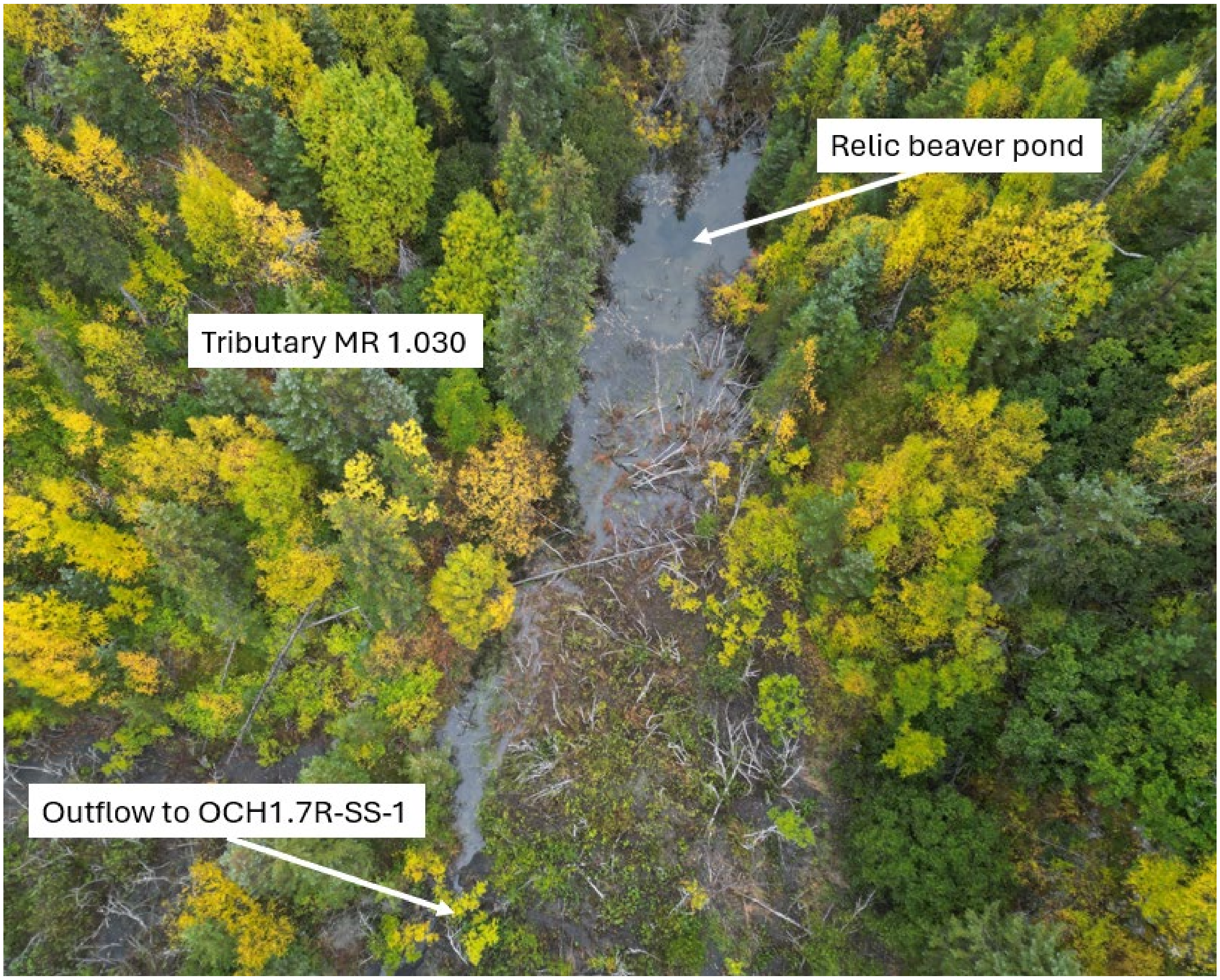

Photo 3-8 Tributary MR1.030 relic beaver pond and outflow to OCH1.7R-SS-1.

3.5.5.2 Off-channel Complex OCH1.7L

This macrohabitat is an off-channel complex composed of a main side slough (OCH 1.7L-SS-1) and two secondary channels (OCH 1.7L-SS-1.1040, and OCH 1.7-SS-1.1050). Two small tributaries, MR1.040 and 1.050 were identified from aerial imagery as potential tributaries to OCH1.7L-SS-1 and were targeted for fall fish and mesohabitat sampling. Side slough OCH 1.7L-SS-1 was surveyed during the spring field event and was wetted at the time of the survey. The confluence between OCH1.7L-SS-1 and the mainstem includes a long slow glide abutting a bedrock bluff and appears to have been scoured during periods of prior high flow (Photo 3-9).

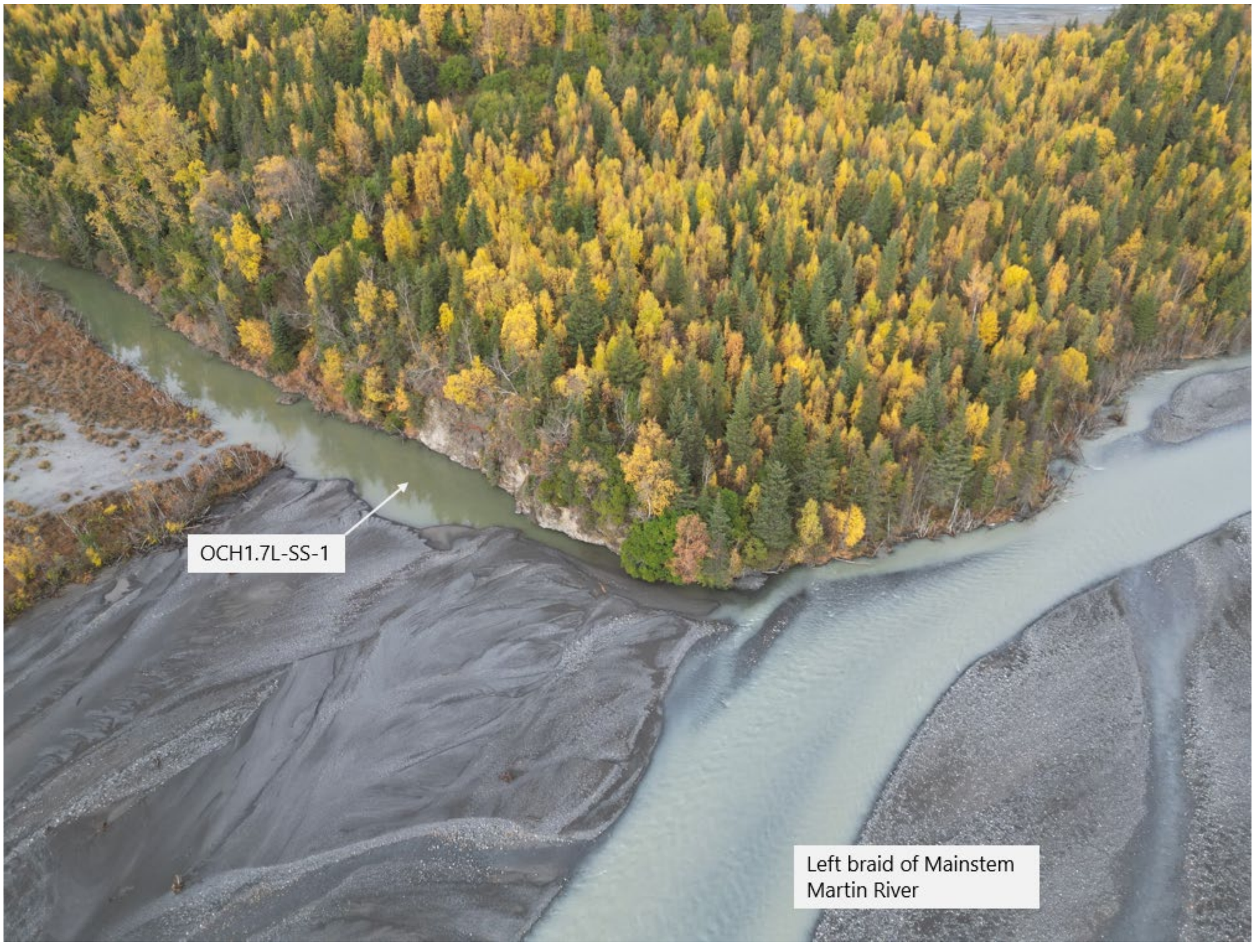

Photo 3-9 The confluence between OCH1.7L-SS-1 and the mainstem Martin River, October 5, 2024.

3.5.5.2.1 OCH1.7L-SS-1

During the spring, 883 m of OCH 1.7L-SS-1 was surveyed for mesohabitat composition. Slough OCH1.7L-SS-1 was the second largest of the OCHs surveyed. The mean wetted width was 6.02 m (Photo 3-10). The mean thalweg depth was 0.5 m and the mean pool depth was 0.68 m (Table 3-8). The slough was composed of 12 mesohabitat units predominantly glide habitat, estimated as 84 percent by area, with riffle and pool habitat considerably less at 11 and 5 percent respectively (Table 3-8). Two large glides covered 80 percent of the slough by area with a mean thalweg depth of 0.86 m and substrate dominated by sand and organics, indicative of suitable habitat for yearling salmon resident fishes. In contrast, the three pools totaled 319.30 m^2 with a mean depth of 0.68 m, indicating a relatively small area of early-rearing salmon habitat. Both secondary channels contained only a small amount of glide habitat (97 m^2 in OCH1.7L-SS-1.040 and 16 m^2 in OCH1.7L-SS-1.050) and contained 100 percent organic substrate.

In many areas, the presence of both dry and wetted channels was indicative of rapid channel migration, new channel formation, and a shifting mosaic of habitat types that is typical of dynamic river systems.

Photo 3-10 OCH1.7L-SS-1 pool-glide complex surveyed on May 3, 2024.

The water flowing through the slough was turbid during spring sampling but other water quality parameters were compatible with healthy aquatic habitat criteria. A continuous temperature logger was installed at an upstream and downstream portion of OCH 1.7R-SS-1 but both were completely buried by sediment during the August 2024 flood event which transported a large amount of bedload into the area. The upstream logger was recovered but the data was not representative of surface water temperature. The downstream logger was not recovered.

3.5.5.2.2 Tributary MR1.040 and Tributary MR1.050

During fall field efforts to survey tributaries MR1.040 and MR1.050, the field crew identified a shallow vegetated run-off gully on the west slope of the valley at each location, but there was no evident channel that contained any habitat, wet or dry, that could be connected to the mainstem under higher flow conditions or could provide fish habitat under any flow condition (Photo 3-11). Small pockets of accumulated rainwater or stormwater were present in leafy depressions.

Photo 3-11 Drainage channels at locations identified as Tributary MR1.040 (left) and Tributary MR1.050 (right).

3.5.5.3 Upper and Lower Swan Lake Complex

Tributary MR1.070 drains into a clear water relic beaver pond known as Upper Swan Lake, perched slightly above valley grade, which flows through a constriction into the larger, Lower Swan Lake. Upper Swan Lake (totaling 7,188 m^2 in area) is bounded by steeper bedrock cliffs and hillslopes on the north shore and is encroached with a large area of floating sphagnum fen on the south shore near the mouth of Tributary MR1.070. Upper Swan Lake is highly sedimented with fine particular organic matter, clay, and mud and contained limited patches of submerged aquatic macrophytes. Submerged large woody debris and vegetated shorelines provide cover and habitat for juvenile rearing.

Lower Swan Lake (totaling 111,450 m^2 in area) is connected to Upper Swan Lake and sits slightly below the Upper Swan Lake grade, indicated by the clear water conditions in Upper Swan Lake and turbid conditions in Lower Swan Lake which receives floodwater from the mainstem Martin River during high flows. OCH2.8R-SS-1 (discussed below) also flows into this lake complex. Lower Swan Lake is bounded on the north shore by bedrock cliffs and steep hillslopes and on the south shore by a marshy meadow or moss and grasses. Sediment in Lower Swan Lake is predominantly fine organics, clay, and mud, except near its outlet where inflow from the OCH2.8R complex merges with Lower Swan Lake outflow, and the sediment is predominantly gravel and sand. Submerged large woody debris and vegetated shorelines provide cover and habitat for juvenile rearing.

3.5.5.3.1 Tributary MR1.070/Swan Lake Complex

Tributary MR1.070 drains the east slopes, joining the Swan Lake complex on the right side of the floodplain. Tributary MR1.070 is fed by a perched lake several hundred feet above the valley floor and is not influenced by mainstem flow, but did contribute cold water (<4°C) in all seasons. Tributary MR1.070 is a relatively large tributary that extends approximately 3.6 km from its confluence with Swan Lake and the mainstem Martin River at RM 1.7 (Photo 3-12). The tributary becomes steeper approximately 3.6 km from the lake confluence where it flows through a steep gully with larger cobble and boulder substrate and step pools. A total of 517 m of Tributary MR1.070 were mesohabitat surveyed in May of 2024 including 24 distinct mesohabitat units which were present in a typical repeated riffle-glide-pool sequence which ranged from 0.1 m water depth in riffles to 0.5 m water depth in pools when flows were low.

Tributary MR1.070 was by far the longest tributary surveyed and contained the most fish habitat for rearing and overwintering of juveniles and resident species and spawning of adult anadromous and resident fish.

Photo 3-12 Tributary MR1.070 near the confluence with Swan Lake (right) and an example of spawning habitat identified in the tributary (left).

The mean wetted width in Tributary MR1.070 was 4.68 m. The mean thalweg depth was 0.44 m during the May survey (see Summary Table 3-8). The portion of the tributary that was surveyed was predominantly riffle habitat which was estimated as 65 percent of the surveyed habitat by area, with glide and pool habitat considerably less at 18 and 17 percent by area, respectively (Table 3-8). The eight pools documented totaled 423.84 m^2 with a mean depth of 0.92 m, indicating a relatively small area of early rearing salmon habitat or overwintering habitat for juvenile fish. Potential salmon spawning habitat was evident in 13 out of 16 riffles and glides with gravels accounting for at least 50 percent of the substrate in those habitat units, and the average thalweg depth in riffles and glides was 0.42 m. Spawning surveys in the fall documented the use of the tributary by spawning Coho Salmon and Dolly Varden (see Fish Use Study, Section 4.0).

The water flowing through this tributary was clear (<5 NTUs) during spring and fall and other water quality parameters were compatible with healthy aquatic habitat criteria. Water temperature measured during the fall survey was 4.8°C and was consistent with the other cold-water tributaries. DO concentrations were high at 12.7 mg/L, typical of clear, cold, flowing water. Discharge estimates for this tributary ranged from >16 cfs in the spring associated with runoff to 6.2 cfs in the late fall before the onset of fall rains.

3.5.5.4 Off-channel Complex OCH2.8R

This macrohabitat was a large off-channel complex composed of a main side slough (OCH 2.8R–SS-1), 10 secondary channels (OCH2.8R-SS-1.010, OCH2.8R-SS-1.010.10, OCH2.8R-SS-1.010.20, OCH2.8R-SS-1.020, OCH2.8R-SS-1.030, OCH2.8R-SS-1.040, OCH2.8R-SS-1.050, OCH2.8R-SS-1.050.10, OCH2.8R-SS-1.060, and OCH2.8R-SS-1.10) and two small tributaries, Tributary MR1.090 and Tributary MR1.100. Off-channel OCH2.8R-SS-1 drains into the mainstem Martin River via the Swan Lake outlet (Photo 3-13). The slough complex was surveyed during both spring and fall field events for habitat, water quality, and fish use and the primary slough was wetted at the time of the surveys. During habitat surveys, three of the 10 secondary channels were dry or contained only isolated pools with no flowing connection to the slough (OCH2.8R-SS-1.030, OCH2.8R-SS-1,040, and OCH2.8R-SS-1.10). Similarly, Tributary MR1.090 was disconnected from the slough complex during fall surveys and not accessible to fish, while Tributary MR1.100 had a steep drop at the connection point that appeared inaccessible to fish at the time of the survey (Photo 3-14).

Approximately 2.3 km (13,229 m^2) of OCH2.8R-SS-1 was surveyed and characterized during spring and fall of 2024. Overall, the mean wetted width of the slough was 5.05 m and thalweg depth ranged from 0.12 to 1.8 m with a mean depth of 0.38 m. A total of 100 distinct mesohabitat units were surveyed in 2024, predominantly comprised of glide habitat, estimated as 57 percent of the total habitat by area, with riffle habitat following at 30 percent, and pools and cascades covering considerably less area at 12 and 0.5 percent respectively (see Summary Table 3-8). Twenty-one surveyed pools totaled 1,634.4 m^2 in area with a mean depth of 0.81 m, indicating a relatively large area of early rearing salmon habitat. Potential salmon spawning habitat was evident in 75 percent of riffle and glide habitats that contained substrate composed of 50 to 90 percent gravels. Spawning surveys in these habitats in the fall resulted in identification of both Coho and Sockeye Salmon use of OCH2.8R-SS-1 for spawning (Photo 3-15).

Photo 3-13 Off-channel complex OCH2.8R including Swan Lake and location of the outflow into the Martin River.

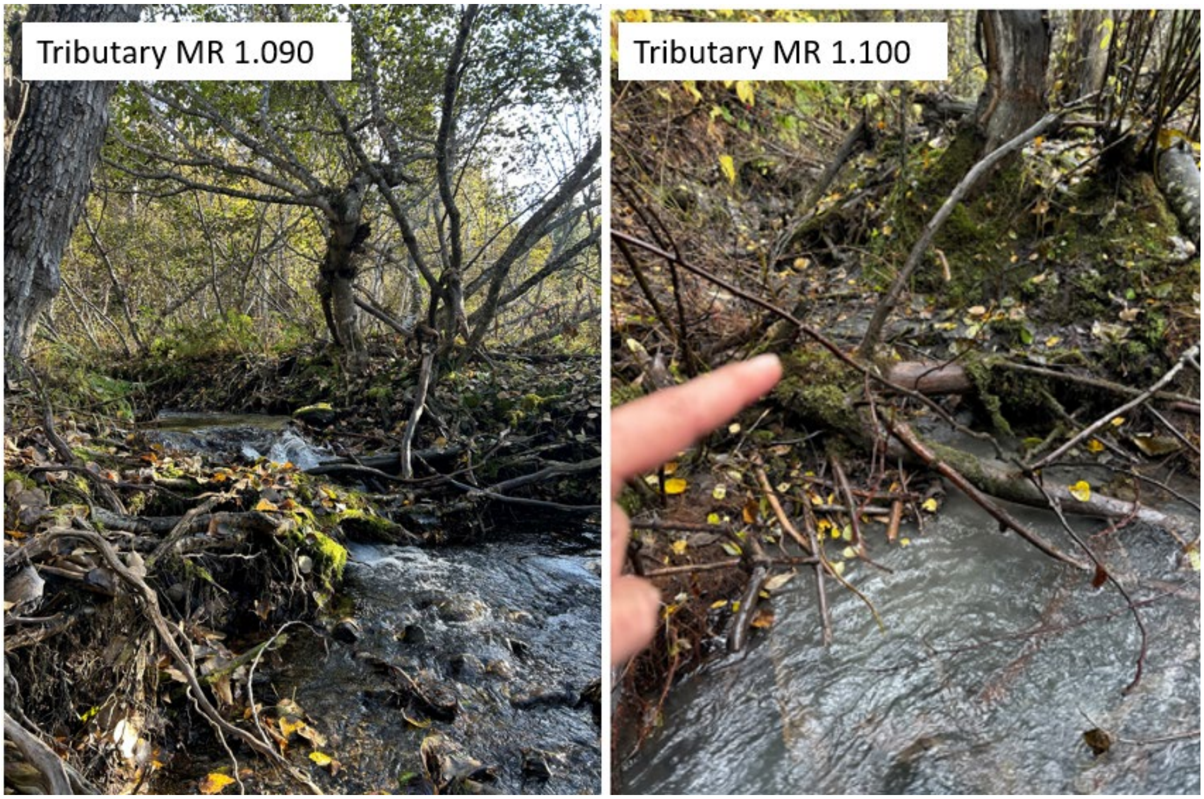

Photo 3-14 Tributaries MR1.090 and MR1.100 (confluence with OCH 2.8R-SS-1 (left) and nearly dry channel (right).

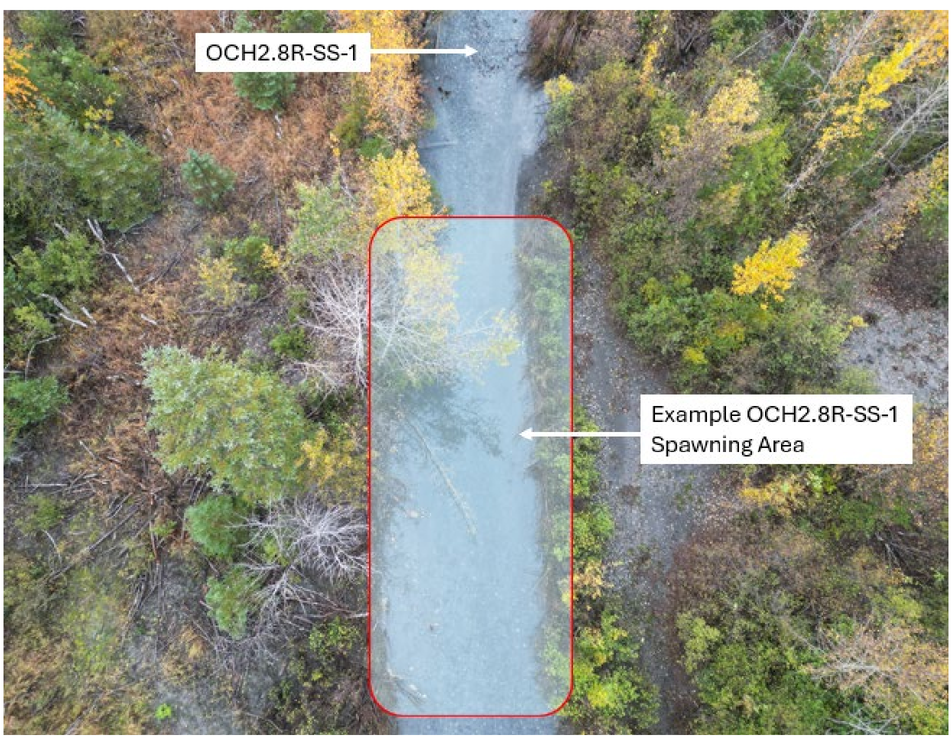

Photo 3-15 Off-channel OCH2.8R-SS-1 and example habitat where Sockeye Salmon were observed spawning.

Water quality parameters were measured on September 24 and 26, 2024 during fall fish use surveys and spawning surveys. Water temperature was 3.3 to 4.2°C, DO concentrations were 10.6 and 11.8 mg/L—values consistent with water quality standards and expectations for clear, cool water. Turbidity during this sampling event was low, <5 NTUs, but observations during higher flow events indicate that this macrohabitat does become turbid when mainstem flow is high enough to connect the slough to the mainstem at its upstream end.

In off-channel slough OCH2.8R-SS-1, three temperature loggers were installed at the upper, middle, and lower reaches of the complex. This complex is intermittently connected to the mainstem as evident both by influx of cold mainstem water coming from the EFMR and visible increases in turbidity when upstream connection points are watered. Figure 3-12 documents the progression of warming from upstream where temperatures ranged from 1 to 5°C with no exceedances or response to mainstem flooding, to the downstream site where warm water from the adjacent lake, thermal loading, and the influx of main channel floodwater from the August flood are evident. At the lower site, the logger was dewatered due to post-installation channel changes until mid-September when Martin River flows were sufficient to rewater the site.

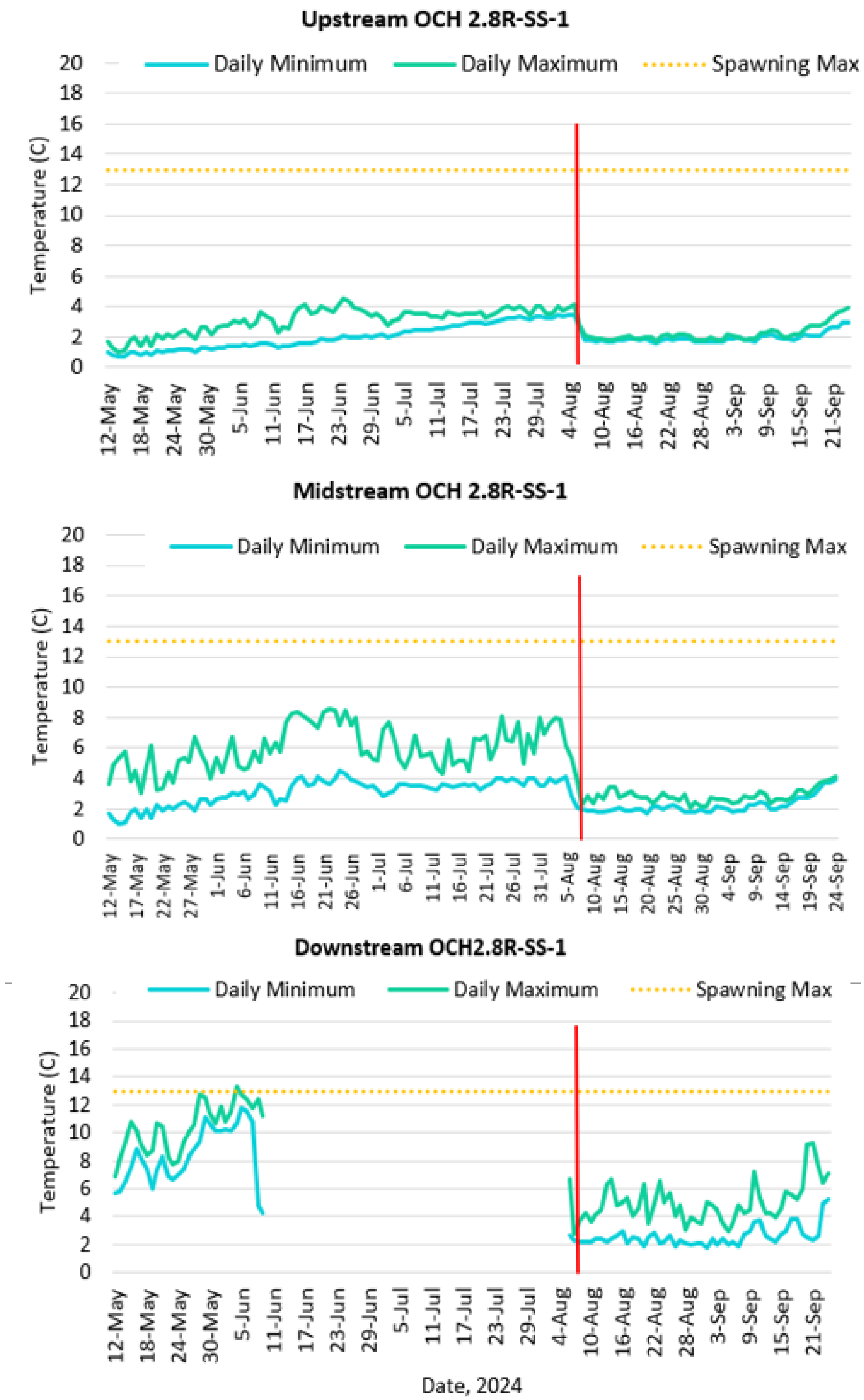

Figure 3-12 Upstream (top), midstream (center), and downstream (bottom) temperature monitoring data from OCH2.8R-SS-1.

3.5.5.4.1 OCH2.8R-SS-1.010

Six wetted secondary channels to OCH2.8R-SS-1 were surveyed and characterized during spring surveys. Slough OCH2.8R-SS-1.010, one of the longer secondary sloughs, was surveyed along a 367 m transect. Fifteen mesohabitat units were identified covering 1,342 m^2 of wetted area. The mean wetted width of this slough was 3.5 m and mean thalweg depth was 0.2 m. Glide was the dominant habitat type in OCH2.8R-SS-1.010 comprising 61.7 percent of habitat by area. Two pools were documented in the habitat, with a mean maximum pool depth of 0.7 m. This slough had two smaller channels connected to it including OCH2.8R-SS-1.010.10 and OCH2.8R-SS-1.010.20. Slough OCH2.8R-SS-1.010.10 had a survey length of 56 m and contained one riffle and one glide under low spring flow conditions. The mean wetted width was 1.6 m and the mean thalweg depth was 0.2 m. Sand/fines was the dominant substrate with 60 percent by area comprised of this substrate type. The survey extent of side slough OCH2.8R-SS-1.010.20 was 56.9 m and was comprised of 100 percent glide habitat with a mean wetted width of 1.40 m and a thalweg depth of 0.13 m; the substrate was 90 percent organics and fine particulates.

3.5.5.4.2 OCH2.8R-SS-1.050

Slough OCH2.8R-SS-1.050 was short, with one 85.0-m-long glide. The flow in this slough was extremely low such that there was not a definable channel. However, as the crew continued walking upstream, the depth increased to 0.62 m near the head where slough OCH2.8R-SS-1.050.10 drained into OCH2.8R-SS-1.050. This upstream tertiary slough, OCH2.8R-SS-1.050.10, had a more defined channel. The surveyed area was 183 m in length and contained 6 distinct mesohabitat units that covered 414 m^2. The mean wetted width was 2.3 m and the mean thalweg depth was 0.2 m. Gravels were the dominant substrate at 61 percent across all habitats. The one relatively small pool documented covered 33.5 m^2 with a maximum depth of 0.33 m and 80 percent gravel substrate.

3.5.5.4.3 OCH2.8R-SS-1.060

Slough OCH2.8R-SS-1.060 was the uppermost secondary channel to slough OCH2.8R-SS-1. Approximately 334 m length of the slough was surveyed and characterized. It contained 13 distinct mesohabitats, with riffles the most dominant at 60 percent by area followed by glides at 38.7 percent and pools at 0.9 percent. Sand/fines was the dominant substrate at 49 percent over all habitats. The one small pool documented covered an area of 15.3 m^2 with a maximum depth of 0.7 m and 70 percent gravel substrate.

Photo 3-16 shows the confluence between OCH2.8R-SS-1.060 and OCH2.8R-SS-1 on September 25 when both access and egress would be limited due to shallow water coverage on the alluvial fan at the mouth of OCH2.8R-SS-1.060. Water quality parameters were measured on October 3, 2024, and included temperature of 3.8°C, DO of 12.68 mg/L, conductivity of 83.6 μS/cm, and low turbidity at <5 NTUs.

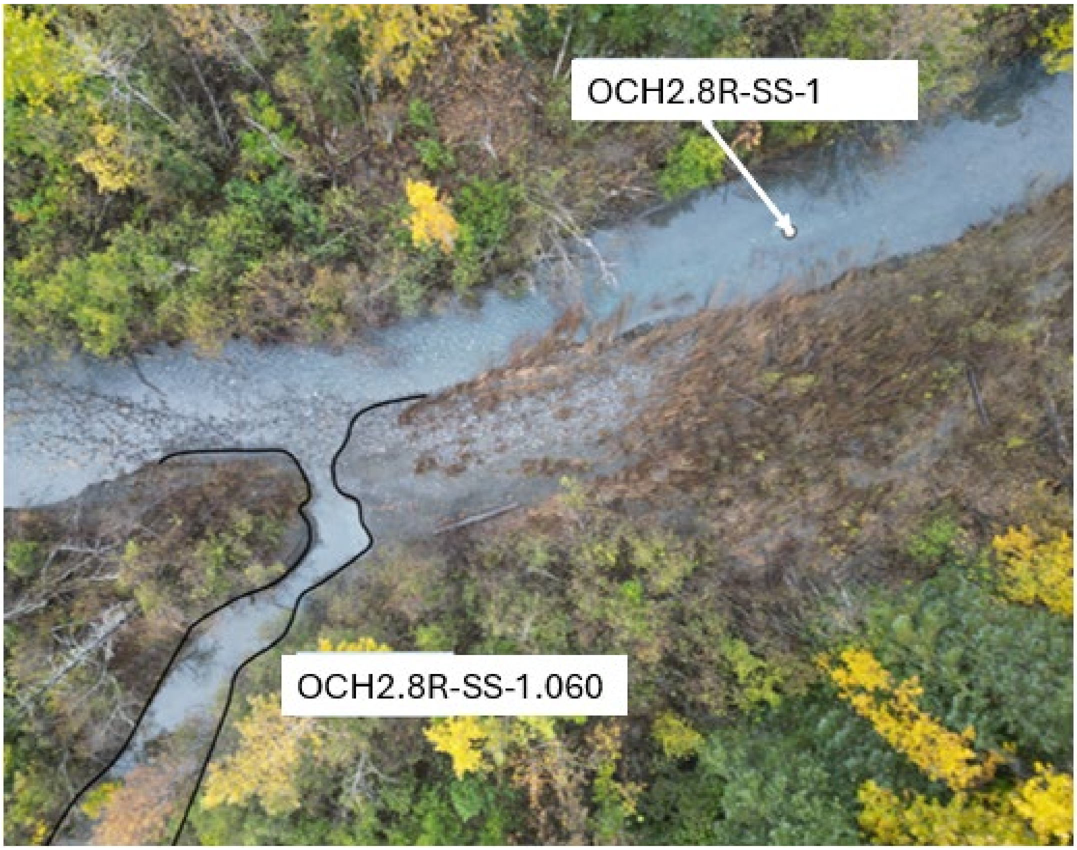

Photo 3-16 OCH2.8R-SS-1.060 confluence with OCH2.8R-SS-1.

The water flowing through the main slough, OCH2.8R-SS-1, and secondary slough OCH2.8R-SS-1.060 was clear in the spring (<5 NTUs) but the primary slough was more turbid during fall (24 NTUs). Water temperature in the main slough was moderate at 4.2°C during fall and other water quality parameters were compatible with healthy aquatic habitat criteria. The continuous temperature logger at this site recorded minimum and maximum daily temperatures within a few degrees of each other until July 17, 2024 when daily maximum temperatures increased, either due to shallow conditions and more exposure of the instrument to thermal loading, or influx of warmer water from rain events (Figure 3-13). The rain event on August 6-7, 2024, resulted in immediate decline in water temperatures, consistent with that observed in other OCHs where cold mainstem water inundated habitats previously dominated by inflow from off-channel sources.

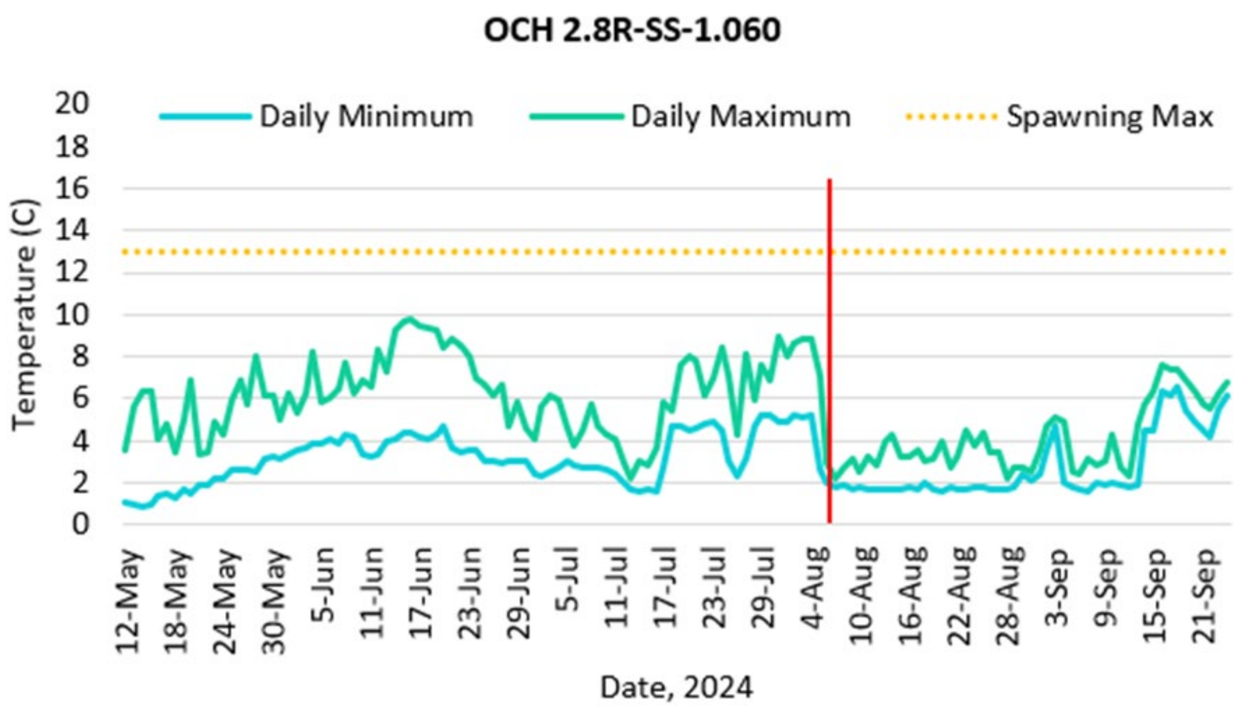

Figure 3-13 Stream temperature at OCH2.8R-SS-1.060 with August 2024 flood event shown in red.

3.5.5.5 Off-channel Complex OCH3.0L

This macrohabitat is a side slough which joins a left-bank braid of the mainstem Martin River near RM 3.0 via shallow gravel riffle that may be impassable to adult fish at low flows (Photo 3-16). OCH3.0L-SS-1 receives input during low flow conditions both from groundwater and the lake complex which includes MR1.080.L1, MR1.080.L2, and the intermittent connecting seep, Tributary MR1.080 which was dry and encroached with grass at the time of survey on September 27, 2024.

3.5.5.5.1 OCH3.0L-SS-1

At higher flow levels, OCH3.0L-SS-1 connects to the main stem Martin River near RM 3.5 (Photo 3-17). On May 7, 2024, 1,371 meters of OCH 3.0L-SS-1 were surveyed, including 24 mesohabitat units that included riffle-glide-pool sequences. The average wetted width of mesohabitat units was 4.04 m, while the average BFW was 8.28 m. Glide and riffle habitat were predominant comprising 43 percent and 54 percent of the total habitat by length, respectively. The three pool habitat units made up less than 2 percent of the total habitat. The average wetted depth of the three pool units was 0.5 m with maximum depths of 0.7 m at each, which represents a limited quantity of juvenile rearing habitat.

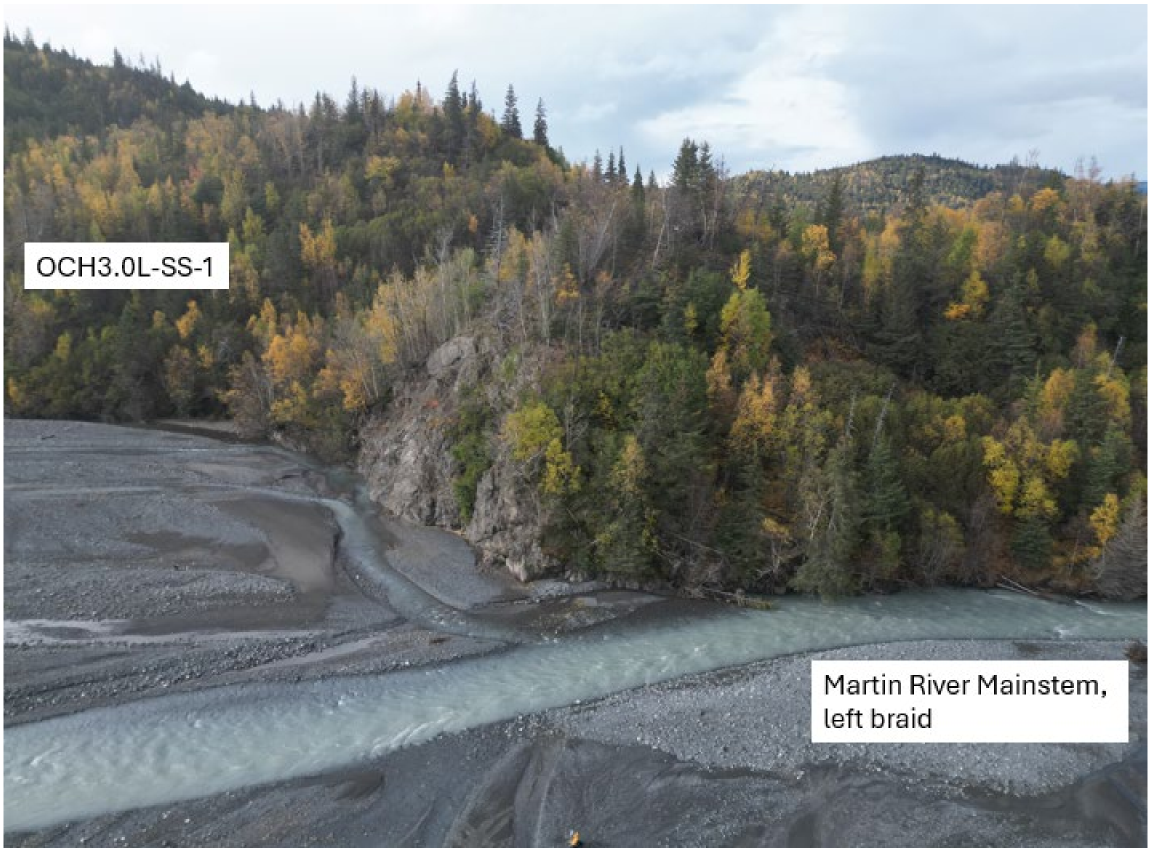

Photo 3-17 Confluence of OCH3.0L-SS-1 and the left braid of the mainstem Martin River on October 5, 2024.

The OCH at OCH3.0L-SS-1 is fed by the MR1.080 Lake complex perched about 50 feet above the grade of the floodplain. The upper temperature logger site at OCH3.0L was located in a higher gradient section of the channel and that was thermally influenced by outflow from the warm feeder lakes which were shallow, tannic lakes with heavily silted substrate, submerged aquatic vegetation, and sun exposure, resulting in higher temperatures than many other sites. This site demonstrated no exceedances of ADEC Water Quality Standards for Alaska Fresh Water Uses from mid-May through early August (Figure 3-14).

Water quality measurements were taken on September 23, 2024 which included a temperature of 3.9°C, DO of 10.0 mg/L, specific conductance of 161 μS/cm and turbidity of <5 NTUs. Continuous temperature monitoring at this site identified a pattern of cooling between early May and mid-June, then a cooling in late June and July associated with onset of glacial melt. The significant rainfall event that triggered flooding in the watershed on August 6-7 resulted in a rapid increase in temperature, indicative both of the influence of warmer rainwater as well as inflow from the mainstem as floodwaters connected OCH3.0L-SS-1 to mainstem flow (Figure 3-14).

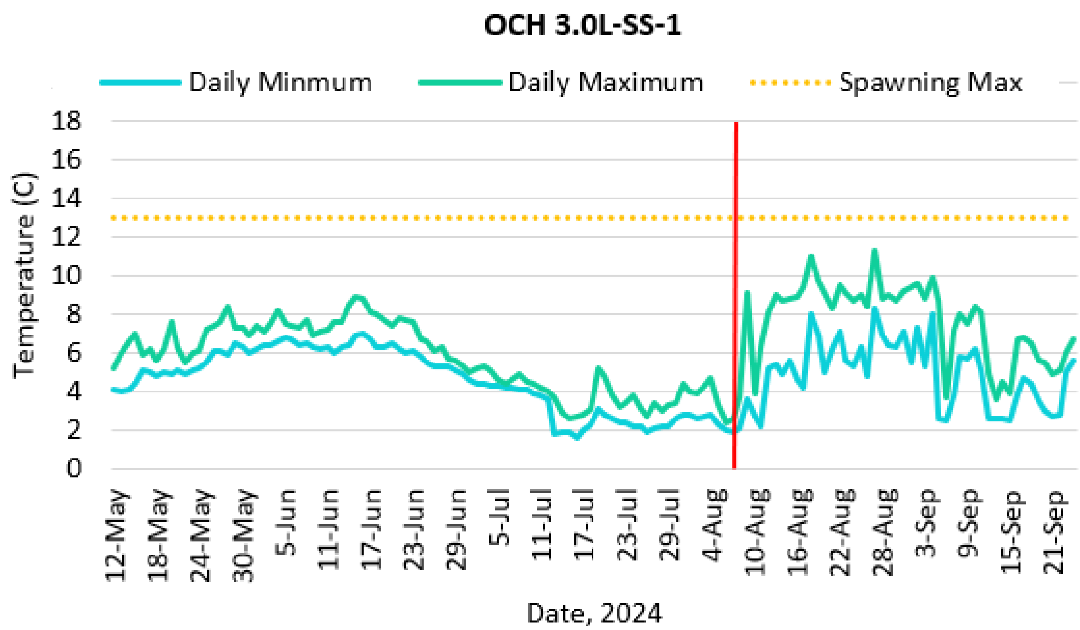

Figure 3-14 Continuous temperature monitoring results for OCH3.0L-SS-1 with August 2024 flood event shown in red.

3.5.5.5.2 OCH3.0L-SS-1.010

This macrohabitat is a short side slough inflowing to OCH3.0L-SS-1 and contained only three habitat units totaling 99.7 m, comprised of one riffle which was 55 percent of the habitat by length, and two glides accounting for the remaining 45 percent of the slough. The wetted depth ranged from 1.0 to 2.5 m, and thalweg depths ranged from 0.0 to 0.15 m, which were too shallow for these units to be of value to rearing or migrating juveniles or adult fish under the observed flow conditions.

3.5.5.5.3 Tributary MR1.080

Tributary MR1.080 is a vegetated drainage channel between the two lakes (MR1.080.L1 and MR1.080.L2) which contribute flow to OCH3.0L-SS-1 (Photo 3-18). This macrohabitat was identified through aerial imagery as a potential tributary that may provide rearing or conveyance habitat to rearing life stages of fishes. However, at the time of the survey, there were isolated puddles of water encroached with grass and other heavy vegetation and appeared to be residual from intermittent runoff events between the higher elevation MR1.080.L1 and the lower elevation MR1.080.L2. There was no evident fish habitat, and it appeared that Tributary MR1.080 functions only as a drainage channel and does not provide fish habitat.

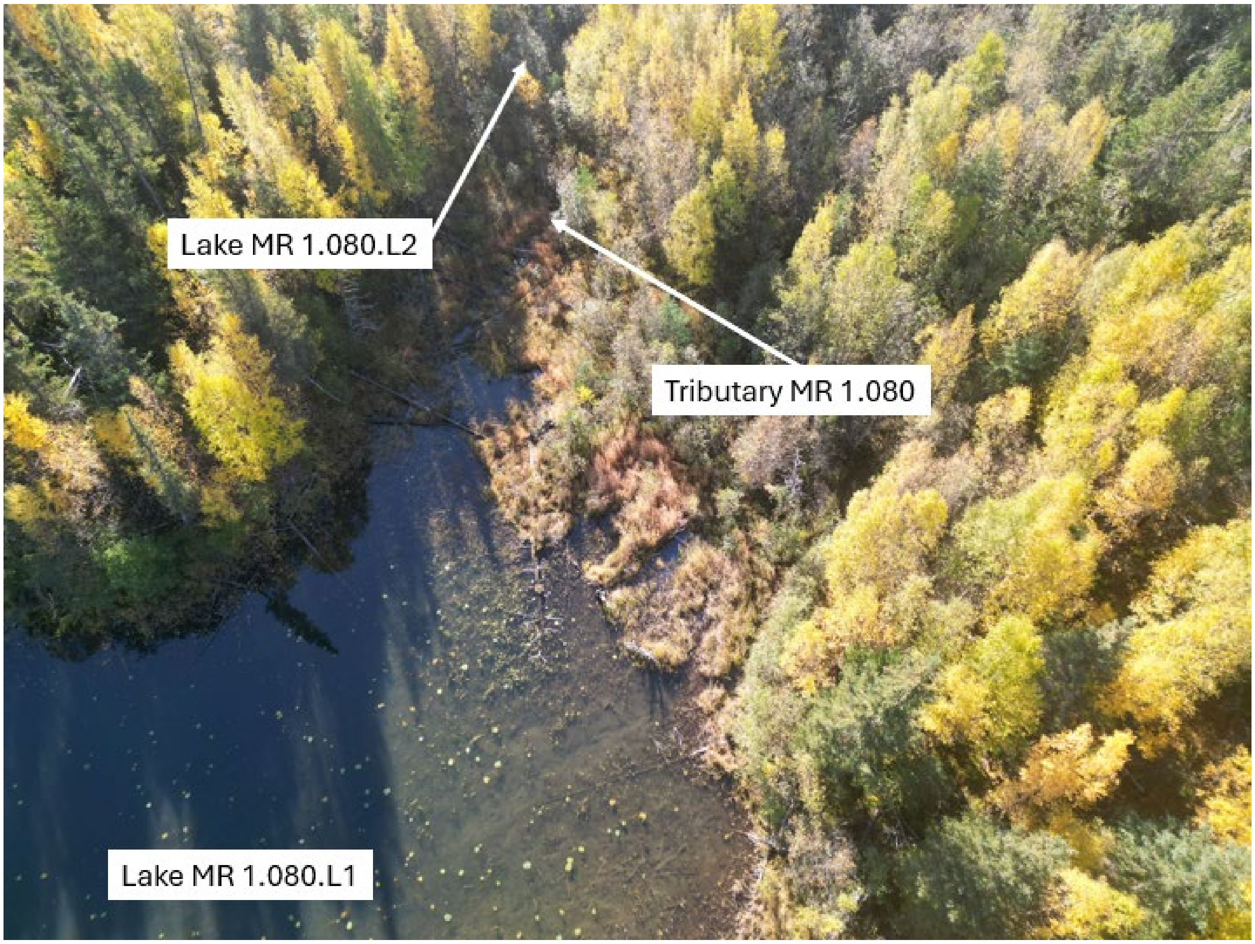

Photo 3-18 Lake MR1.080.L1 showing the inflow area of Tributary MR1.080.

3.5.5.5.4 Lake MR1.080.L1

This macrohabitat is a 17,514-m^2 tannic lake perched about 30 feet in elevation above the Martin River mainstem floodplain. Lake MR1.080.L1 is bifurcated by a grassy isthmus which equalizes flow between its two halves (Photo 3-19). Both halves of MR1.080.L1 appear shallow, have heavy growth of macrophytes, aquatic lilies, and aquatic grasses, and tannic brown water that receives unobstructed solar warming. The substrate around the lakeshore was 100 percent fine organic material, and disturbance of these sediments often yielded sulfuric smells, indicating potential anoxic conditions in the substrate. Water quality parameters measured on September 27, 2024 included temperature of 11.0°C, pH of 7.47, DO concentration of 9.18 mg/l and 82 percent which are lower than observed for cool, flowing habitats elsewhere in the basin, and low turbidity of <5 NTUs.

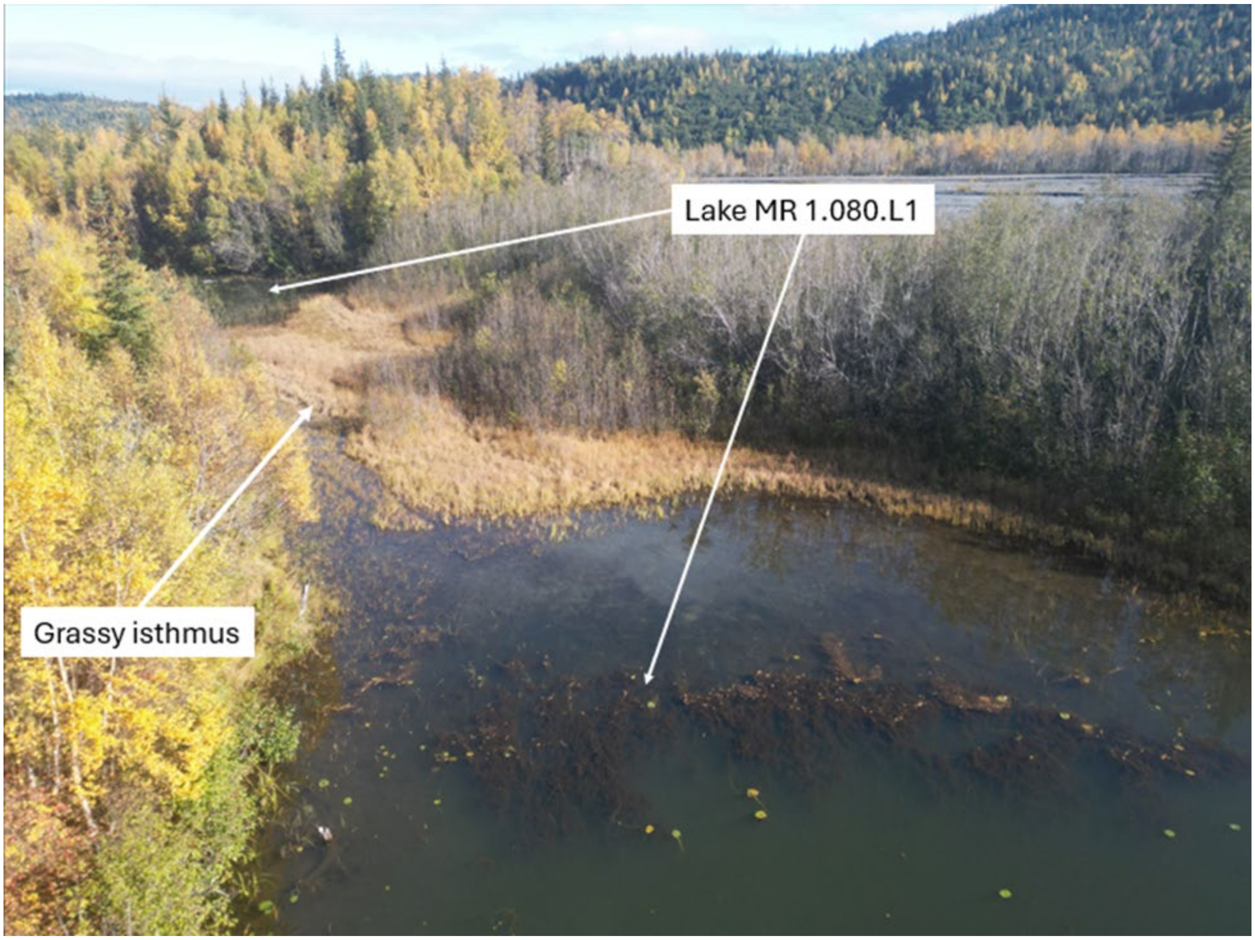

Photo 3-19 Lake MR1.080.L1 showing the isthmus separating the lake.

3.5.5.6 Off-channel Complex OCH3.8L

3.5.5.6.1 OCH3.8L-SS-1

This macrohabitat is a side slough that is fed by a combination of outflow from a perched tannic lake known as Hawk Lake (due to its bird-like shape), and surface or subsurface flow from the main channel at some flow conditions (Photo 3-20). On April 30, 2024 OCH3.8L-SS-1 contained 12 mesohabitat units totaling 378.9 m in length and covering 1,139.6 m^2 in wetted area. The average total wetted width was 2.8 m and average BFW of 6.3 m. Total wetted depth averaged 0.25 m and ranged from riffle habitat less than 0.1 m in depth to pool habitat 0.7 m in depth.

Photo 3-20 Middle reach of OCH3.8L-SS-1 showing a pool habitat with silt/sand sediment.

Glide and riffle habitat were equally represented in OCH3.8L-SS-1 with 53.7 percent and 37 percent of the wetted habitat for each. Pool habitat covered 9.33 percent of the habitat by length and about 106.4 m^2 by area Substrate in glide habitat averaged about 25 percent gravel substrate by area, with smaller substrate like sand making up the majority of substrates in riffle and glide habitats (55.6 percent). Substrate in pool habitat was fine organic material or sand. Glide or riffle habitat which contained potentially suitable spawning gravel may be unsuitable for this life history stage because observed depths of these habitats averaged less than 0.15 m which is insufficient for many adult fish for migration or spawning. The four pool mesohabitats were separated by shallow riffles and represent small pockets of rearing habitat for juvenile fishes.

Water quality parameters could not be measured during habitat surveyed at this site due to equipment malfunction, but continuous temperature monitoring at two sites within OCH3.8R-SS-1 successfully recorded thermal conditions from early May to late September of 2024. At the upstream site, stream temperature remained below the ADEC water quality criteria for spawning of 15°C. Unlike OCH3.0L-SS-1 which appeared to receive cold interstitial or groundwater flow from the mainstem, OCH3.8L-SS-1 was fed by a warm water lake, which was reflected in the relatively stable temperature of 6 to 10°C throughout the monitoring period. However, after the August 6-7 precipitation event, colder water from the mainstem inundated OCH3.8L-SS-1, resulting in cooling of water in this macrohabitat unit following that event (Figure 3-15).

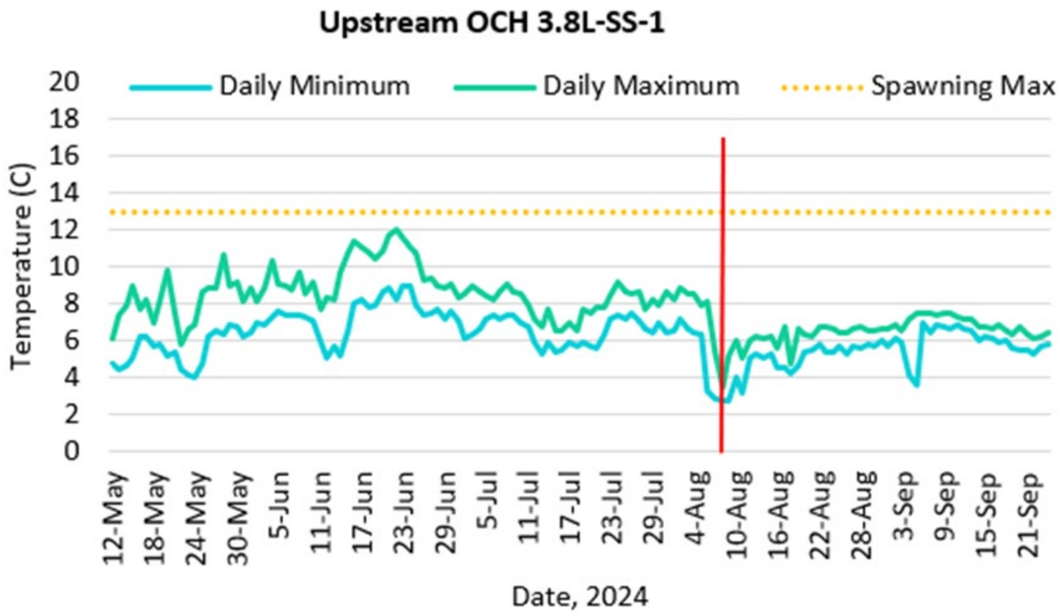

Figure 3-15 Continuous temperature monitoring data for the upstream site at OCH3.8L-SS-1 with August 2024 flood event shown in red.

At the downstream continuous temperature monitoring site on OCH3.8L-SS-1, water temperatures appear influenced by lake runoff during the spring months from May 5 to June 20, after which cooling occurred. This is indicative of ground water or interstitial input from the colder main channel in the lower portion of this macrohabitat unit which resulted in a difference of more than 2°C during July. Following the August 6-7 precipitation event, the response of water temperature in the downstream temperature monitoring site on OCH3.8L-SS-1 was the opposite of that observed at the upstream site. Flooding resulted in an increase in water temperatures at the downstream location, indicative that floodwaters were warmer than baseline groundwater or interstitial inflow to OCH3.8L-SS-1 in the lower reaches (Figure 3-16).

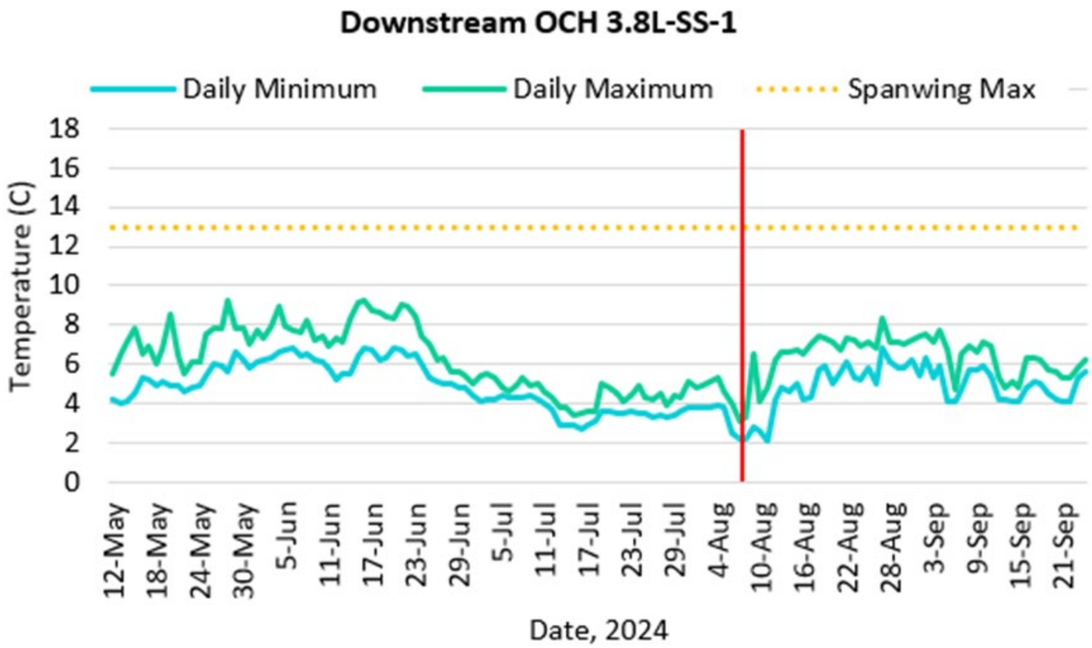

Figure 3-16 Continuous temperature monitoring in the lower site of OCH3.8L-SS-1 with August 2024 flood event shown in red.

3.5.5.6.2 Hawk Lake

Hawk Lake is a tannic lake perched at least 50 feet in elevation above the grade of the Martin River floodplain. The lakeshore is crowded and shaded with thick evergreen trees, and the nearshore aquatic habitat has large quantities of submerged large woody debris, lily pads and other aquatic vegetation, and a thick layer of fine sediment and particulate organic material.

3.5.5.7 Off-channel Complex OCH4.2R

3.5.5.7.1 OCH4.2R-SS-1

This macrohabitat is a side slough that drains Lake MR1.120.L1 and enters the Martin River from the right side of the floodplain (Photo 3-21). In spring, 394.5 m of OCH 4.2R-SS-1 were surveyed covering 15 habitat units. Wetted width averaged 4.19 m and BFW averaged 6.14 m. Mean thalweg depth was 0.3 m and mean pool depth was 0.61 m. Habitats surveyed included typical riffle-glide-pool sequences, with riffles comprising 32.8 percent of habitat by length, glides comprising 45.73 percent and pools comprising 18.53 percent.

Substrates in glide habitat was predominantly cobble and gravel, with gravel averaging 47 percent of all glide habitat by area. There were 578 m^2 in potential gravel spawning area for fishes in glide habitat in OCH4.2R-SS-1 at the time of the survey. With mean total wetted depth of 0.3 m in this area, this macrohabitat may be suitable for adult fish spawning. Pool habitat comprised 300 m^2 of OCH4.2R-SS-1 which represents a small proportion of the rearing habitat available to juvenile fish on the floodplain.

Continuous temperature monitors were installed at OCH4.2R-SS-1 for the Water Quality study, and results of that monitoring are provided in the Water Quality Monitoring Study (Section 2.0).

Photo 3-21 OCH 4.2R-SS-1 confluence with the mainstem Martin River (left) and upstream near the outlet from Lake MR1.120.L1.

3.5.5.7.2 Lake MR1.120.L1

This macrohabitat is a lake that drains the surrounding hillslopes via several runoff gullies (Photo 3-22). MR1.120.L1 is bisected in the center by a shallow constriction where the water was less than 1.0 m in depth with soft, organic substrates, fine particulate organic matter, and aquatic macrophyte growth. The southern half of the lake was less turbid than the north half of the lake during September 2024 fish survey efforts, suggesting that inundation from the mainstem occurred more recently in the north half of the lake, and that the north portion may be at a slightly lower elevation than the southern lobe.

Photo 3-22 South lobe of Lake MR1.120.L1, September 29, 2024 (upper image) and bifurcation between clear and turbid lobes (lower image).

3.5.5.7.3 Tributaries MR1.120, MR1.120.10, MR1.120.20

These macrohabitats were identified from aerial imagery as potential tributaries to OCH4.2R-SS-1. This site was visited on September 29, 2024, for mesohabitat and fish surveying. The field crew identified a shallow, grassy channel on the east slope of the lake basin; however, no evident channel contained surface water or any discernible habitat—wet or dry—that could support fish rearing or spawning under different flow conditions (Photo 3-23).

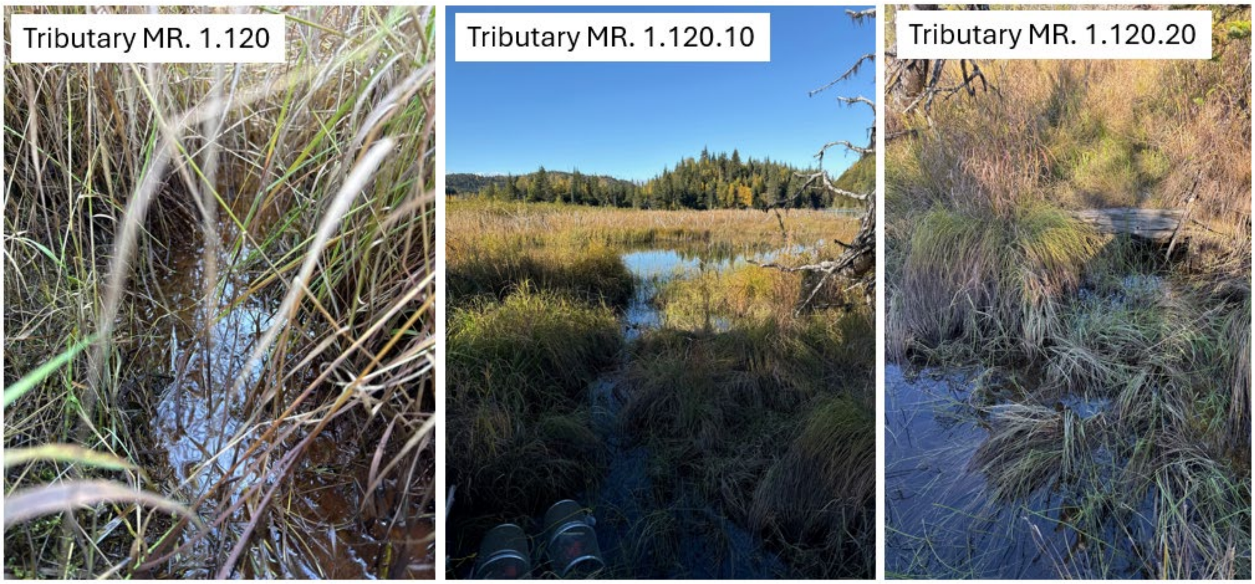

Photo 3-23 Encroached drainage channels at tributaries MR1.120, MR1.120.10, and MR1.120.20.

3.5.6 East Fork Martin River Potential Fish Barriers

A foot survey of the EFMR canyon was conducted on April 27, 2024 under extreme low flow conditions to evaluate potential barriers following the methods of Powers and Orsborn (1984). The stage reading at the USGS Gage No. 15238951 EFMR at Mouth near Homer, Alaska ranged between 3.99 feet and 4.02 during the time of the survey. The canyon entrance was not wadable at the first survey attempt in May of 2023 but was wadable up to EFMR RM 1.35 by April 27, 2024 (Photo 3-24).

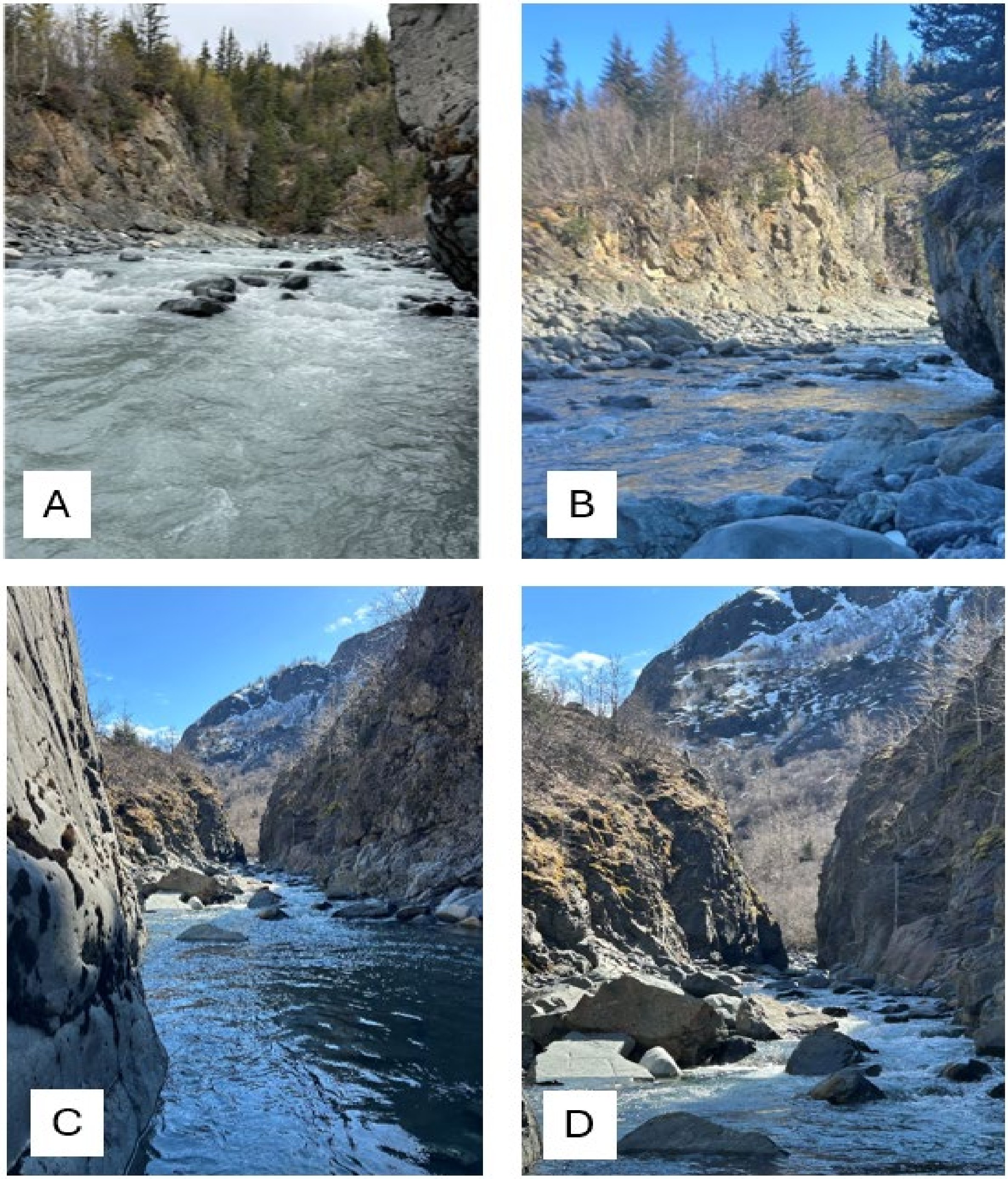

Photo 3-24 EFMR on April 27, 2024 when the fish passage barrier survey was completed. Image A and B show the mouth of the EFMR looking upstream, while C and D show the EFMR looking upstream into the constriction near RM 1.35.

The survey terminated where the river became unwadable at the constriction PB_EFM_RM1.45 identified from the air in 2023 (Figure 3-17). The constriction confined the river flow and water depth exceeded 1.8 meters; thus foot survey was not possible beyond this point. Steep rock banks prevented access upstream along the banks. It appeared that this constriction could create a partial fish barrier under high flow conditions. Access upstream to evaluate the waterfalls identified in 2023 required helicopter access. A potential landing zone near EFMR RM 1.5, outside of the wilderness area, was identified in 2023 but flight restrictions to avoid disturbing goats prevented access during the 2024 field effort when goats were observed on upland slopes in the area.

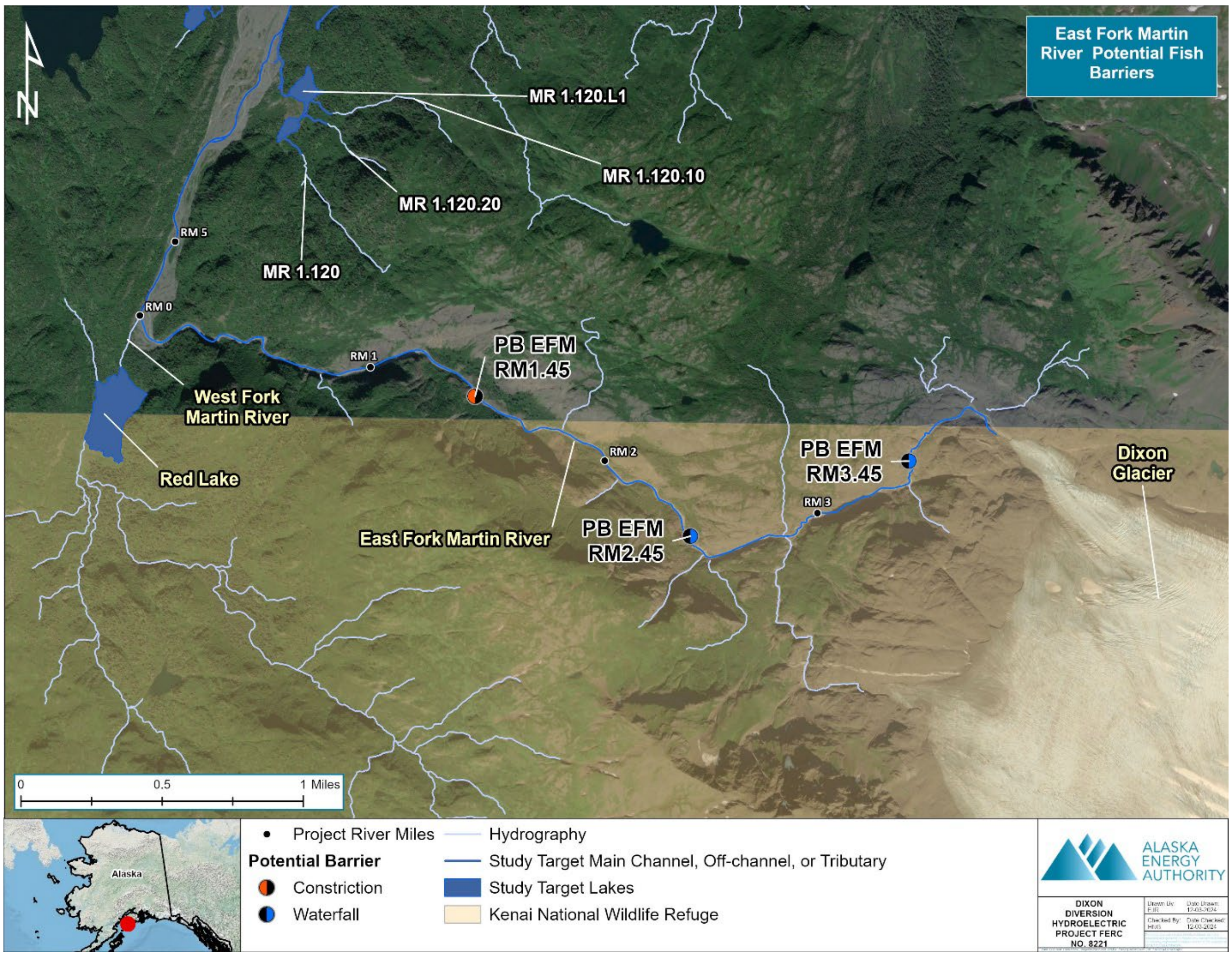

Figure 3-17 Potential fish passage barriers in the EFMR.

3.6 Discussion

The Aquatic Habitat Characterization Study provided baseline data to evaluate the potential loss or gain in accessible fluvial habitat that may result from flow diversion in the Martin River and provided data that informed other studies including the Martin River

Fish Use and Hydraulic Modeling, Geomorphology, and Aquatic Habitat Connectivity Study (Kleinschmidt Associates 2025; Watershed GeoDynamics 2025).

Habitat surveying and thermal monitoring of side channel sloughs such as the OCH2.8R, OCH1.7L, and OCH3.0L complexes highlighted the influence of mainstem flow input to lower reaches of these sites during periods of increased flow from runoff or precipitation as evident by turbid and coldwater conditions. The upstream reaches within these complexes were at slightly higher elevations and were more thermally impacted by source lake or groundwater with warmer, clearwater present during spring and summer months. The Hydraulic Modeling, Geomorphology, and Aquatic Habitat Connectivity Study further analyzed the hydraulic connectivity between sites at different flows.

At many sites that had been identified as tributaries by the remote GIS habitat mapping and were characterized as a potential fish habitat, ground sampling documented either no connectivity to downstream habitat, or no water at all. In most cases, the identified sites were snowmelt or rainwater runoff channels that did not contain fish habitat. The notable exception was Tributary MR1.070 which was fed by a combination of lake source and smaller tributary inflow and not only had accessible habitat with documented fish use in all seasons, more than 20 Coho Salmon were documented spawning in the fall of 2024 (see Fish Use Study, Section 4.6.3).

Both tributary and side slough OCH was dominated by riffle/glide sequences, occasionally punctuated by pool habitat, relict beaver ponds, and large woody material. This habitat complexity results in a mosaic of fish habitat, that was found to be used by various species and age classes of juvenile fish (see Fish Use Study, Section 4.0). In the fall, when Coho and Sockeye salmon adults were spawning in off-channel and tributary habitats of OCH2.8R-SS-1 and MR1.070 (see Fish Use Study, Section 4.6.3), water depths were rarely more than 20-30 cm, and spawning areas where redds were observed were small pockets of gravel ranging from 1 to 3 square meters.

It was noted during fall mesohabitat surveying between September 23 and September 25 when the EFMR stage height at the USGS Gage was 5.6 to 5.8 feet, that some areas with suitable fish habitat were almost completely isolated from downstream sites, most notably at Tributary MR1.030, OCH1.70-SS-1, and OCH2.8R-SS-1.060. When the sites were revisited during adult salmon spawning surveys September 29-October 1, 2024, the EFMR stage height was up to 6.1 feet, there had been several days of heavy rain, and these habitats again had sufficient flow to provide access or egress to juvenile fishes.

The significant atmospheric river precipitation event that occurred on August 6-7, 2024 brought valley-floor-spanning floodwater to the entire Martin River floodplain. The nearby Battle Creek USGS Gage reported a nearly 1,500 percent increase in discharge resulting from this event. The effect of this event on the geomorphology of the Martin River, and site-specific changes in channel form is discussed in the Geomorphology and Sediment Transport Study Report (Watershed GeoDynamics 2025) There were bedload shifts that resulted in gravel and sediment deposition downstream, channel migrations, new avulsions, and large wood recruitment. Habitats that were surveyed during spring efforts were completely different in the fall, highlighting how dynamic the Martin River can be and the transient nature of accessible habitat. While the August 2024 event was especially intense, there is evidence of dynamic habitat shifts throughout the floodplain from other events such as gravel-choked trees, flooded vegetation, fine-sediment deposits where no water is currently flowing, etc. Overall, the habitat within the Martin River floodplain is typical of the shifting habitat mosaic of river geomorphology (Stanford et al. 2005). The prevalence of juvenile Dolly Varden and Coho Salmon of multiple age classes in habitats across the landscape indicated that the fish use the off-channel and are adapted to the dynamic conditions in the Martin River. More information on fish use for juvenile rearing and adult spawning is provided in Section 4.0 (Fish Use Study).

3.7 References

Alaska Energy Authority (AEA). 2022b. Draft Study Plan. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Proposed Dixon Diversion. November 2, 2022. Available online: https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2022.11.02%20Dixon%20Diversion%20Draft%20Study%20Plan.pdf

Brittain, J.E. and A. Milner. 2001. Ecology of glacier-fed rivers: current status and concepts. Freshwater Biology, 46(12), 1571-1578. https://doi.org/10.1046/j.1365-2427.2001.00845.x.

Kleinschmidt Associates. 2025. Hydraulic modeling and aquatic habitat connectivity study report. Bradley Lake Hydroelectric Project Dixon Diversion. Prepared by Kleinschmidt Associates for the Alaska Energy Authority. January 2025.

Mauger, S., R. Shaftel, E.J. Trammell, M. Geist, and D. Bogan. 2015. Stream temperature data collection standards for Alaska: Minimum standards to generate data useful for regional-scale analyses. Journal of Hydrology: Regional Studies, 4, pp.431-438.

Milner, A. 2013. Glacier-fed Rivers and Climate Change in Alaska Parks. Article 10 in Alaska Park Science – Volume 12 Issue 2: Climate Change in Alaska's National Parks. Available online: https://www.nps.gov/articles/aps-v12-i2-c9.htm.

Powers, P.D. and J.F. Orsborn. 1985. Analysis of barriers to upstream fish migration, an investigation of the physical and biological conditions affecting fish passage success at culverts and waterfalls. Washington State University, Department of Civil Engineering, Albrook Hydraulics Lab, Pullman, WA.

Stanford, J.A., M.S. Lorang, and F.R. Hauer. 2005. The shifting habitat mosaic of river ecosystems. Internationale Vereinigung für theoretische und angewandte Limnologie: Verhandlungen, 29(1), 123-136.

United States Forest Service (USFS). 2001. Alaska region aquatic habitat management handbook. Chapter 20. USDA Forest Service. FSH 2090.21. R-10 Amendment 2090.21-2001-1. Available online: https://www.fs.usda.gov/cgi-bin/Directives/get_dirs/fsh?2090.21.

Watershed GeoDynamics. 2024. 2023 Geomorphology Observations. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Proposed Dixon Diversion. Prepared by Watershed GeoDynamics for the Alaska Energy Authority. February 2024. Available online: https://www.akenergyauthority.org/Portals/0/BradleyLakeHydroelectricProject/2024.02.01DixonDiversionGeomorphologyObservationsReport.pdf.

Watershed GeoDynamics. 2025. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Dixon Diversion Project. Geomorphology and Sediment Transport Study Report. Prepared by Watershed GeoDynamics for the Alaska Energy Authority, Anchorage, Alaska. January 2025.

Wheaton, J.M. 2002. Physical Habitats of Salmonids in a Glacial Watershed, Copper River, Alaska. Glacial and Periglacial Processes as Hydrogeomorphic and Ecological Drivers in High-Latitude Watersheds. Eds. J. Mount, P. Moyle and S. Yarnell. Davis, CA.

4.0 MARTIN RIVER FISH USE STUDY

4.1 Background

In 2024, AEA funded the third year of ADF&G monitoring of adult Sockeye and Coho salmon entering Red Lake with an autonomous video counting tower (AVCT). AEA also implemented the first year of fish sampling in clearwater off-channel areas of the Martin River and select tributaries during the spring and fall to establish fish species presence and distribution.

4.2 Study Plan Modifications

Based on the information summarized in the DSP, AEA conducted a reconnaissance evaluation of potential spawning habitat for Eulachon near the mouth of the Martin River on May 24, 2023. Regional information suggests that Eulachon may enter rivers in the vicinity of the Martin River between mid-May and late June (AEA 2022a). This timing corresponds with the period of the ADF&G personal use of Eulachon fishery in Cook Inlet (ADF&G 2022).

The DSP outlined sampling for Eulachon in the lower Martin River in habitat suitable for migrating Eulachon including the slow-moving waterways without long stretches of high-velocity flow required by Eulachon's weak swimming abilities (AEA 2022b). Sustained water velocities greater than 1.2 feet/second may limit the upstream passage of Eulachon (Spangler 2020).

As documented in the 2023 Geomorphology Observations report (Watershed GeoDynamics 2024), the Martin River has been aggrading near its mouth since the construction of the levee in 1991. The aggradation of sediment around the mitigation ponds and, in the delta, has increased the stream gradient near the mouth of the river since the construction of the Mitigation Ponds. Martin River mainstem mesohabitats included riffles with velocities that appeared unsuitably high for Eulachon due to their limited swimming capabilities (Photo 4-1) and May 2023 field observations did not find suitable spawning habitat for Eulachon. Therefore, sampling for adult Eulachon was determined to not be warranted.

After the May 2023 field reconnaissance, the levee between the Martin River and the mitigation ponds was breached sometime between July 31 and August 2, 2023 (Watershed GeoDynamics 2024). This breach re-routed the Martin River mouth through the lowermost mitigation pond and into the adjacent unnamed basin to the east. Channel conditions have remained dynamic but under current conditions are unlikely to provide suitable low-gradient habitat for Eulachon spawners. Eulachon adult sampling has been removed as a study objective from this study. The gradient of the mouth of the Martin River was re-surveyed in 2024 following significant channel changes and confirmed that the conditions observed in 2023 that justified removal of adult sampling from this study were still in effect.

Photo 4-1 High velocity riffle habitat along levee in Geomorphic Reach 1 (Delta) September 29, 2024.

4.3 Goals and Objectives

The proposed Dixon Diversion may have indirect effects on fishes in the Martin River basin by diverting Dixon Glacier meltwater from the EFMR. Fishes have the potential to be impacted by the proposed reduction in Martin River flows via flow-based changes in fish habitat or seasonal access to fish habitat.

Characterizing fish use in the Martin River basin will support resource management goals related to fish and wildlife habitat protection. Both the construction of the proposed Dixon Diversion Project features and operation will have the potential to impact aquatic habitat conditions in downstream waters which in turn could impact fish resources. The ADF&G, NMFS, and USFWS have resource management goals directly related to the potentially affected resource.

The goal of this study is to characterize fish use of aquatic habitats in the Martin River basin that have the potential to be affected by the proposed Dixon Diversion Project. Specific objectives are to:

1. Characterize the distribution and relative abundance of fishes in clearwater habitats of the Martin River;
2. Operate an AVCT at Red Lake outlet to estimate daily count of adult Pacific salmon from approximately early June – late October; and
3. Document evidence of Sockeye and Coho salmon spawners in suitable clearwater habitats in the Martin River.

4.4 Study Area

The study area for this study includes the mainstem Martin River off-channel, tributary and lake habitats. The delineation of habitat within the watershed that may support different life stages of resident and anadromous fish was completed under the Aquatic Habitat Characterization Study (Section 3.0) and included analysis of habitat connectivity, habitat gradient, and position in the watershed. Figure 4-1 displays target sampling sites for 2024 efforts for this study.

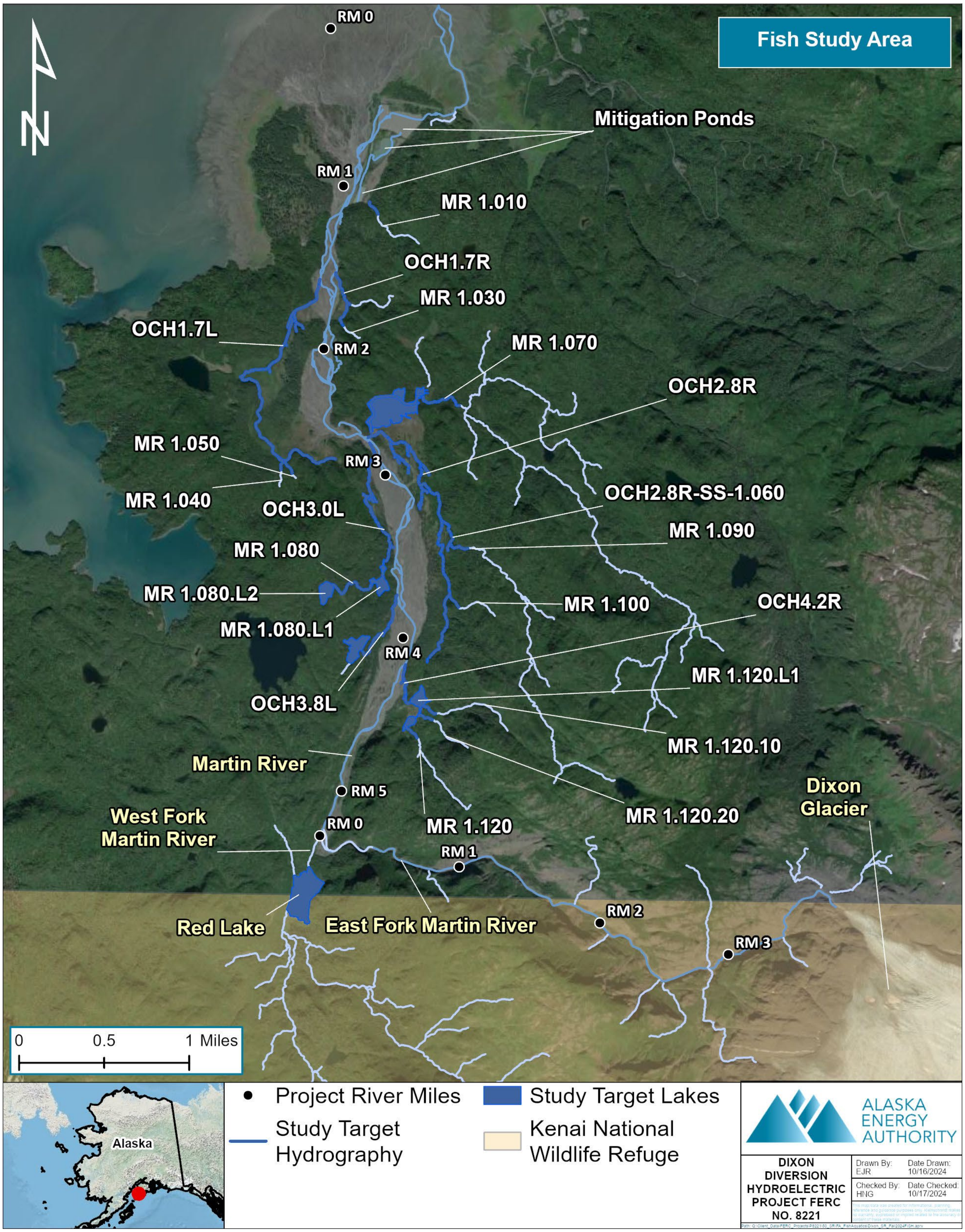

Figure 4-1 Martin River fish use study area.

4.5 Methods

The effectiveness of fish sampling methods in riverine habitats can depend on sampling conditions (water velocity, depth, turbidity, water temperature, etc.), target fish species and life stages and their behavioral characteristics, and the timing of sampling. Sampling was conducted in May and September/October using a couple of methods to meet multiple study objectives as described below, under each study objective.

4.5.1 Distribution and Relative Abundance of Fishes in Clearwater Habitats

Due to the highly turbid and fast-flowing nature of the main channel, sampling for juvenile anadromous and resident fishes in rearing habitats focused on clearwater OCHs and tributaries during 2024. To maximize the extent of clearwater habitats along the Martin River, all fish sampling was done during open-water low-flow conditions, which typically occur in spring (late April and May) and fall (late September and October) depending on annual variation in snowpack and weather. All Martin River off-channel clearwater macrohabitats that were watered and accessible at the time of field efforts were sampled to evaluate fish use.

Fish sampling did not extend upstream beyond the confluence of the EFMR and WFMR. The Red Lake outlet AVCT monitoring has already established the use of the WFMR and Red Lake by Sockeye and Coho salmon and Dolly Varden. Field reconnaissance and review of potential barriers in the EFMR indicate that the lower canyon area may provide habitat during very low flows up to about EFMR RM 1.3 (see Section 3.5.6). However, there was no off-channel or holding areas observed to provide suitable fish habitat during higher flows.

In addition to OCHs along the Martin River valley floor, small tributaries provide clearwater habitats that may be accessible to fish. Fish use of tributary habitats was evaluated with sampling starting in the Martin River valley and progressing upstream until either (1) a gradient of greater than 12 percent was encountered or (2) a reach equivalent to at least 40 times the channel width, or at least 150 meters was sampled. In addition, any lakes or ponds along tributary streams, which provide unique fish habitat, were targeted for fish sampling. Pedestrian surveys to evaluate adult salmon use of OCHs for spawning included all habitat accessible to adult fish.

Fish sampling methods included minnow trapping, dip net seining, and beach seining. Although electrofishing can be effective for a wide range of fish species, life stages, and habitat types (Temple and Pearsons 2007), the use of electrofishing as a fish capture technique is tightly regulated by ADF&G and is not permitted in areas where adult salmonids, including char, are present. Therefore, electrofishing was not used to sample fish in this study.

Gee-type minnow traps (17.5 inches by 9 inches, with approximately 1-inch openings and 0.25-inch mesh) were baited with salmon eggs that were commercially preserved. Traps were deployed in areas with sufficient depth to completely cover the trap to avoid exposure to vandalism by bears or other animals. Where possible, traps were spaced throughout a sampled reach to provide longitudinal data on fish distribution or relative abundance. However, in off-channel sloughs and tributary habitat, evenly spaced deployment locations were not always available, and so trap deployment density depended upon habitat complexity, and traps were set more densely in complex habitats with appropriate depth (Bryant 2000). Minnow traps were set in microhabitats with slow water and/or cover to maximize catch and were set for a period ranging from three to twenty-four hours. The number of traps deployed, and their locations were recorded to maximize trap recovery. Trap retrieval lines were tethered to streamside vegetation or staked and marked with fluorescent flagging that included a trap identification number and ADF&G permit information.

Beach seines are an effective method to capture a range of fish species and life stages in a multitude of slow-water habitats. In addition, seining allows the sampling of relatively large areas in short periods of time as well as the capture and release of fish without significant stress or harm. Limitations to beach seining include fast flows, water depth, coarse substrates, and woody and organic debris (Hahn et al. 2007). Woody debris and boulders can create snags and lift off the lead line allowing the fish to escape. Ideal habitats for beach seining are wadable, slow moving water with level uniform substrate (e.g., gravel and/or sand). In wadable systems, smaller nets were used and deployed by hand with one end of the net anchored to the shore and the other end extended out from shore and then looped around to encircle the fish as the ends were pulled in against the beach or gravel bar. With most seine sets, lead and cork lines should be withdrawn at approximately equivalent rates until close to shore. Once the lead line approaches the shore, it should be withdrawn more than the cork line until a secure pond or corral is formed in the bag of the net and the lead line is on the beach or gravel bar (Hahn et al. 2007). To the extent possible, the same area was fished during each sampling event; and net sizes and soak times were standardized. Seine nets of various sizes were available for use that ranged from 14 to 120 feet long, 3 to 6 feet wide, and had mesh diameters that range from 0.125 to 1 inch.

In most tributary habitats of the Martin River, beach seining was not an effective method of fish capture. Heavy loads of large wood caused constant snags, and areas with sufficient depth for sampling often had significant fine sediment which resulted in poor visibility, and unhealthy conditions for sampled fish. Also, the presence of spawning adult fish led to concern about disturbing substrate and spawning activity. Further, many off-channel and tributary habitats sampled in the fall of 2024 were not deep or wide enough for seine use to be effective. In these areas, an alternative method of netting was used.

A trapezoidal dip net measuring 18 inches at the base and 10 inches at the top with soft ¼-inch mesh was used to net fish using two techniques. In fast flowing water, areas with undercut or vegetated banks, or in swift riffle habitats, the net was positioned downstream of the habitat to be sampled and a biologist walked quickly downstream along the habitat to force fish to swim downstream where they were captured. In pools with overhanging vegetation or submerged grasses or macrophytes, the net was scooped upward from the bottom and fish taking refuge in the vegetation or cut bank were captured. The trapezoidal net was also highly effective for selectively and carefully capturing adult salmon for reference photographs and speciation from holding locations along cut banks, in log jams, or other structure without disturbing substrate where redds had been dug.

All fish sampled were immediately transferred into dark-colored buckets with fresh river water. The first 25 individuals of each size class of fish captured at each site were measured in 10-mm size bins, after which tallies were made by species to reduce the time fish spent in buckets. For measuring, fish were transferred quickly into clear vinyl sachets with enough water to allow clear view of the fish for identification, taking reference photographs as necessary, and measuring by placing a ruler along the fish's body outside the sachet (Photo 4-2, Photo 4-3).

Catch per Unit Effort (CPUE) was used to estimate the relative abundance of Coho Salmon and Dolly Varden in fall minnow trapping samples. The total number of fish of each species captured per minnow trap was summed to generate a total catch by trap. Efforts for minnow trapping was standardized as 24-hour sets. CPUE per trap was calculated as the number of fish captured per 24-hour trap set, and CPUE for each site was the average CPUE for all traps by species. In the spring, some minnow trap sets were 3-4 hours or 9-10 hours, so shorter set times were used to calculate CPUE for these sites.

Photo 4-2 Example reference photograph of a juvenile Coho Salmon collected from OCH1.7R on September 23, 2024. The clear vinyl sachet allowed clear identification of species.

Photo 4-3 Example reference photograph of a juvenile Coho Salmon collected from the Lake MR1.080.L1 on September 27, 2024.

4.5.2 Run Timing of Sockeye and Coho Salmon

Run timing for Pacific salmon entering Red Lake was evaluated by ADF&G for a third year using AVCT which employed above-stream remote video cameras and digital time-lapse recording equipment to record fish entry into the lake. The Red Lake AVCT was located along the WFMR in the outlet from Red Lake. The AVCT system was comprised of several off-the-shelf electronic and video components attached to a pole located streamside at a site conducive both for counting fish and for generating sufficient solar power to operate the system. The camera was enclosed in a weatherproof camera housing affixed to the 3.1-meter pole extension atop the tower with a field of view encompassing the creek's entire cross section, from bank to bank. A high-contrast substrate panel comprised of a 4.6-mm (0.1875-inch) mesh beach seine was stretched across the stream bottom perpendicular to the channel to make it easier to see fish swimming past the AVCT.

The Red Lake video system was installed by June 15 and was operated from early June through late-October, as weather conditions allowed. There were approximately 4 hours each night (00:00-04:00) when it was too dark to see fish without supplemental lighting in June/July with daylight shortening throughout the monitoring period. Although disk space required for a day’s video varied with the complexity of the images (e.g., varying light conditions, cloud shadows, etc.), the 2 terabyte hard drives used typically accommodated about 50 days of recorded video. A time-lapse recording rate of 3 frames per second was proposed to optimize hard drive space without compromising the reviewer’s ability to track individual fish transiting the video site. During the season, staff periodically swapped out the hard drives during regularly scheduled site visits before they approached maximum storage capacity (approximately 7 weeks). Removal of the video station occurred in late October before significant ice formation occurred, while still allowing for documentation of the passage of most anadromous species.

Hard drives were retrieved at least once every 50 days and reviewed. Fish counts and other noteworthy observations (e.g., weather, dawn/dusk, video quality, and sightings of bears, moose, or other wildlife captured on video) were recorded. Daily fish counts were stratified by species into 6-hour time blocks (e.g., 00:01-06:00, 06:01-12:00, 12:01-18:00, and 18:01-24:00). ADF&G staff recorded any periods of video loss or other technical difficulties. Daily counts were used to describe run timing and escapement indices for Red Lake by species during the study period.

4.5.3 Document Adult Coho and Sockeye Salmon Spawning Behavior

Evidence of Sockeye and Coho salmon spawning in suitable clearwater habitats was documented using visual observations of adult spawners, carcasses, and completed redds within the habitats and in mixing zones between clearwater and the more turbid mainstem Martin River and Red Lake. Evidence of successful spawning was also inferred using the presence of young-of-year or emergent fry life history stages of Coho and Sockeye salmon.

Adult salmon and carcass surveys were prioritized along MR1.070L and in the clearwater channels on river right flowing into OCH2.8R, both of which have been preliminarily identified as potential spawning habitats. Additionally, all fish-accessible off-channel and tributary habitat was surveyed on foot during the period when Sockeye and Coho salmon were observed spawning in OCH2.8R – MR1.070 complex.

Within these clearwater habitats, pedestrian surveys were conducted from a downstream to upstream direction to enumerate live adult salmon by species in the survey reach. Where multiple stream channels were present in braided areas, each channel was surveyed and adult salmon counts were separated into right side braids, left side braids, and single channels. Field data was entered in field notebooks including the GPS locations of observed salmon spawners, spawning activity, or established redds (latitude/longitude in decimal degrees in the World Geodetic System (WGS84) datum. In addition to GPS locations of spawning areas, aerial photos and survey maps were used to record notes about fish observations and behavior during each survey. Post-spawned adult salmon or carcasses were photographed to document species presence. Locations of any observed evidence of Sockeye or Coho salmon spawning were documented.

Spawning surveys was also completed in the mainstem from the upper extent of tidal influence to the confluence between the Red Lake Outlet and the EFMR. One complete pedestrian survey was completed. Helicopter-based surveys were conducted on two occasions during periods of high water clarity and low-flow which produced conditions where fish could be observed from the air. The helicopter was flown at a height of about 100 feet above the stream and to either the left or right of the channel to provide a clear view for observers. The main channel and side channels were surveyed for evidence of redd building activity or substrate disturbance not attributable to bears or moose, and the presence of adult fish, if any were visible. Additional areas where adult salmon may stage before entering OCHs or tributaries such as the pools at the outlet of MR1.070 and OCH2.8R, and Red Lake were surveyed via helicopter observations whenever possible, in many cases, daily between September 25 and October 5, 2024.

Weather, temperature, turbidity, discharge, timing of a survey, and the experience of observers can affect adult fish counts in spawning habitats. Observers evaluated and recorded these environmental conditions for fish surveys. Water temperature (°C), visibility (m), and turbidity (NTUs) were collected during each spawner survey at established locations. Water visibility in tenths of meters was estimated with a survey rod to indicate the visible depth to the stream substrate. Surveys were conducted mid-day to minimize shadow effects on visibility. Polarized glasses were worn by observers.

Emergent fry and young age-class salmon juveniles were encountered during sampling under Objective 1 (Fish Distribution in Clearwater Habitats) during the portion of the year (May/June and September/October) when a combination of low water levels, decreased turbidity, and safe access allowed the use of minnow traps or seining. Successful collection of early age-class fish, especially emergent fry in mainstem habitats during improved visibility conditions, provided context for more focused efforts in 2024 to identify the potential for riverine spawning areas used by adult Sockeye or Coho salmon in mainstem or off-channel reaches.

4.5.4 Eulachon

The accessibility of the lower river to Eulachon was re-assessed following the 2023 breach of the levee at the mitigation ponds that re-routed the mouth of the river and again after the August 6, 2024 flooding event. The gradient of swifter riffle habitat reaches was measured using a clinometer to estimate percent grade.

4.5.5 Field Data Quality Assurance and Quality Control

Many of the planned studies included the collection of field data. The goals of data management were to establish a data QA/QC protocol to be applied at logical stages of data collection and processing and to ultimately create a database of all QC'd data collected for the Dixon Diversion Project. Five levels of QC (QC1 to QC5) were completed to govern data collection efforts and ensure a rigorous and high-quality product. Each QC level was tracked either within tabular datasets (Microsoft Excel and database tables), or within file path names (as for raw field data files). This allowed for quick determination of the QC status of all data. A data dictionary describing the database entities and attributes was compiled to accompany the database and to provide an understanding of data elements and their use by anyone querying or analyzing the data.

Data QC was ensured by implementing five levels of data quality review:

- QC1: Field data was checked for accuracy and completeness by a team member other than the recorder prior to site departure.
- QC2: All data were checked following entry to identify entry errors.
- QC3: Before data analysis, data were inspected for completeness, outliers, or inconsistencies by field staff familiar with the sampling events and site conditions.

- QC4: Database Validation: Tabular data files were verified to meet project database standards. Data are verified for completeness, project standards (codes, field name conventions, date formats, units, etc.), calculated and derived fields, QC fields, etc.
- QC5: Technical Review: Data revision or qualification by senior professionals when analyzing data for reports. Data calculations may be stored with the data. Some data items may have been corrected or qualified within the database, while others have only been addressed in report text. QC5 may be iterative, as data are analyzed in multiple years.

All data quality measures were documented with the reviewer's initials and date.

4.5.6 Analytical Methods

Evaluation of the presence of Coho or Sockeye salmon spawners included adult salmon observations as well as any other evidence of spawning (redds, carcasses, etc.). The presence of resident fishes or juvenile anadromous fishes encountered during minnow trapping or seining was also documented using GIS spatial tools. The size distribution of sampled fishes was analyzed and is provided in summary tables along with water quality parameters measured during each sampling effort. CPUE was calculated for minnow trapping (number of fish/trap hour) and seining (number of fish/pull, number of fish/unit area) when possible.

4.6 Results

4.6.1 Distribution and Relative Abundance of Fishes in Clearwater Habitats

Fish use of aquatic habitat in the Martin River targeted off-channel, tributary, and lake habitat during spring and fall sampling seasons in 2024. Most targeted sampling areas were successfully minnow trapped, beached seined, or mini-seined, with the exception of some target tributary sites where no water was present. These landscape features were mostly very steep (>40 percent gradient) and are likely ephemeral runoff channels for spring snowmelt and not permanent streams that provide fish habitat.

Stream flow and channel conditions were ideal for completing the fish sampling of the Martin River during both spring (April 29-May 15) and fall (September 23-October 3). Low, clearwater conditions enabled the fishing team to access and process fish in the Martin River off-channel and tributary habitat within all target sampling areas, though not all areas were suitable for fish sampling (i.e., insufficient water depth).

Figure 4-2 indicates locations where fish sampling occurred in the spring or fall of 2024.

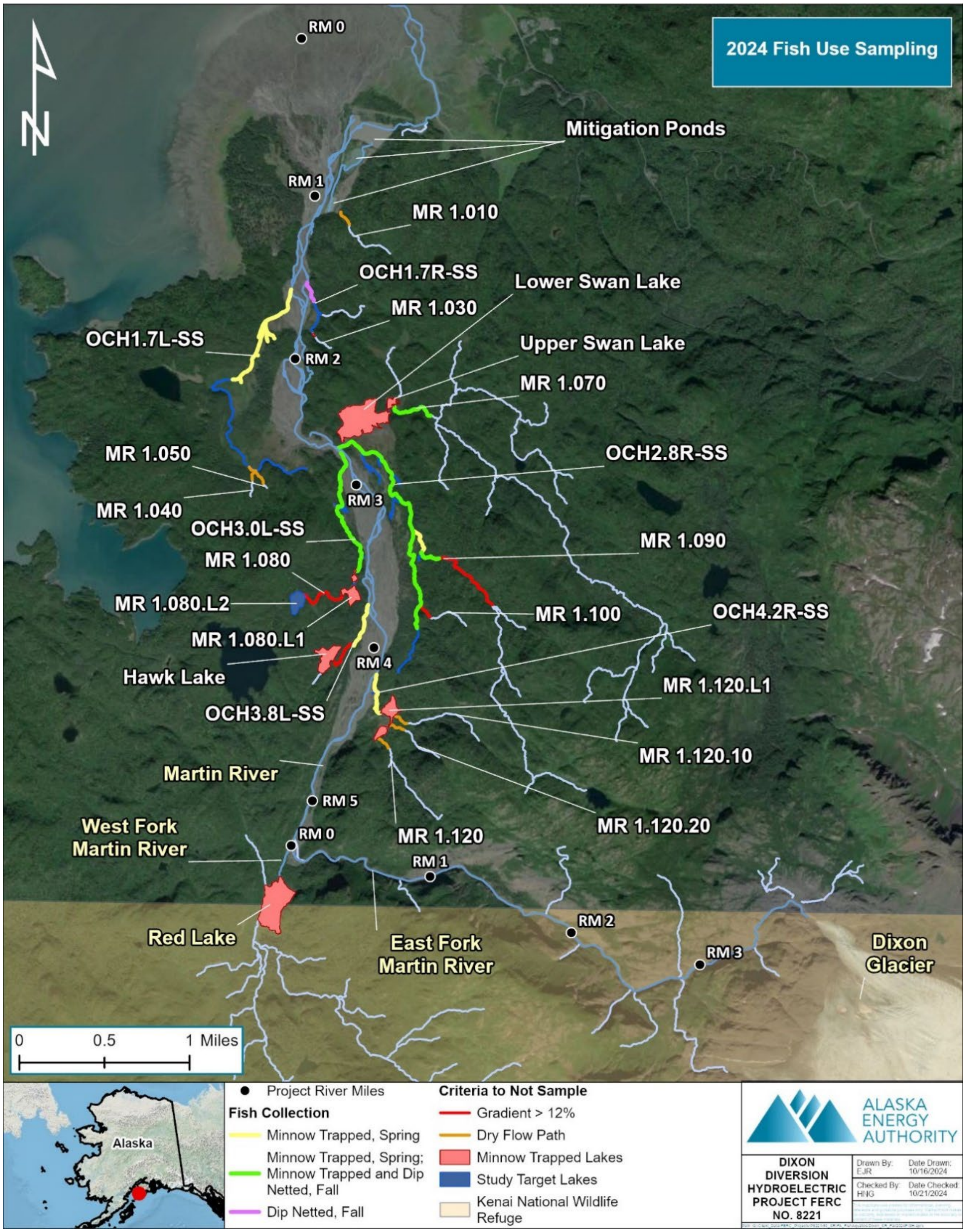

Figure 4-2 2024 Martin River fish sampling area.

Dolly Varden was the most common salmonid species documented, and juveniles of various age-classes were found in all Martin River off-channel and tributary macrohabitats surveyed with the exception of Hawk Lake. Coho Salmon were also ubiquitous, being present in multiple age-classes across the off-channel and tributary landscape in both spring and fall seasons. No Sockeye Salmon juveniles were captured or observed in any off-channel or tributary complex in 2024, likely because they are the progeny of river or sea-type Sockeye which outmigrate quickly following emergence. The lack of Sockeye Salmon juvenile collections in Red Lake could be due to sampling methodology or outmigration timing being asynchronous with fish sampling in 2024. Threespine (*Gasterosteus aculeatus*) and Ninespine (*Pungitius pungitius*) stickleback were the only non-salmonid fishes encountered and were also present in many macrohabitats, especially in slow or slack water mesohabitats such as vegetated margins of lakes or slow-flowing pools. Most, but not all, wetted habitat surveyed had at least some fishes.

The USGS Gage at the EFMR recorded stage heights of 4.0 to 4.5 feet from April 29 to May 15, 2024, when spring fish sampling efforts were completed and during the fall surveys recorded stage heights of 5.5 to 6.2 feet (September 23-September 29, 2024).

The distribution and relative abundance of fish captured in off-channel and tributary habitats of the Martin River in 2024 are presented by off-channel complex in the following sections. Table 4-1 indicates the sites where fish sampling efforts were made in 2024. Some macrohabitat units that were delineated under the Aquatic Habitat Characterization study in the spring were changed significantly as a result of the flood event on August 6-7, 2024, and could not be repeat-sampled for fish due to these changes. Further, many of the macrohabitats that were delineated during the Aquatic Habitat Characterization study did not contain sufficient water for seining or dip netting. Minnow traps were not set in aquatic habitats if the trap could not be sufficiently submerged to keep the entrance holes accessible to fish and the bait underwater to avoid attraction of bears. These are indicated in Table 4-1 as not sampled (N/S). Dip netting was feasible in shallow areas but was primarily used to sample undercut and vegetated bank areas too shallow for minnow traps.

Table 4-1 Presence of fish species and life stages observed in 2024 at Martin River study sites.

Site	Fish Presence	Fish Species Present									
		Dolly Varden		Coho Salmon		Sockeye Salmon		Threespine Stickleback		Ninespine Stickleback	
		Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult
Tributary MR1.010	Dry										
Off-channel Complex OCH1.7R											
OCH1.7R-SS-1	Yes	x		x						x	x
Tributary MR1.030	Yes	x		x				x	x	x	
Off-channel Complex OCH1.7L											
Tributary MR1.040/MR1.050	Dry										
OCH1.7L-SS-1	Yes	x		x				x			
Tributary MR1.070/Swan Lake Complex											
Tributary MR1.070	Yes	x	x	x	x		x	x	x		
Upper Swan Lake	Yes	x		x				x	x	x	x
Lower Swan Lake	Yes	x		x							
Off-channel Complex OCH2.8R											
OCH2.8R-SS-1	Yes	x	x	x	x		x	x			
OCH2.8R-SS-1.010	N/S										
OCH2.8R-1.050	N/S										
OCH2.8R-SS-1.060	N/S										
Off-channel Complex OCH3.0L											
OCH3.0L-SS-1	Yes	x		x				x	x	x	x
OCH3.0L-SS-1.010	N/S										
Tributary MR1.080	Dry										
Lake MR1.080.L1	Yes	x		x				x	x		
Off-channel Complex OCH3.8L											
OCH3.8L-SS-1	Yes										
Hawk Lake	No										

Site	Fish Presence	Fish Species Present									
		Dolly Varden		Coho Salmon		Sockeye Salmon		Threespine Stickleback		Ninespine Stickleback	
		Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult	Juv	Adult
Off-channel Complex OCH4.2R											
OCH4.2R-SS-1	Yes	x		x							
Lake MR1.120.L1	Yes	x		x				x	x		
Tributary MR1.120	Dry										
Tributary MR1.120.10	Dry										
Tributary MR1.120.20	Dry										
Red Lake Complex											
Red Lake	Yes	x		x	x		x				

Note: N/S = not sampled.

4.6.1.1 Off-channel Complex OCH1.7R

This macrohabitat is an off-channel complex composed of a SS, Tributary MR1.020, and Tributary MR1.030 which was composed of entirely ponded habitat due to beaver dam. The side slough was sampled during the fall fish sampling and was wetted at the time of the surveys and contained fish; however, both Tributary MR1.030 and Tributary MR1.020 had sufficient water to support a surface connection to OCH1.7R-SS-1.

Shallow riffles less than 0.02 m in depth separated OCH1.7R-SS-1 from these smaller habitats. Despite isolated conditions in late September, both areas contained rearing fish of multiple age classes. Following heavy rains on October 2 and 3, 2024, there appeared to be significantly more surface connection to allow juvenile fish to access and transition between habitats in this off-channel complex, though flows still appeared insufficient to allow access of larger bodied adult Pacific salmon such as Sockeye or Coho salmon to access and use this habitat for spawning.

4.6.1.1.1 OCH1.7R-SS-1

The water flowing through the slough was quite turbid (>240 NTUs) during the fall, but other water quality parameters were compatible with healthy aquatic habitat criteria. The water temperature was cold at 5.9°C during fall sampling on September 24, 2024, but was also the highest of the three sloughs sampled and was similar to Red Lake which was 6.2°C during the same sampling event. A total of 87 Coho Salmon and 26 Dolly Varden, juveniles and 3 Threespine Stickleback and 9 Ninespine Stickleback were captured in OCH1.7R-SS-1 on September 23 and 24, 2024. No adult fish were observed. Figure 4-3 includes total fish capture for the OCH1.7R complex including OCH1.7R-SS-1 and Tributary MR1.030.

The size distribution of juveniles captured in OCH1.7R-SS-1 indicated early life-stage use of this shallow habitat, with most juveniles of both salmonid species being less than 80 millimeters (mm) in fork length. The median fork length bin of juvenile Coho Salmon was 40-49 mm which accounted for half of all Coho Salmon juveniles captured. The very small size of Coho Salmon juveniles suggested that spawning in the previous year may have occurred nearby, however, the large flooding event in August of 2024 likely resulted in redistribution of rearing fish among off-channel floodplain habitats. The size of Dolly Varden juveniles appeared normally distributed, with a median fork length bin of 60-69 mm (Figure 4-4). No larger specimens of either species were observed. Fish captured can be seen in Photo 4-4.

Photo 4-4 Fish captured in OCH1.7R-SS-1.

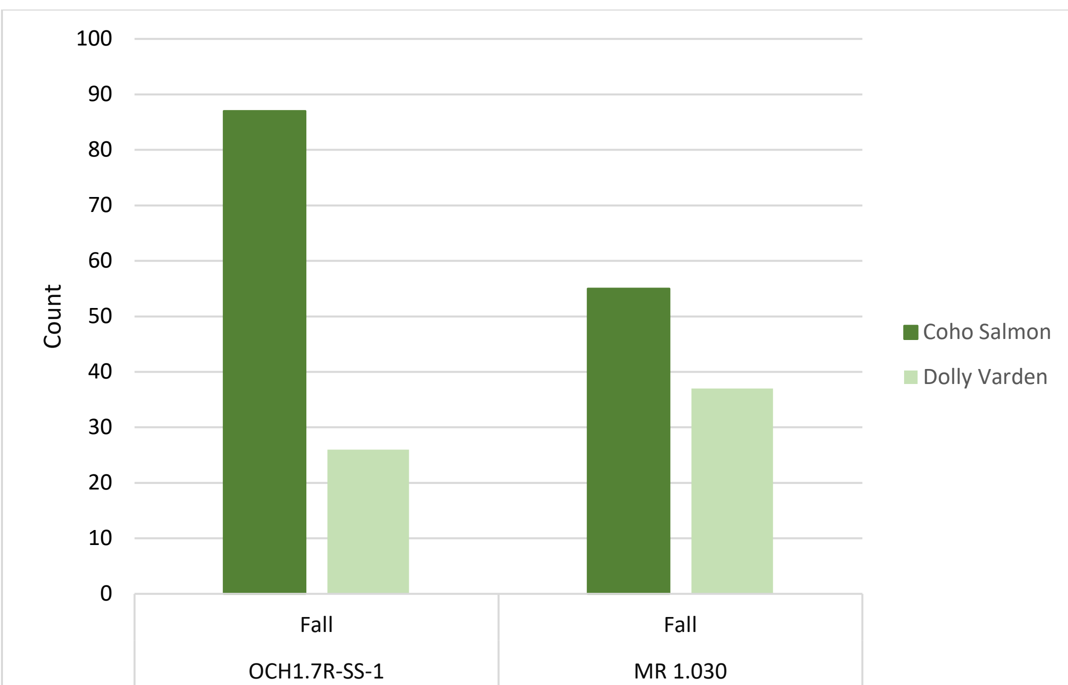

Figure 4-3 Total fish captured from minnow trap and dip net sampling at OCH1.7R complex in September 2024.

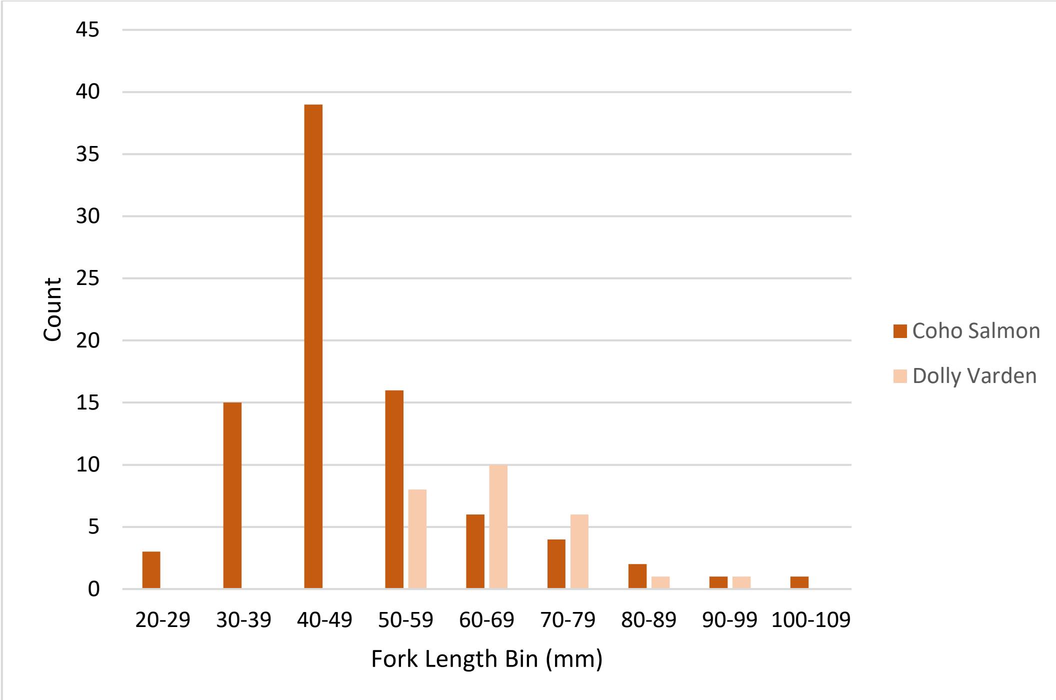

Figure 4-4 Size distribution of Dolly Varden and Coho Salmon juveniles captured at OCH1.7R-SS-1, September 2024.

4.6.1.1.2 Tributary MR1.030

This macrohabitat was a tributary of mainly ponded habitat due to a beaver dam at its connection with OCH1.7R-SS-1.

Water quality parameters measured on September 23, 2024 included a temperature of 5.3°C, pH 7.18, DO of 9.2 mg/L, and 76 percent saturation. Specific conductance was 142 µS/cm, and turbidity was low at less than 5 NTUs. All parameters were within the criteria for healthy habitat for rearing juvenile fishes in Alaska.

A total of 55 Coho Salmon, 37 Dolly Varden, and 15 Sticklebacks were captured during minnow trapping and dip netting efforts at this site, from a 24-hour deployment of 10 traps. The relic beaver pond, which likely provided excellent rearing and overwintering habitat for juvenile fishes contained juvenile Dolly Varden representing a variety of age classes from probable young-of-year fish under 60 mm in fork length to 1+ or 2+ year classes over 130 mm in fork length (Figure 4-5). The length distribution of Coho Salmon juveniles suggested that at least two age classes of the species were present, with one length-distribution peak at the 50-59 mm fork length bin size representing young-of-year fish, and a second peak in abundance of fish 80-89 mm, likely representing 1+ year fish.

Photo 4-5 Fish captured in Tributary MR1.030.

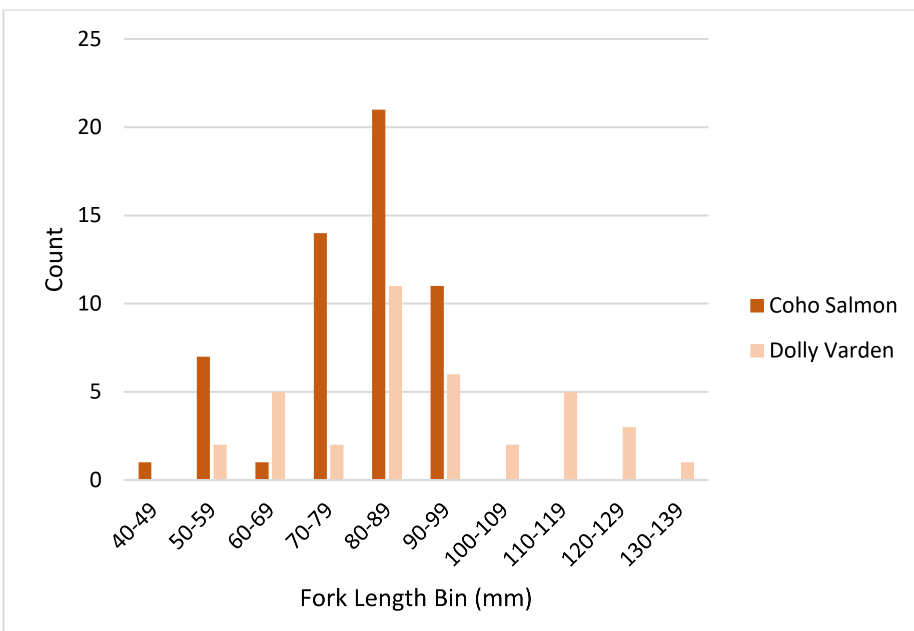

Figure 4-5 Size distribution of Dolly Varden and Coho Salmon juveniles captured at Tributary MR1.030, September 2024.

4.6.1.1.3 OCH1.7R Relative Abundance

Relative abundance of fish species present in the OCH1.7R complex was estimated based on minnow trapping CPUE data with catch being the total number of fish captured per minnow trap, and effort being a standardized number of trap hours that each trap was fished during a sampling effort. CPUE from each minnow trap (10 traps set) was averaged to determine average CPUE for each species per site. CPUE for the spring session was 0.0 for all species. CPUE was 3.63 fish per minnow trap hour for Coho Salmon at OCH1.7R-SS-1 and 2.30 fish per minnow trap hour for Coho Salmon in Tributary MR1.030. CPUE for Dolly Varden was 1.08 at OCH1.7R-SS-1 and 1.54 at Tributary MR1.030 (Figure 4-6).

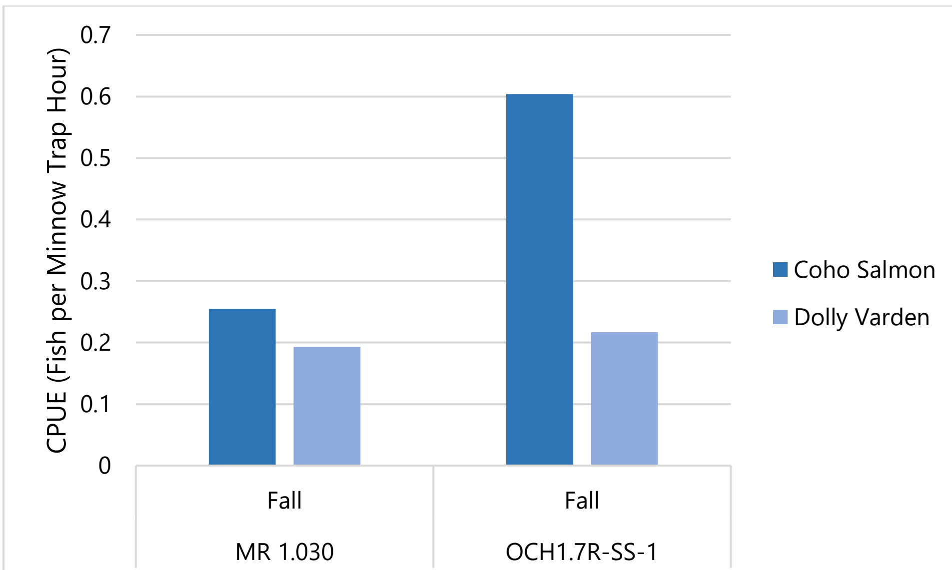

Figure 4-6 CPUE for macrohabitats in off-channel complex OCH1.7R based on minnow trapping efforts, September 2024. CPUE of 0.0 for both species at both habitats in the spring not shown.

Overall, the OCH1.7R complex provided both rearing and overwintering habitat for juvenile fishes. The relic beaver pond, which was very deep, likely provided protection from extreme winter temperatures and any potential isolation or dewatering associated with low baseflow during early spring or late fall, such as those conditions observed during both spring and fall fish sampling sessions when the stage height measured at the EFMR USGS Gage was 5.5 to 6.0 feet.

4.6.1.2 Off-channel Complex OCH1.7L

This off-channel complex was composed of a main side slough (OCH1.7L–SS-1) and two secondary channels (OCH1.7L-SS-1.1010 and OCH1.7-SS-1.1030). Two small tributaries, MR1.040 and 1.050 were identified from aerial imagery as potential tributaries to OCH1.7L-SS-1 and were targeted for fall fish sampling and mesohabitat surveying. Side slough OCH1.7L-SS-1 was surveyed during the spring field event and was wetted at the time of the survey. The confluence between OCH1.7L-SS-1 and the mainstem included a long slow glide abutting a bedrock bluff and appeared to have been scoured during periods of prior high flow.

In many areas, the presence of both dry and wetted channels was indicative of rapid channel migration, new channel formation, and a shifting mosaic of habitat types that is typical of dynamic river systems.

4.6.1.2.1 OCH1.7L-SS-1

OCH1.7L-SS-1, a side slough about 2.0 miles long, is connected at the downstream end to the mainstem Martin River at about RM 1.7 and is fed by spring snow runoff from MR1.040 and MR1.050. Between May 2 and May 6, 22 minnow traps were deployed within OCH1.7L-SS-1 in areas where the water was sufficiently deep to cover the bait. A total of 129 Dolly Varden and 60 Coho Salmon juveniles were captured. 10 Sticklebacks or other non-salmonids were captured at this site (Figure 4-7).

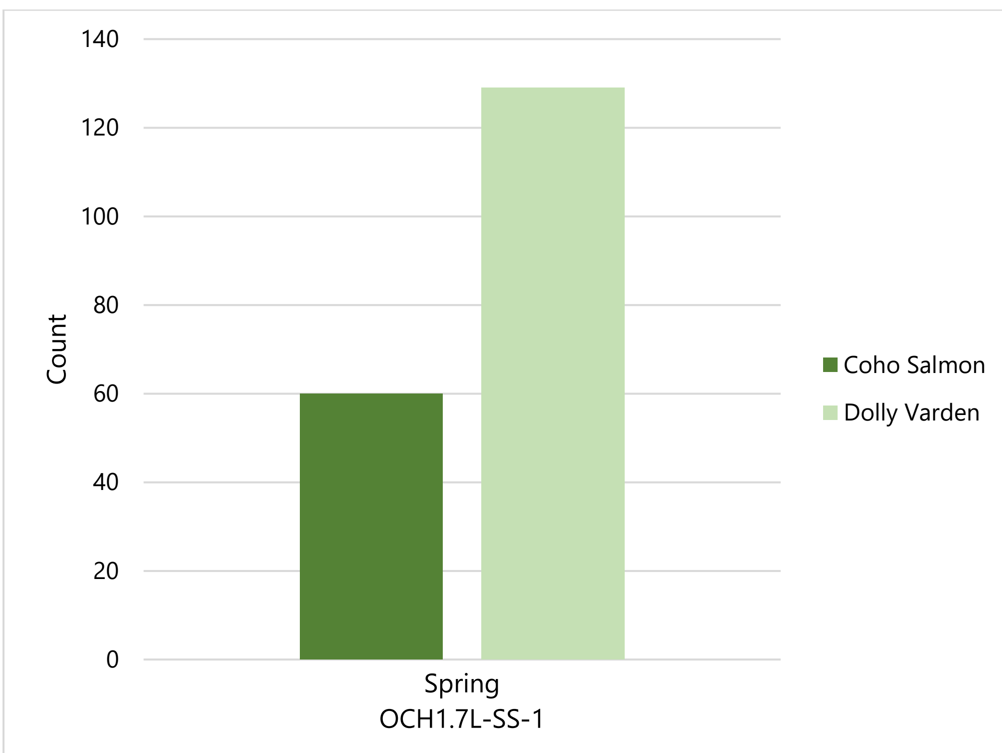

Figure 4-7 Total fish catch of Coho Salmon and Dolly Varden from minnow trapping at OCH1.7L-SS-1 on May 6, 2024.

Coho Salmon juveniles in OCH1.7L-SS-1 ranged from 60 – 119 mm and did not include any young-of-year individuals. Larger Dolly Varden individuals ranged from 50 – 150 mm. (Figure 4-8).

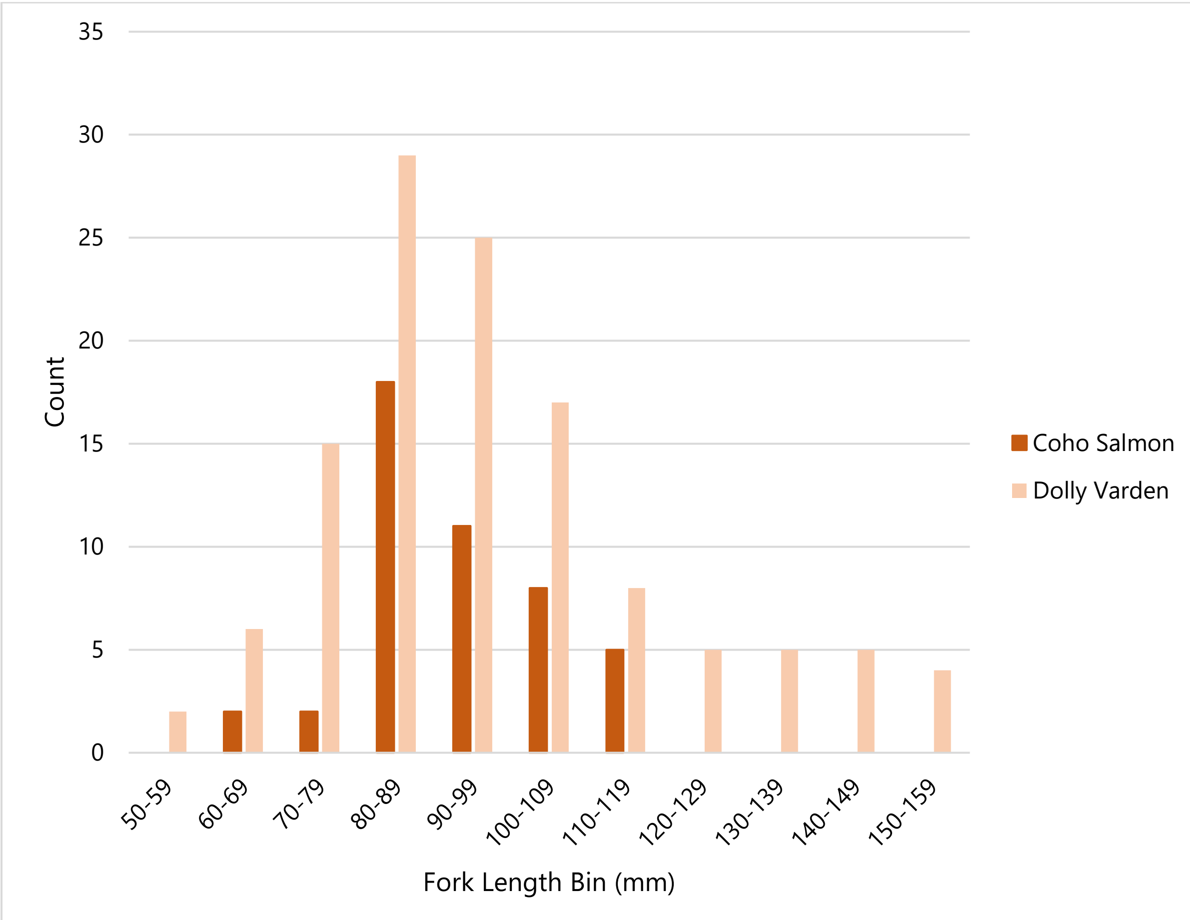

Figure 4-8 Size distribution of Dolly Varden and Coho Salmon juveniles minnow trapped in OCH1.7L-SS-1 on May 6 2024.

4.6.1.2.2 Tributary MR1.040 and Tributary MR1.050

During fall field efforts to survey tributaries MR1.040 and MR1.050, the field crew identified a shallow vegetated run-off gully on the west slope of the valley at each location, but there was no evident channel that contained any habitat, wet or dry, that could be connected to the mainstem under higher flow conditions or could provide fish habitat under any flow condition. Therefore, no fish sampling was attempted.

4.6.1.2.3 OCH1.7L Relative Abundance

Only one macrohabitat sampled in the OCH1.7L complex contained fish in 2024, OCH1.7L-SS-1, which was sampled in only the spring. CPUE from each minnow trap (22 traps in the spring and 10 traps in the fall) was averaged to determine average CPUE for each species per site for each season. CPUE for the spring session was 0.19 for Coho Salmon and 4.2 for Dolly Varden (Figure 4-9).

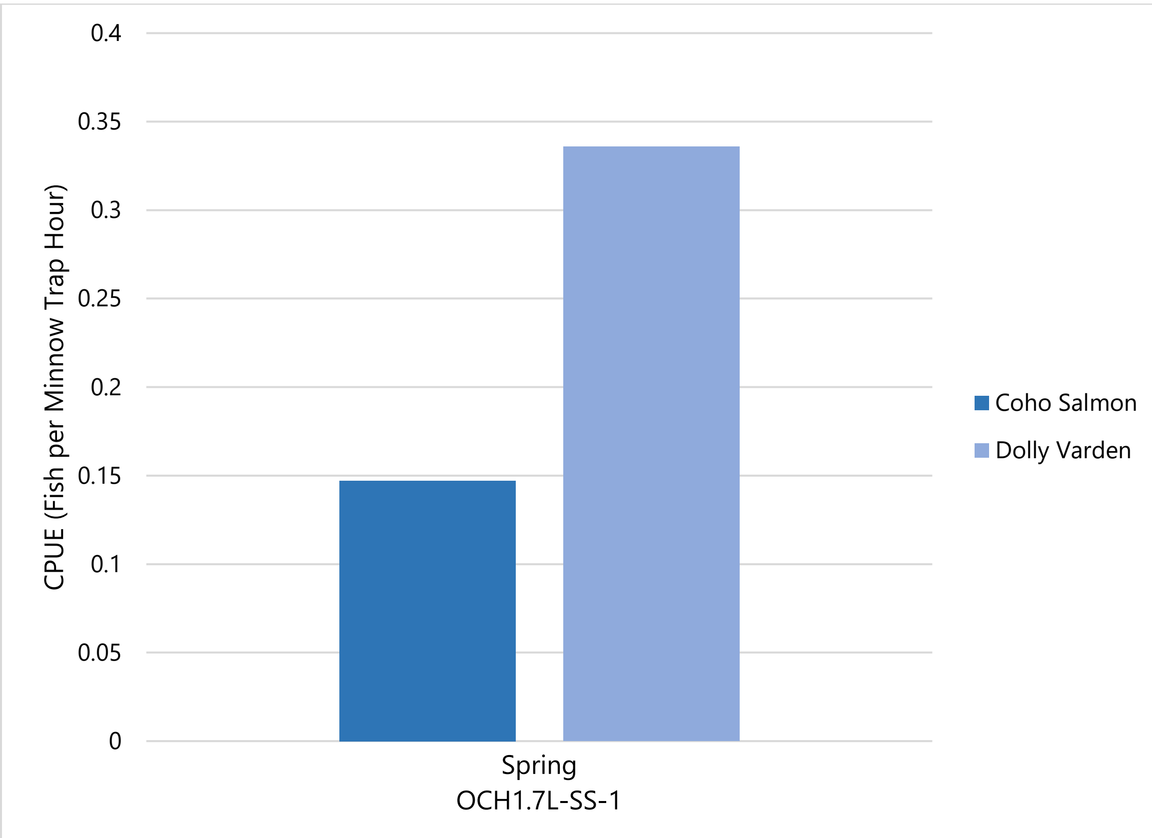

Figure 4-9 CPUE for Coho Salmon and Dolly Varden captured during minnow trapping efforts at OCH1.7L-SS-1 in the spring of 2024.

4.6.1.3 Tributary MR1.070/Swan Lake Complex

Tributary MR1.070 drains the east slopes into a clearwater relic beaver pond known as Upper Swan Lake, perched slightly above valley grade, which flows through a constriction into the larger, Lower Swan Lake that enters the mainstem Martin River at RM 1.7 (Photo 3-12). Tributary MR1.070 is fed by a perched lake several hundred feet above the valley floor and is not influenced by mainstem flow.

4.6.1.3.1 Tributary MR1.070

Tributary MR1.070 was by far the longest tributary surveyed and contained the most fish habitat for rearing and overwintering of juveniles and resident species and spawning of adult anadromous and resident fish. The tributary becomes steeper approximately 3.6 km from the lake confluence where it flows through a steep gully with larger cobble and boulder substrate and step pools. Mesohabitat observed was a typical riffle-glide-pool sequence which ranged from 0.1 m water depth in riffles to 0.5 m water depth in pools.

The water flowing through this tributary was clear (<5 NTUs) during spring and fall and other water quality parameters were compatible with healthy aquatic habitat criteria. Water temperature measured during the fall survey was 4.8°C and was consistent with the other cold-water tributaries. DO concentrations were high at 12.7 mg/L, typical of clear, cold, flowing water. Discharge estimates for this tributary ranged from >16 cfs in the spring associated with snowmelt runoff to 6.2 cfs in the late fall before the onset of fall rains.

In the spring minnow trapping efforts, 15 traps set for 6 hours, resulted in capture of zero fish in Tributary MR1.070. On October 1, 13 traps set for 24 hours resulted in capture of more fish than were caught anywhere else, with 596 Dolly Varden juveniles, 85 Coho Salmon juveniles, and 1 Threespine Stickleback (Figure 4-10). Adults of both species as well as Sockeye Salmon were observed spawning in Tributary MR1.070, and aquatic habitat characterization resulted in identification of at least 3.6 linear kilometers of rearing habitat with depths greater than those observed elsewhere. Tributary 1.070 and its associated lakes appear to provide significant habitat within the basin for rearing fish.

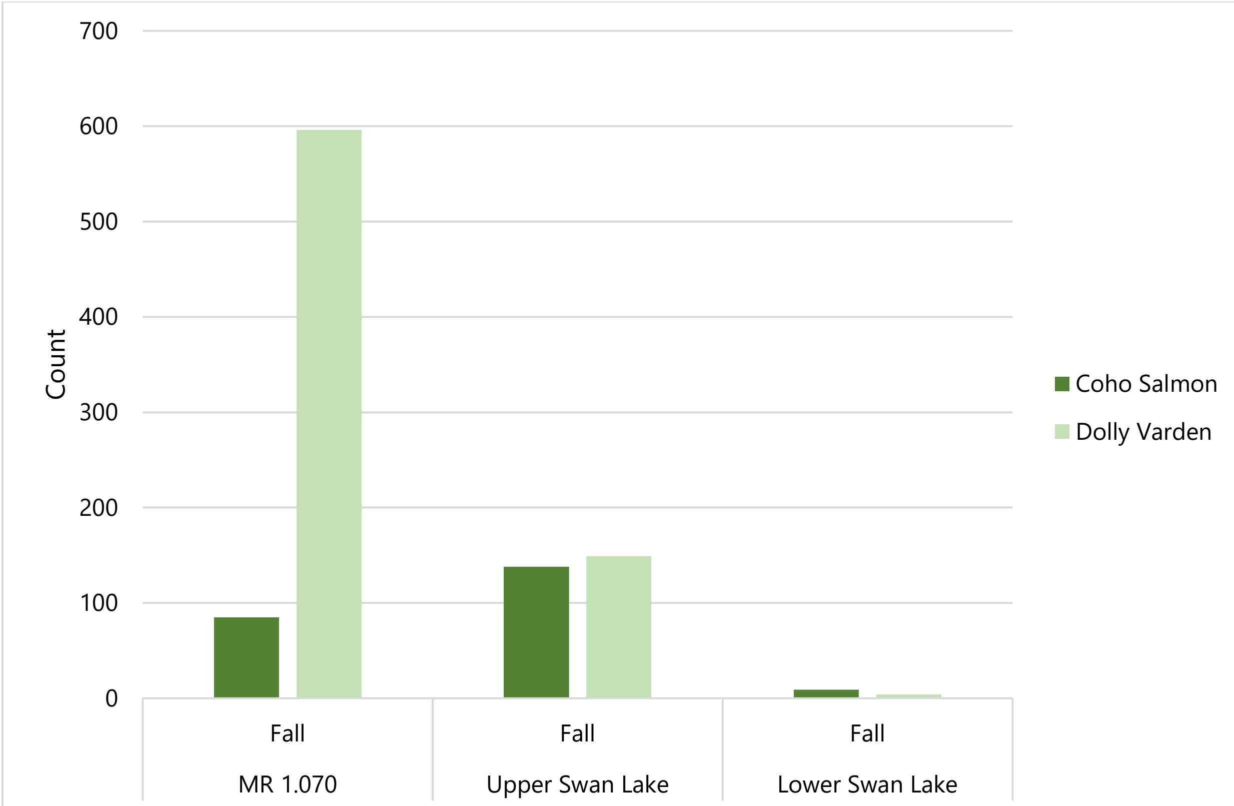

Figure 4-10 Total catch of Coho Salmon juveniles and Dolly Varden at the Tributary MR1.070/Swan Lake Complex from minnow trap sampling on October 1 and 2, 2024.

As noted above, 682 fish were captured at Tributary MR1.070 in the fall. The size distribution of these fish clearly indicates the presence of multiple size classes further enforcing the importance of Tributary MR1.070 for rearing habitat within the Martin River watershed. Dolly Varden juvenile size distribution included peaks at 50-59 mm, 70-79 mm, and 120-129 mm. Coho Salmon juvenile size distribution included peaks at 40-59 mm, 80-89 mm, and 120-129 mm (Figure 4-11).

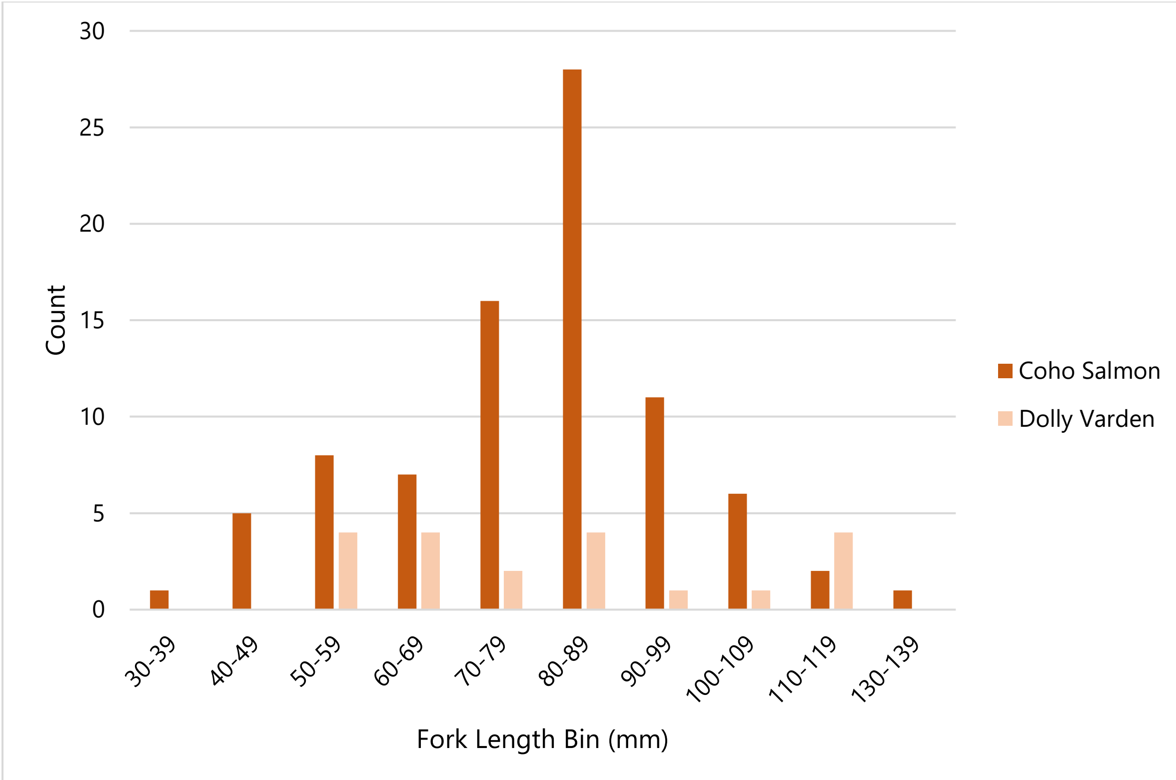

Figure 4-11 Size distribution of Dolly Varden and Coho Salmon captured during minnow trapping at Tributary MR1.070 in October 2024.

4.6.1.3.2 Upper Swan Lake

Upper Swan Lake (totaling 1,788 m^2 in area) is bounded by steeper bedrock cliffs and hillslopes on the north shore and is encroached with a large area of floating sphagnum fen on the south shore near the mouth of Tributary MR1.070. Upper Swan Lake is highly sedimented with fine particulate organic matter, clay, and mud and contained limited patches of submerged aquatic macrophytes. Submerged large woody debris and vegetated shorelines provided cover and habitat for juvenile rearing.

Upper Swan Lake was also productive for fish. Ten minnow traps set overnight (24 hours) on the south shore and near the mouth of Tributary MR1.070 resulted in capture of 142 Dolly Varden and 108 Coho Salmon as well as 15 Threespine Sticklebacks. Upper Swan Lake is a clearwater lake compared to the turbid Lower Swan Lake, and the number of fish greatly exceeded the catch at Lower Swan Lake which was only 7 Coho Salmon and 4 Dolly Varden (Figure 4-10).

The size distribution of juveniles of both Coho Salmon and Dolly Varden included less apparent peaks in Upper Swan Lake than in Tributary MR1.070, perhaps suggesting more mixed origin of fish present. There was a clear group of very small Dolly Varden juveniles (50-59 mm), and the remainder were normally distributed around 80-99 mm (Figure 4-12). Coho Juveniles ranged from 60-140 mm in fork length and followed a generally normal distribution of fork length in the fall sample on October 1, 2024 (Figure 4-12).

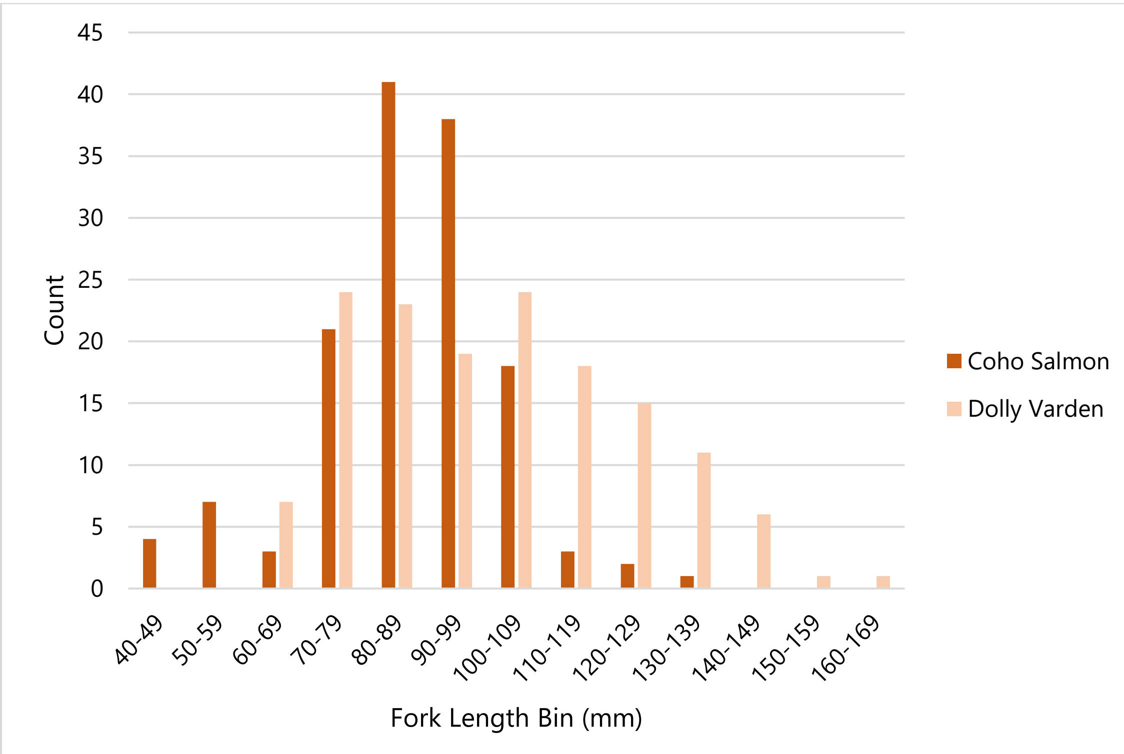

Figure 4-12 Size distribution of Dolly Varden and Coho Salmon captured during minnow trapping efforts at Upper Swan Lake, September 2024.

4.6.1.3.3 Lower Swan Lake

Lower Swan Lake (totaling 111,450 m^2 in area) is connected to Upper Swan Lake and sits slightly below the Upper Swan Lake grade, indicated by the clear water conditions in Upper Swan Lake and turbid conditions in Lower Swan Lake which receives floodwater from the mainstem Martin River during high flows. Lower Swan Lake is bounded on the north shore by bedrock cliffs and steep hillslopes and on the south shore by a marshy meadow or moss and grasses. Sediment in Lower Swan Lake is predominantly fine organics, clay, and mud, except near its outlet where inflow from the OCH2.8R complex merges with Lower Swan Lake outflow, and the sediment is predominantly gravel and sand. Submerged large woody debris and vegetated shorelines provide cover and habitat for juvenile rearing.

The size distribution of fish lengths in Lower Swan Lake did not include enough fish to clearly identify the presence of multiple age or size classes (Figure 4-13). Coho Salmon juveniles were 70-99 mm and Dolly Varden were 60-109 mm. Both species were present in much lower numbers than in the clearwater Tributary MR1.070 and Upper Swan Lake.

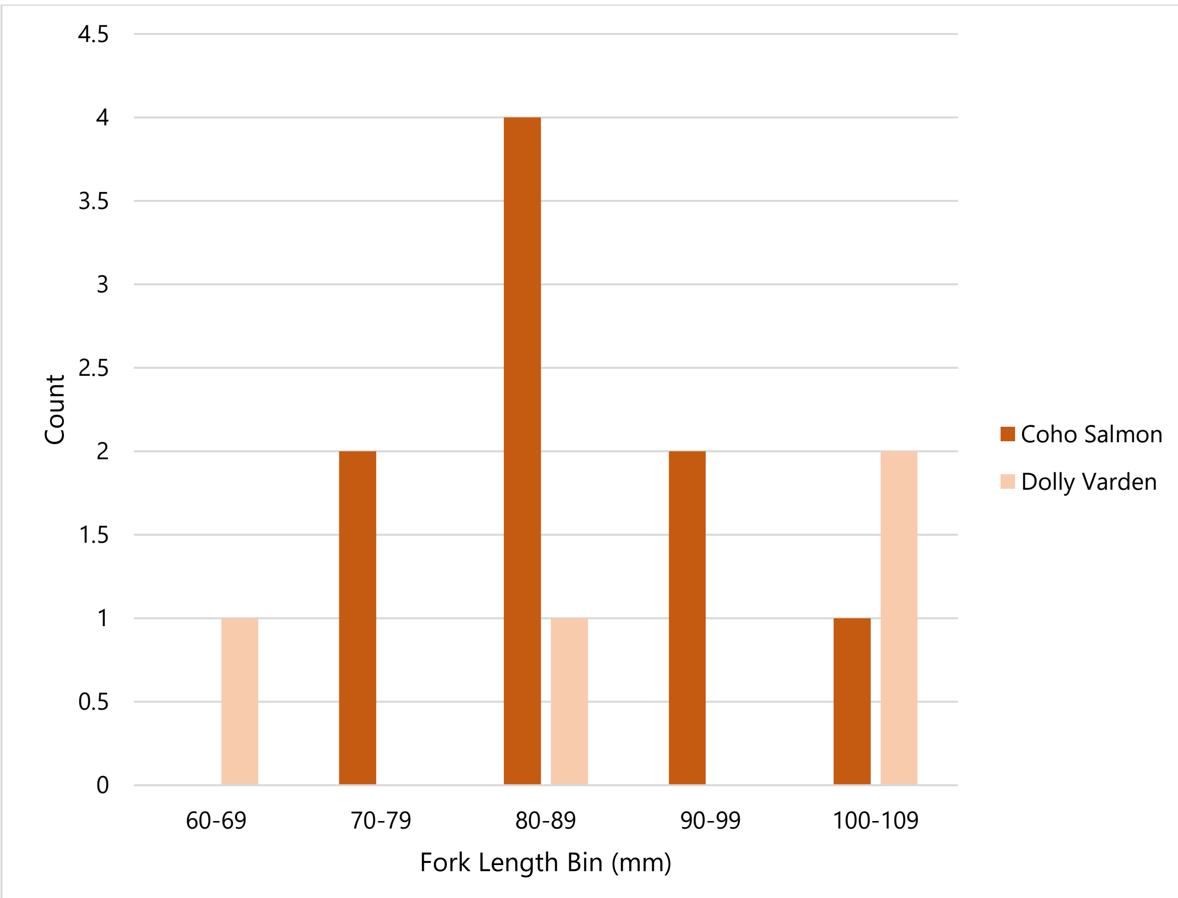

Figure 4-13 Size distribution of Dolly Varden and Coho Salmon collected during minnow trapping at Lower Swan Lake, September 2024.

4.6.1.3.4 Tributary MR1.070/Swan Lake Complex Relative Abundance

Unsurprisingly, CPUE in the Tributary MR1.070/Swan Lake Complex was highest for fall samples at Tributary MR1.070, with CPUE numbers higher than anywhere else in the basin, in some cases by a full order of magnitude. Catch per trap in Tributary MR1.070 exceeded 100 fish at some deployment locations (Figure 4-14).

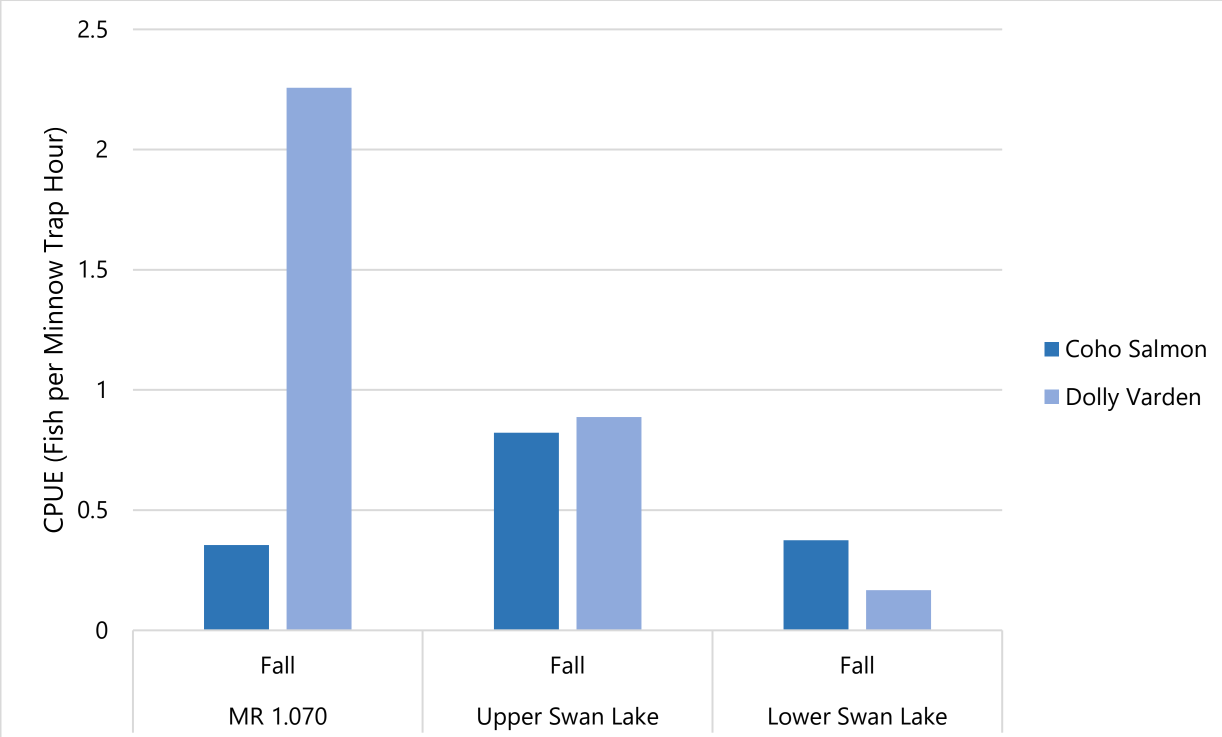

Figure 4-14 Relative abundance within sites at Tributary MR1.070/Swan Lake Complex based on minnow trapping.

4.6.1.4 Off-channel Complex OCH2.8R

Off-channel complex OCH2.8R is a braided side slough complex about 2.4 kilometers in length which is fed by a combination of glacial Martin River water at higher flows and clear water from MR1.090, OCH2.8R-SS-1.060, and headwater lakes. Under higher flow conditions, inflow from the Martin River enters OCH2.8R-SS-1 near RM 4.0. At the downstream end, OCH2.8R-SS-1 joins the mainstem at Lower Swan Lake, where egress into either the lakes or the Martin River mainstem was possible at all observed flows.

The slough complex was surveyed for fish during both spring and fall field events and was wetted at the time of the surveys. The flooding event during August 6-7, 2024 resulted in channel changes to the OCH2.8R complex, including the position of braided channels and side sloughs within OCH2.8R. Tributary MR1.090 was disconnected from the slough complex during fall surveys and not accessible to fish, while MR1.100 had a steep drop at the connection point on the survey date and was also likely not accessible to fish.

Water quality parameters were measured on September 24 and 26, 2024 during fall fish use surveys and spawning surveys. Water temperature was 3.3 to 4.2°C, DO concentrations were 10.6 and 11.8 mg/L—values consistent with water quality standards and expectations for clear, cool water. Turbidity during this sampling event was low, <5 NTUs, but observations during higher flow events indicate that this macrohabitat does become turbid when mainstem flow is high enough to connect the slough to the mainstem at its upstream end.

Fish sampling occurred at this site in both spring (May 9) and fall (September 24) of 2024 and was mostly concentrated on the braided channel which was about 5 to 8 meters across and included swift water, a lot of large woody debris, and generally clear water. Due to the length and area of OCH2.8R, 24 minnow traps were deployed in the macrohabitat in both seasons to adequately cover the area.

Fish captured in OCH2.8R were predominantly Dolly Varden in both seasons, with 146 juveniles captured in the spring (24-hour trap sets) and 284 juveniles captured in the fall (24-hour trap sets). Coho Salmon catch included 6 juveniles in the spring and 41 in the fall (Figure 4-15). Ten minnow traps deployed in OCH2.8R-SS-1.060 captured 10 Dolly Varden in the spring and only 2 in the fall. Coho Salmon were not well represented at this site with only 1 individual documented in the spring and zero in the fall (Figure 4-15).

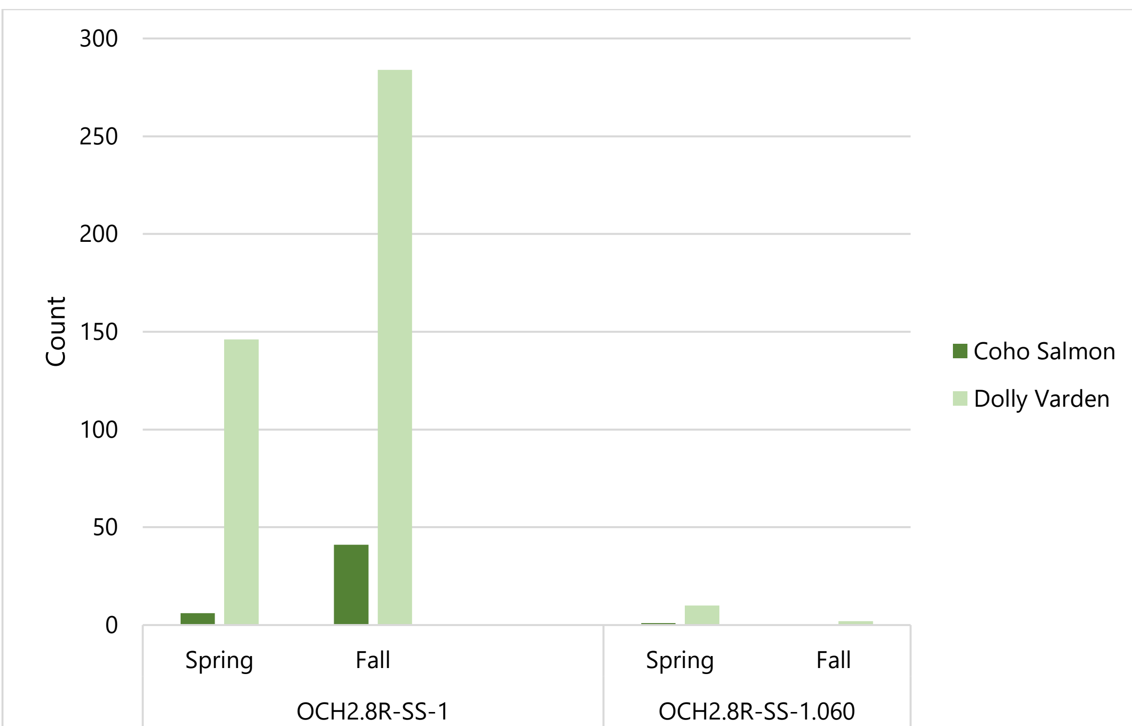

Figure 4-15 Total catch of juvenile Dolly Varden and Coho Salmon captured during minnow trapping at the off-channel complex OCH2.8R in 2024.

4.6.1.4.1 OCH2.8R-SS-1

Coho Salmon size distribution did not change significantly between seasons although significantly more fish were captured in the fall than in the spring, likely due to overnight minnow trap sets. More larger fish were also sampled in the fall than in the spring but both seasons documented a range of fork lengths that indicate multiple age classes of juveniles (40-120 mm; Figure 4-16). Dolly Varden size distribution was also indicative of multiple age classes (40 mm to >140 mm) and like Coho Salmon, included more larger fish in the fall than were observed in the spring (Figure 4-16).

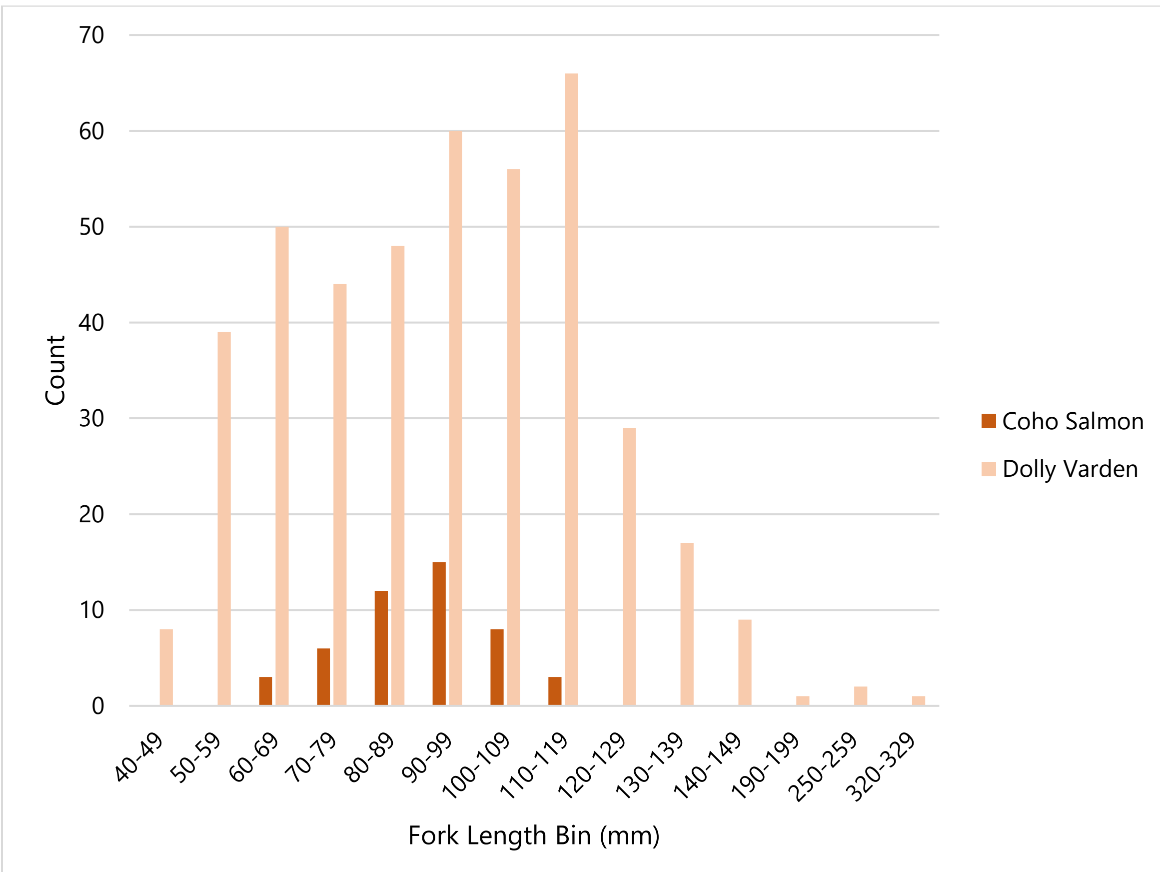

Figure 4-16 Size distribution of Dolly Varden and Coho Salmon juveniles from minnow trapping in OCH2.8R-SS-1 on May 9 and September 24, 2024.

4.6.1.4.2 OCH2.8R-SS-1.060

There were not enough Coho Salmon juveniles captured at OCH2.8R-SS-1.060 in 2024 to develop a length distribution that could suggest age-class composition of this species. Dolly Varden juveniles ranged in size from 50-59 mm to 100-109 mm, with most individuals in the 90-99 mm range (Figure 4-17). Due to shallow conditions, limited portions of this macrohabitat could be sampled with minnow traps. Dip netting along undercut banks and in two small log jams did not yield additional fish.

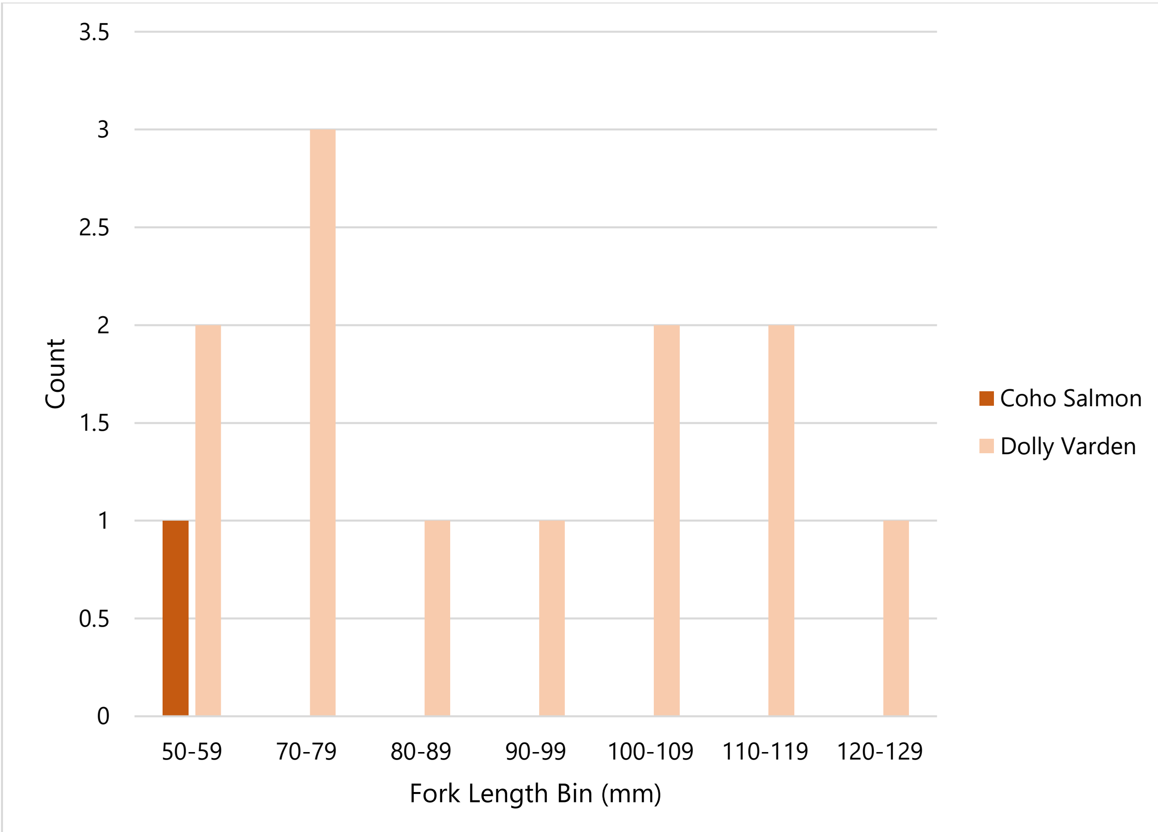

Figure 4-17 Size distribution of Dolly Varden and Coho Salmon captured during minnow trapping at OCH2.8R-SS-1.060 in May of 2024.

4.6.1.4.3 OCH2.8R Relative Abundance

Dolly Varden were more abundant in OCH2.8R than Coho Salmon, and stickleback species were not documented. CPUE for Dolly Varden in the fall was 1.6 fish per trap hour, and 0.16 fish per trap hour in the spring. Coho Salmon had a CPUE of 0.06 in the spring and 0.3 fish per trap hour in the fall. Dolly Varden spring CPUE at OCH2.8R-SS-1.060 was 0.1 fish per trap hour and 0.08 in the fall (Figure 4-18).

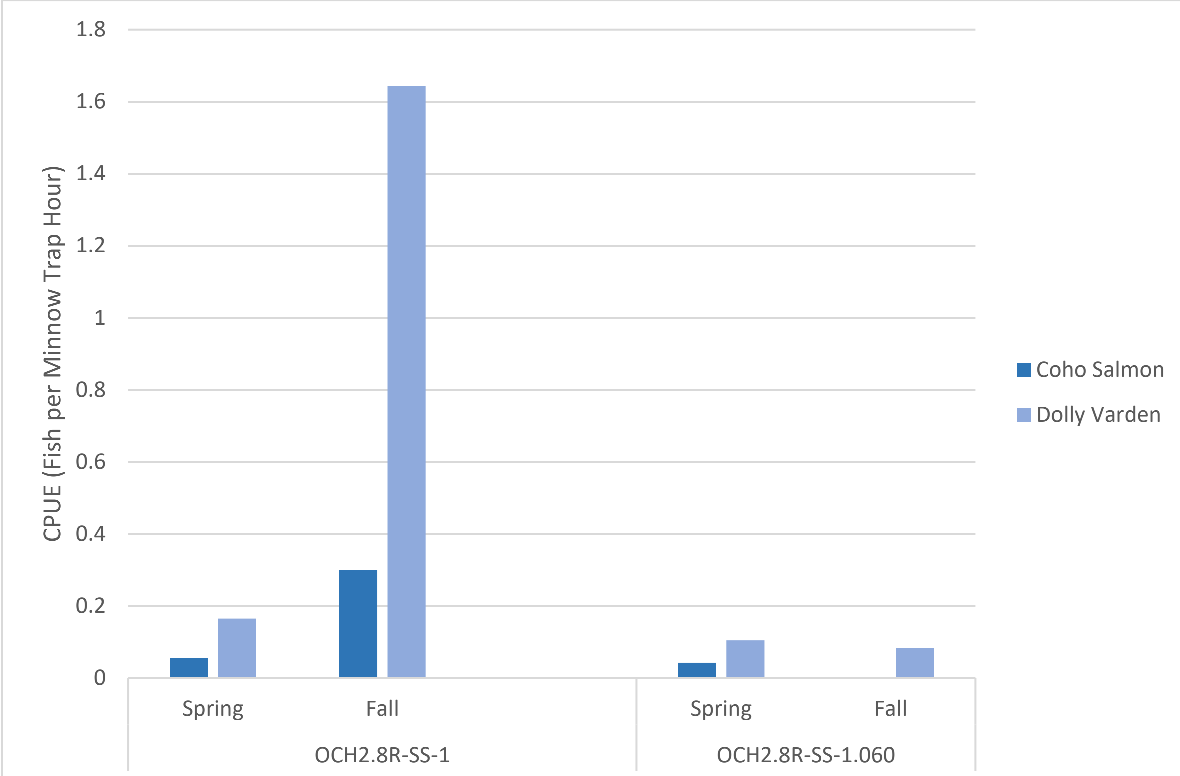

Figure 4-18 CPUE for Dolly Varden and Coho Salmon juveniles captured in off-channel complex OCH2.8R from spring and fall minnow trapping efforts.

4.6.1.5 Off-channel Complex OCH3.0L

This macrohabitat is a slough which joins a left-bank braid of the mainstem Martin River near RM 3.0 via shallow gravel riffle that may be impassable to adult fish at low flows. OCH3.0L-SS-1 receives input during low flow conditions both from groundwater and the lake complex which includes MR1.080.L1, MR1.080.L2, and the intermittent connecting seep, Tributary MR1.080 which was dry and encroached with grass at the time of survey on September 27, 2024.

Ten minnow traps were deployed in the complex in both seasons of 2024 on May 7 (6-hour set) and September 27 (24-hour set), including OCH3.0L-SS-1 and the feeder lake MR1.080.L1 which provided input water but did not appear to have a permanent connection to the mainstem slough. Dolly Varden, Coho Salmon, and both Threespine and Ninespine sticklebacks were documented in the complex. Dolly Varden was the dominant species by number, with 138 juveniles captured in the fall and 44 in the spring at OCH3.0L-SS-1 and 19 individuals captured in Lake MR1.080.L1. Fewer than 40 Coho

Salmon juveniles were present in either habitat. A total of 87 Threespine Sticklebacks were captured in Lake MR1.080.L1 in the fall (Figure 4-19).

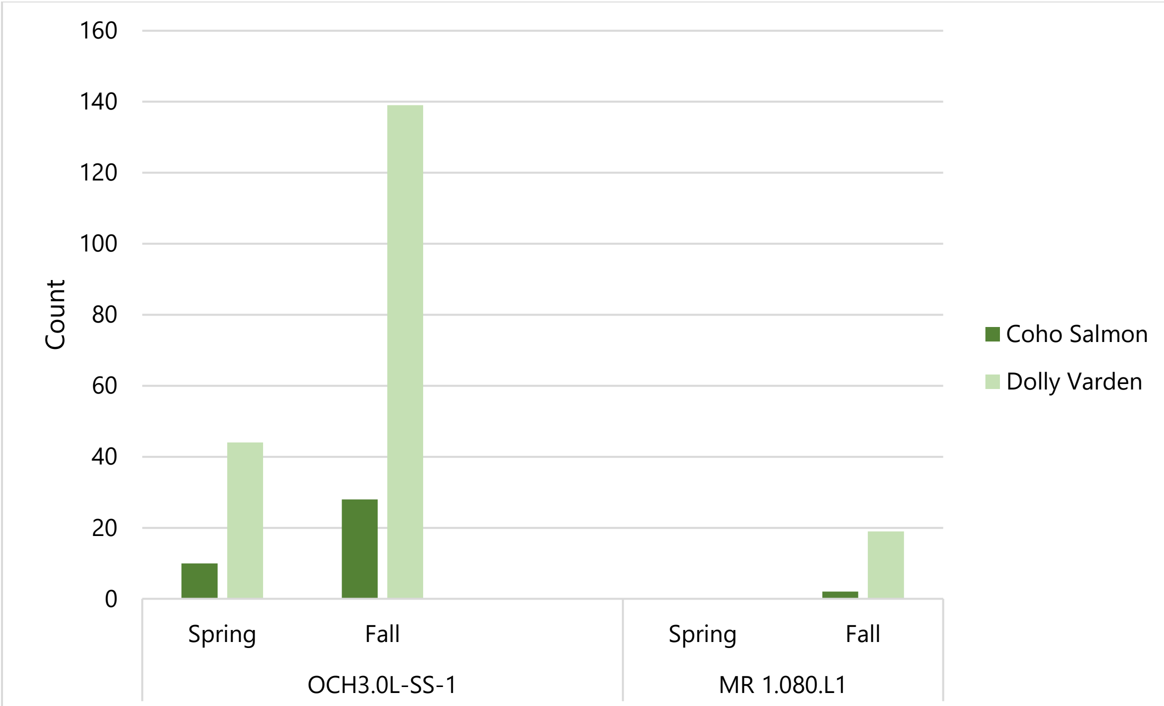

Figure 4-19 Total catch of fish species from minnow trapping in the OCH3.0L complex including OCH3.0L-SS-1 and MR1.080.L1 in 2024.

4.6.1.5.1 OCH3.0L-SS-1

OCH3.0L-SS-1, a side slough about 1.2 km in length fed by the MR1.080 chain-lake complex. OCH3.0L-SS-1 enters the mainstem Martin River at ~RM 2.75 and is mostly a narrow (<2 m wide), shallow (<0.2 m deep) clearwater gravel stream with heavy vegetation and large quantities of large woody debris mostly comprised of alder and cottonwood. Multiple size classes of Coho Salmon juveniles were captured in both spring (May 10) and fall (September 27); individuals under 50 mm indicated that adult spawning may have occurred in the area, or young-of-year fish were transported into OCH3.0L-SS-1 during high water events. Fish of larger age classes were also present in both seasons (Figure 4-20, Coho Salmon). Dolly Varden size distribution also included multiple age classes in both seasons including young-of-year individuals (<40 mm) and larger subadults (>140 mm) (Figure 4-20). Observations of spawning Dolly Varden adults were also made at this site in September of 2024.

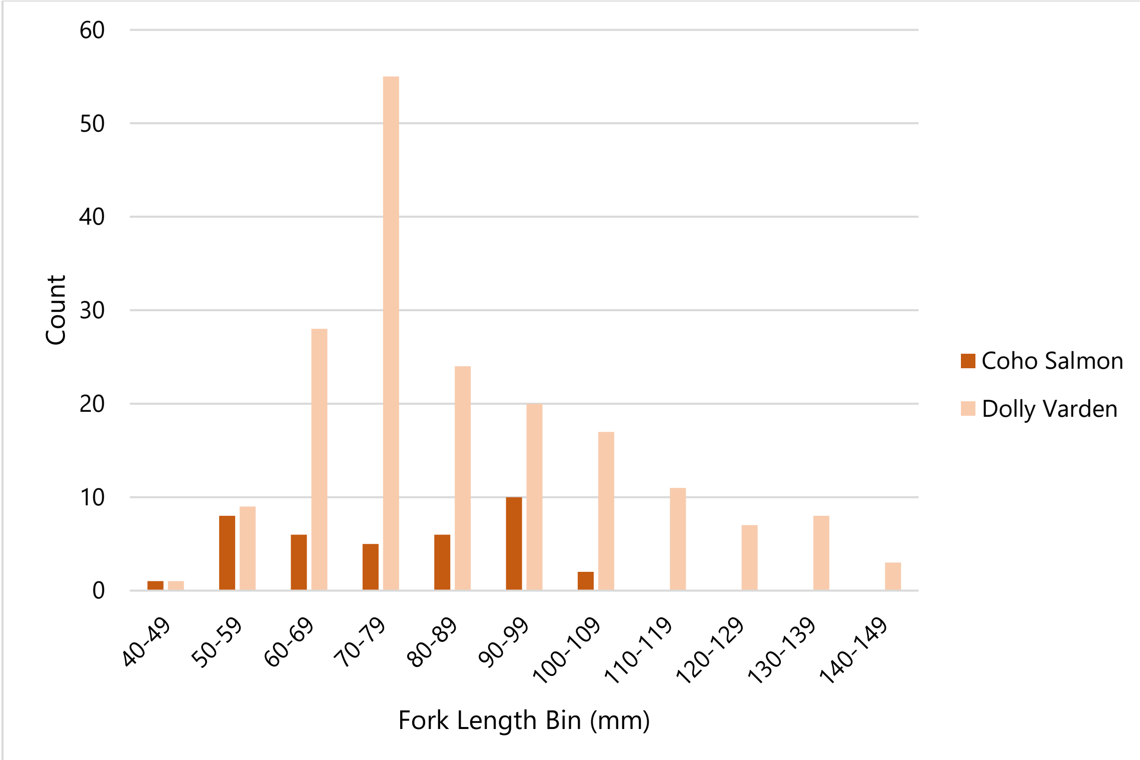

Figure 4-20 Size distribution of Coho Salmon and Dolly Varden juveniles captured during minnow trapping efforts in OCH3.0L-SS-1 on May 10 and September 27, 2024.

4.6.1.5.2 Lake MR1.080.L1

This macrohabitat is a 17,514 m^2 tannic lake perched about 30 feet in elevation above the Martin River mainstem floodplain. Lake MR1.80.L1 is bifurcated by a grassy isthmus which equalizes flow between its two halves. Both halves of MR1.080.L1 appear shallow, have heavy growth of macrophytes, aquatic lilies, and aquatic grasses, and tannic brown water that receives unobstructed solar warming. The substrate around the lakeshore was 100 percent fine organic material, and disturbance of these sediments often yielded sulfuric smells, indicating potential anoxic conditions in the substrate. Water quality parameters measured on September 27, 2024 included temperature of 11.0°C, pH of 7.47, DO concentration of 9.18 mg/l and 82 percent which are lower than observed for cool, flowing habitats elsewhere in the basin, and low turbidity of <5 NTUs.

In fall fish sampling at Lake MR1.080.L1 using minnow traps deployed overnight on September 27, both Coho Salmon juveniles and Dolly Varden were captured, despite observations that there was no egress from the lake to the OCH3.0L-SS-1 channel, and that fish access to the south lobe of the lake (where the fish traps were set) was separated from the north lobe where the outlet exists by an inundated grassy isthmus which was present at the observed lake levels. The Coho Salmon observed were especially robust individuals from 80-89 mm and 110-119 mm (Figure 4-21).

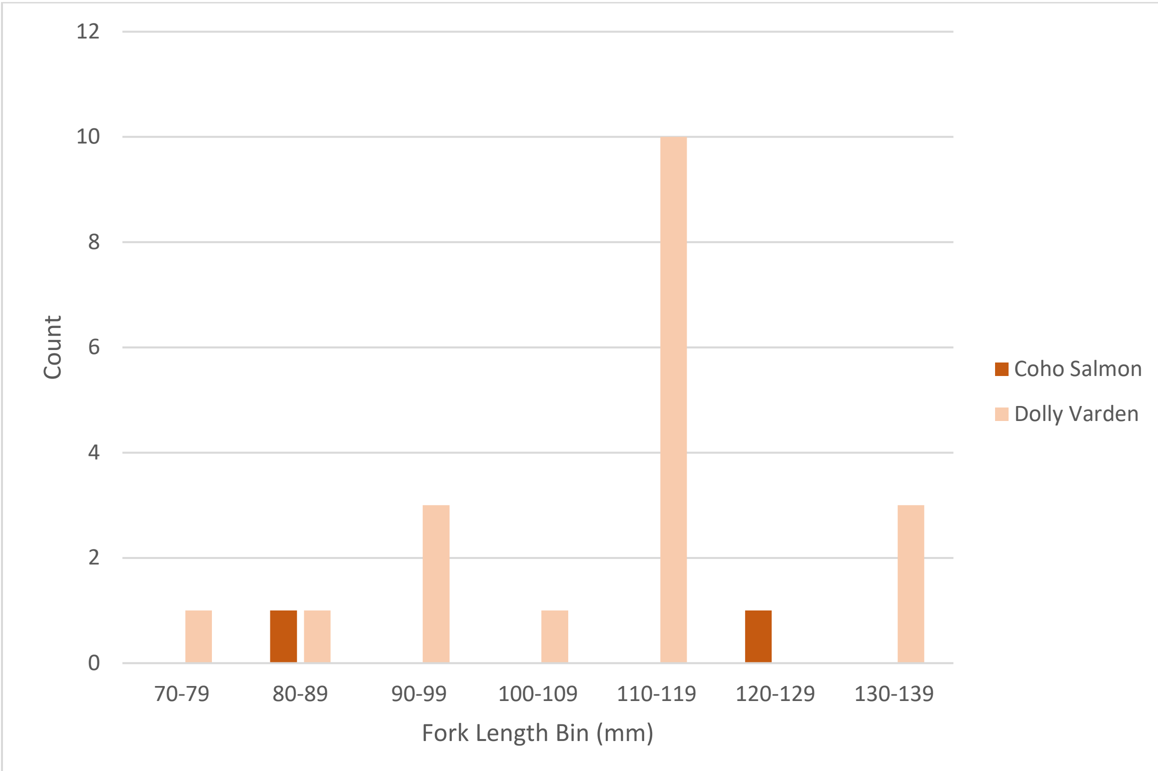

Figure 4-21 Size distribution of Dolly Varden and Coho Salmon juveniles collected during minnow trapping efforts at Lake MR1.080.L1 in October 2024.

4.6.1.5.3 OCH3.0L Relative Abundance

CPUE in the OCH3.0L complex ranged from 0.1 – 0.5 fish per trap hour for the 2024 season and was lowest in Lake MR1.080.L1 and highest for Dolly Varden juveniles sampled from OCH3.0L-SS-1 in the fall (Figure 4-22).

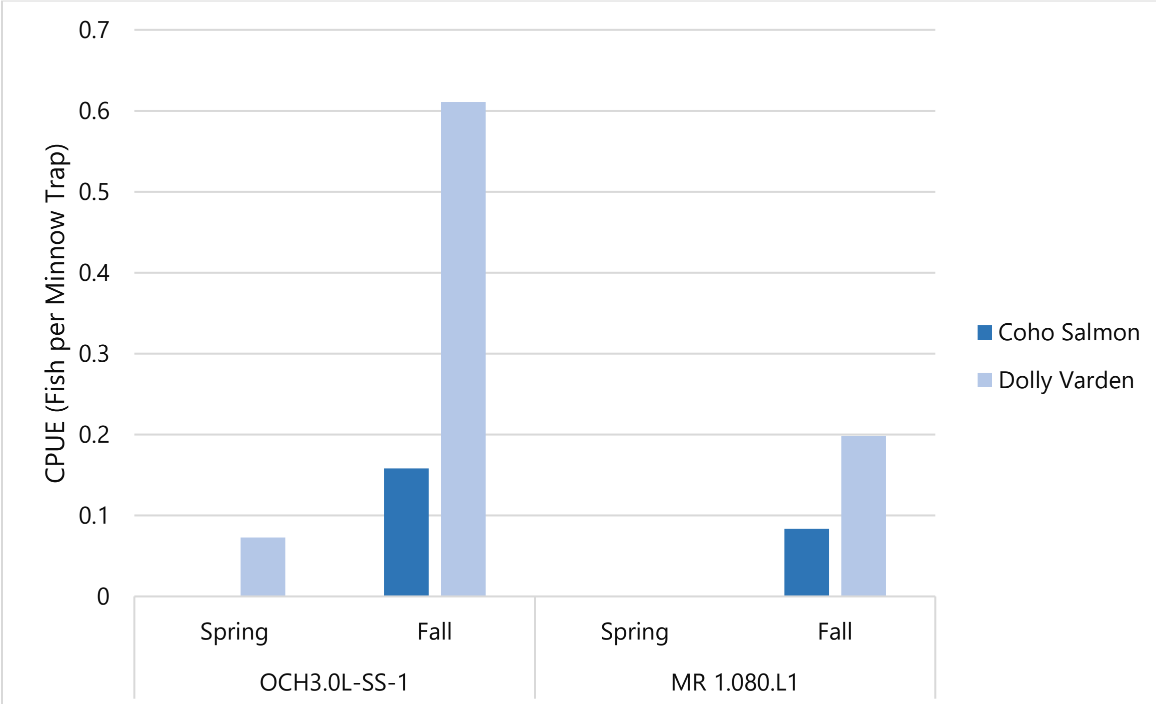

Figure 4-22 CPUE for Coho Salmon and Dolly Varden captured during minnow trapping efforts in the OCH3.0L complex on May 10 and September 27, 2024.

4.6.1.6 Off-channel Complex OCH3.8R

This macrohabitat is a side slough that is fed by a combination of outflow from a perched tannic lake known as Hawk Lake (due to its birdlike shape), and surface or subsurface flow from the main channel at some flow conditions.

4.6.1.6.1 OCH3.8L-SS-1

On April 30, 2024, OCH3.8L-SS-1 contained 12 mesohabitat units totaling 378.9 m in length and covering 1,135.4 m^2 in wetted area. The average total wetted width was 2.8 m and average BFW of 6.3 m. Total wetted depth averaged 0.25 m and ranged from riffle habitat less than 0.1 m in depth to pool habitat 0.7 m in depth. A total of 17 minnow traps were installed in OCH3.8R-SS-1 for an 8-hour set on April 30, 2024. One Dolly Varden was captured in OCH3.8L-SS-1. The habitat was predominantly very shallow and fragmented, and the field crew was challenged to find sufficient opportunities to install minnow traps.

4.6.1.6.2 Hawk Lake

Hawk Lake is a tannic lake perched at least 50 feet in elevation above the grade of the Martin River floodplain. The lakeshore was crowded and shaded with thick evergreen trees, and the nearshore aquatic habitat had large quantities of submerged large woody debris, lily pads and other aquatic vegetation, and a thick layer of fine sediments and particulate organic material. Ten traps were installed at Hawk Lake on October 1, 2024. No fish were captured in Hawk Lake; all retrieved minnow traps had attracted several predaceous diving beetles.

4.6.1.6.3 OCH3.8L Complex Relative Abundance

CPUE was less than 0.05 fish per trap hour for Dolly Varden at OCH3.8L-SS-1 and was 0.0 for Coho Salmon at both OCH3.8L-SS-1 and Hawk Lake.

4.6.1.7 Off-channel Complex OCH4.2R

This macrohabitat is a side slough that drains Lake MR1.120.L1 and enters the Martin River from the right side of the floodplain near RM 4.2.

The off-channel slough at OCH4.2R-SS-1 was sampled for fish on April 28, 2024 when 10 minnow traps were deployed. The Lake MR1.120.L1 was sampled with 10 minnow traps on September 28, 2024 placed in the clearwater south lobe and the clear bifurcation channel between the lobes. During spring minnow trapping efforts, a total of 55 Dolly Varden and 18 Coho Salmon juveniles were captured in OCH4.2R-SS-1. During fall efforts, 64 Dolly Varden, 100 Coho Salmon, and 1,088 Threespine Sticklebacks were captured in MR1.120.L1 (Figure 4-23).

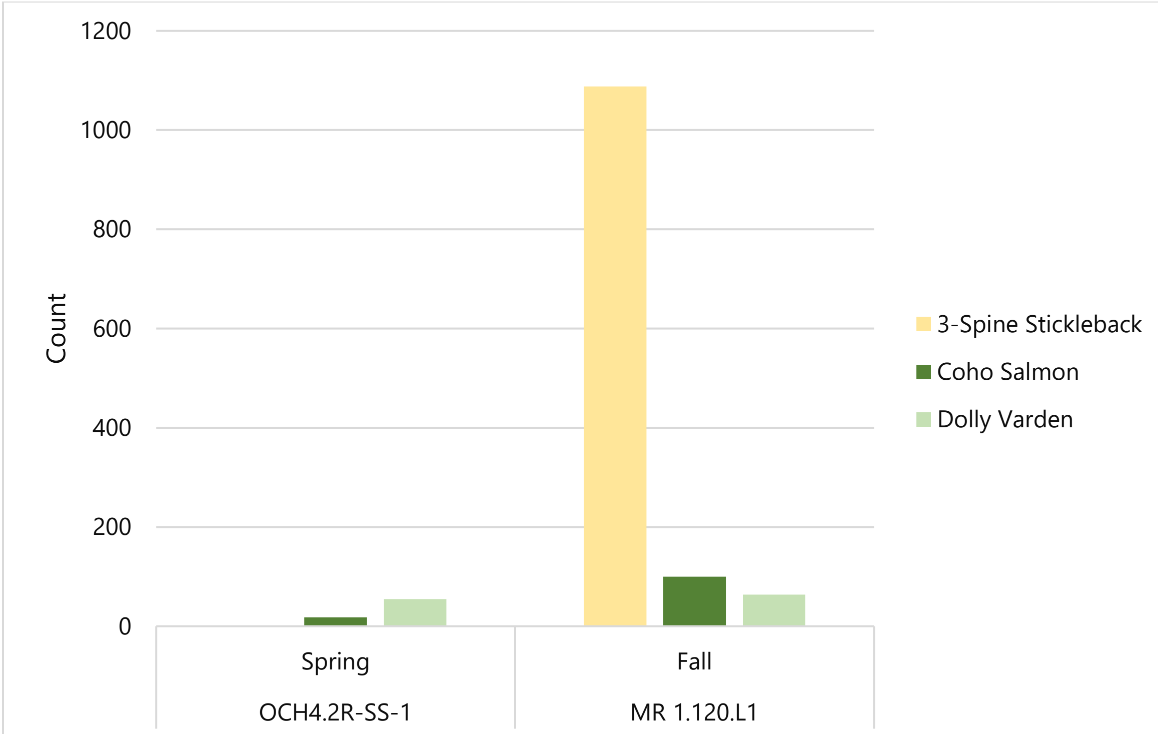

Figure 4-23 Total catch of Dolly Varden, Coho Salmon juveniles, and Threespine Stickleback captured in the OCH4.2R complex in 2024.

4.6.1.7.1 OCH4.2R-SS-1

Size distribution of Coho Salmon juveniles at OCH4.2R-SS-1 in spring included peaks in the 80-89 mm and 100-109 mm fork length bins, as well as one larger individual that was over 140 mm in length. Coho Salmon juvenile lengths were distributed around two weak peaks at 80-89 mm and 100-109 mm, indicating the potential presence of two age classes. One larger individual (120-129 mm range) suggested the potential presence of a third size class that either reared in OCH4.2R-SS-1 or in the bifurcated lake which feeds it (Figure 4-24).

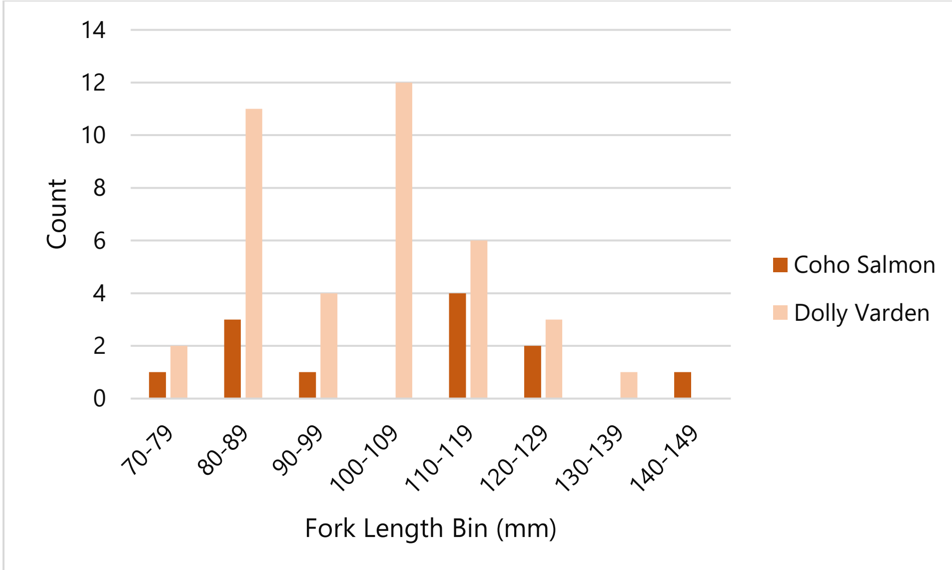

Figure 4-24 Size distribution of Dolly Varden and Coho Salmon juveniles captured during minnow trapping efforts at OCH4.2R-SS-1 in May 2024.

4.6.1.7.2 OCH4.2R Relative Abundance

CPUE was relatively high at this complex, likely related to the quality of Lake MR1.120.L1 as rearing habitat for juvenile fishes. CPUE was 0.44 fish per trap hour for Dolly Varden and 0.41 fish per trap hour for juveniles at Lake MR1.120.L1 (Figure 4-25). Between side slough habitats (Figure 4-25).

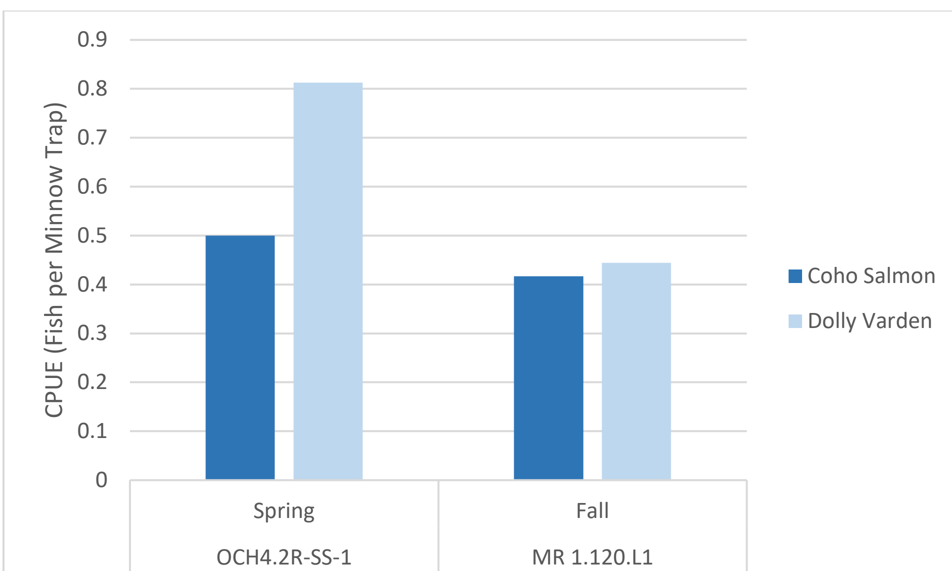

Figure 4-25 CPUE for Dolly Varden and Coho Salmon juveniles captured during minnow trapping efforts during spring (OCH4.2 side slough habitats) and fall (MR1.120.L1) in 2024.

4.6.1.7.3 Lake MR1.120.L1

This macrohabitat is a lake that drains the surrounding hillslopes via several runoff gullies. Lake MR1.120.L1 was bisected in the center by a shallow constriction where the water was less than 1.0 m in depth with soft, organic substrates, fine particulate organic matter, and aquatic macrophyte growth. The southern half of the lake was less turbid than the northern half during September 2024 fish survey efforts, suggesting that inundation from the mainstem occurred more recently in the north half of the lake, and that the north portion may be at a slightly lower elevation than the southern lobe.

The size distribution of salmonid juveniles captured in Lake MR1.120.L1 included Dolly Varden of predominantly larger size classes ranging from 100 to 139 mm in fork length (Figure 4-26). Coho Salmon juveniles were predominantly of young age classes though there were not multiple peaks of abundance by size class. The median Coho Salmon juvenile fork length was 70-79 mm and the remaining distribution was approximately normal, with a total size range of 40 to 99 mm (Figure 4-26).

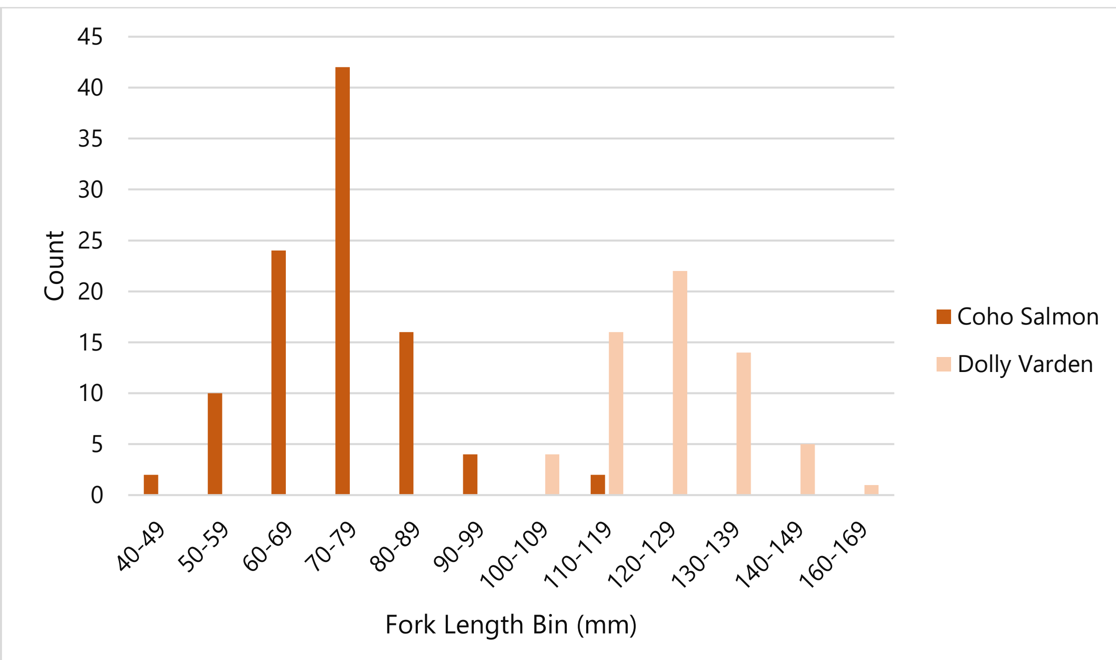

Figure 4-26 Size distribution of Dolly Varden and Coho Salmon juveniles collected during minnow trapping in Lake MR1.120.L1 October 2024.

4.6.1.7.4 Tributaries MR1.120, MR1.120.10, MR1.120.20

During the spring mesohabitat surveying, Tributary MR1.120 consisted of 33 m of glide habitat with an average depth of 0.4 m as tributary flowing from MR1.120.L1 to OCH4.2R-

SS-1. None of the tributaries on the SE side of the lake (inflow) contained any wetted aquatic habitat when visited on September 28 during the fall fish surveys.

4.6.1.8 Red Lake

Red Lake is fed by the WFMR headwaters. As its source glaciers have receded, the lake has become clear. However, during the August 2024 flood event, the EFMR exceeded 1,500 cfs and flowed over the gravel bars at the confluence and backed up into Red Lake. At the time of fish sampling on October 2 and 3, 2024, the lake was turbid, but warmer than the mainstem (6°C). Trapping was limited to the north shore, outside of the Kenai National Wildlife Refuge. A total of 6 Dolly Varden and 4 Coho Salmon juveniles were captured in 6 minnow traps set over a 24-hour period (Figure 4-27).

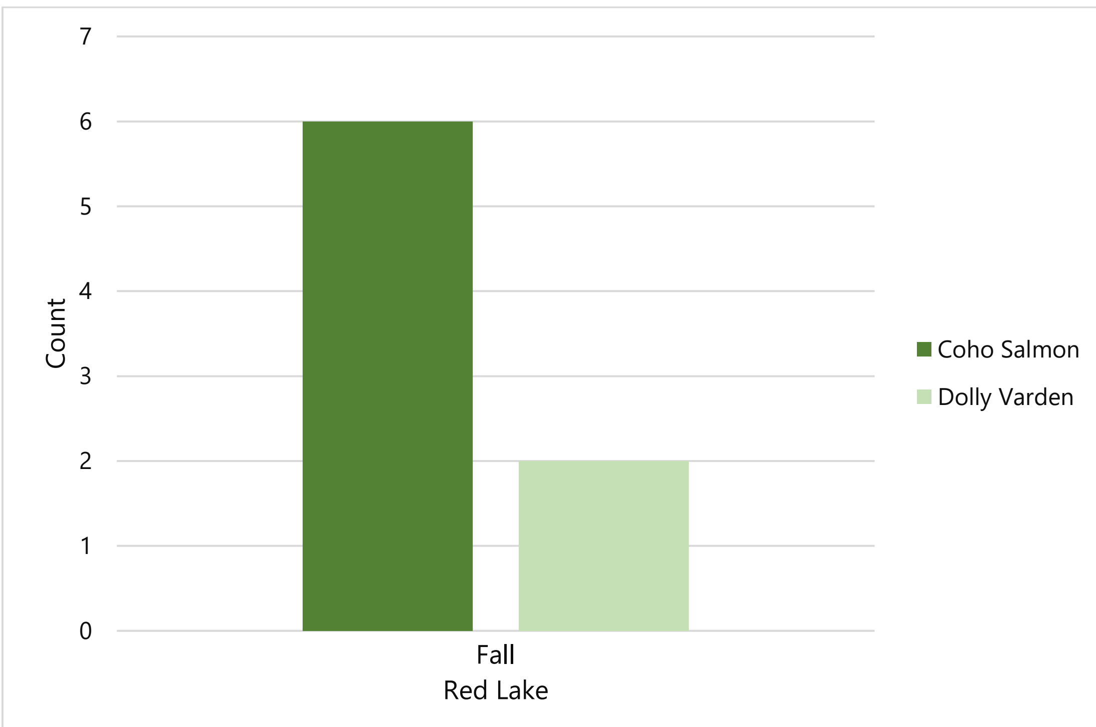

Figure 4-27 Total fish catch data from minnow trapping efforts in Red Lake on October 2, 2024.

Dolly Varden were present in two size classes, 60-89 mm and 110-129 mm while the Coho Salmon juveniles were relatively robust specimens with one individual at 120-129 mm and a second individual over 140 mm fork length (Figure 4-28).

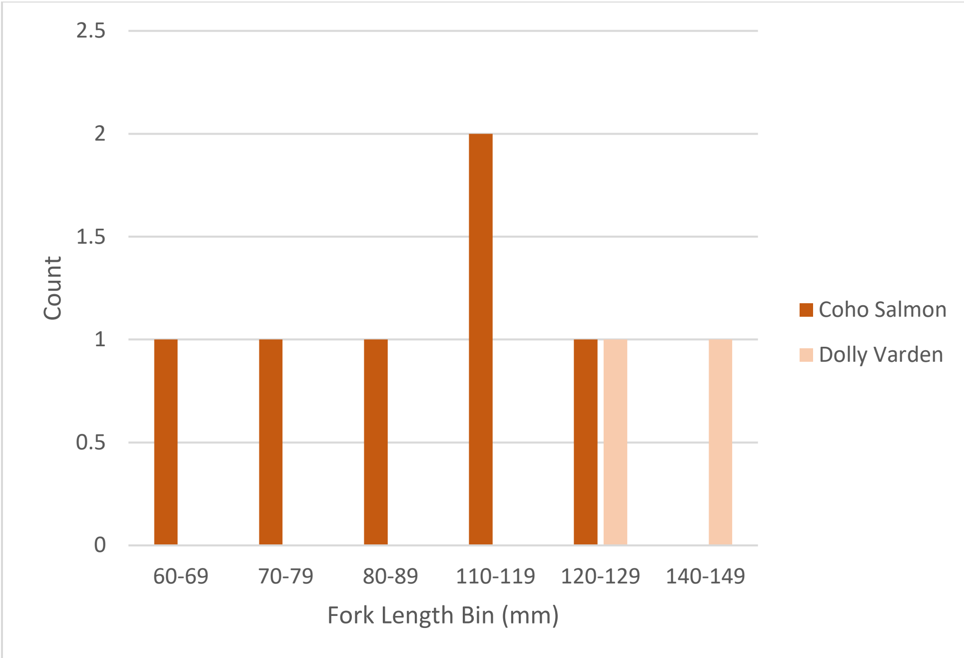

Figure 4-28 Size distribution of fish captured during minnow trapping efforts at north shore of Red Lake, October 3, 2024.

4.6.1.8.1 Red Lake Relative Abundance

CPUE for the Red Lake was low for both species encountered, with values under 0.19 fish per trap hour in 2024 (Figure 4-29).

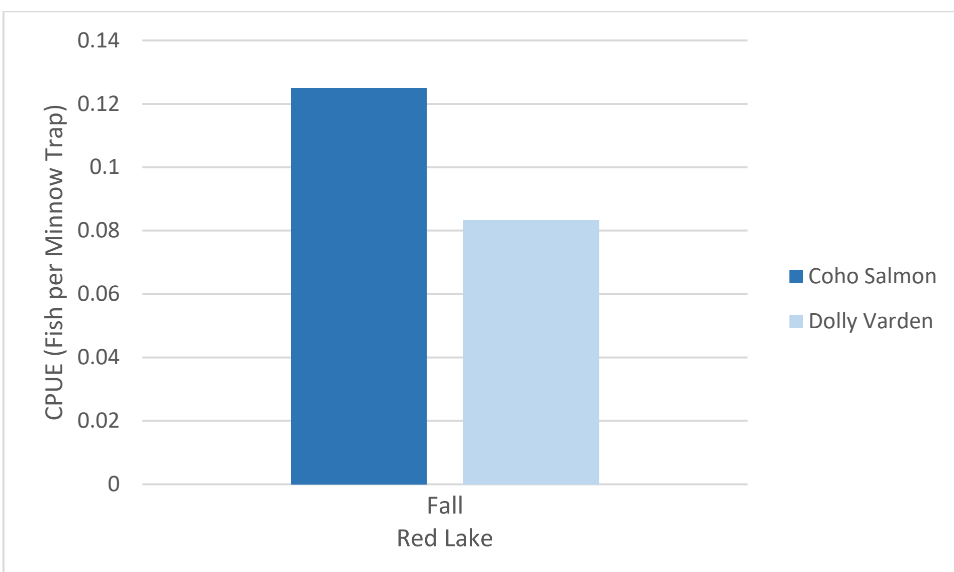

Figure 4-29 CPUE for Coho Salmon and Dolly Varden captured during minnow trapping efforts at north shore of Red Lake on October 2-3, 2024.

4.6.1.9 Summary of Relative Abundance

Minnow trapping CPUE for samples in off-channel and tributary macrohabitats ranged between 0.1 and 1.5 average fish per trap hour for Coho Salmon and between 0.0 and 3.25 average fish per trap hour for Dolly Varden (Figure 4-30). Tributary MR1.070 stands out with the highest CPUE for Dolly Varden and Coho Salmon juveniles in the fall. Dolly Varden were also relatively abundant in off-channel complex OCH4.2R during spring sampling. Due to the large flooding event in August of 2024, with the exception of some lake habitat and Tributary MR1.070, fish could have been redistributed into different OCHs during this event.

The species composition among the four documented species in the Martin River downstream of ~RM 3.25 during spring and fall sampling is displayed in Figure 4-31. As described above in Section 3.0, the habitat in OCH1.7R-SS-1 was a very shallow series of riffles and pools, nearly disconnected from the habitat downstream. A deeper pool (~0.5 m deep) full of large woody debris was present at the top of Tributary MR1.020 and was fed by a steep (>50 percent) gradient inflowing tributary with a 0.5-m drop down to the water surface. Tributary MR1.030 was limited to small pools and very shallow riffles except the upstream end of Tributary MR1.030 which appeared to be a relict beaver pond at the time of sampling and included an inundated area of submerged grasses and downed wood, a pool of more than 1.5 m deep, and a high-gradient inflow from the steep uplands that was dry at the time of sampling. In both locations, Coho Salmon juveniles were predominant and CPUE was relatively high.

OCH1.7L-SS-1 and Tributary MR1.070 were dominated by Dolly Varden juveniles. These habitats had a greater amount of available habitat based on stream length, contained more water than Tributary MR1.020 and Tributary MR1.030, and were better connected to downstream egress. Dolly Varden were especially abundant in Tributary MR1.070, though no fish of any species were captured at this location in the spring, possibly due to differences in habitat suitability between seasons.

Figure 4-32 depicts the proportions among the four documented species in the Martin River off-channel complexes. In all off-channel areas sampled in OCH2.8R-SS-1, OCH2.8R-SS-1.060, and Tributary MR1.090, which feeds OCH2.8R-SS-1, Dolly Varden were the dominant juvenile salmonid observed in all portions of the right-bank off-channel complex.

Figure 4-33 depicts the species composition among the documented species in the Martin River upstream of ~RM 3.25 which includes spring and fall sampling at OCH4.2R-SS-1 and fall sampling at OCH3.8L-SS-1, lakes MR1.080.L1 and MR1.120.L1, and the shore of Red Lake near the outlet. While no sticklebacks were documented in faster flowing habitats in the two side sloughs sampled, Dolly Varden and Coho Salmon juveniles were present in large numbers. Three lakes in this area were sampled, though only two, MR1.080.L1 and MR1.120.L1 contained fish. In both lakes with fish, Threespine Sticklebacks were present, and numerically the most abundant, though a few individual Dolly Varden and Coho Salmon juveniles were present in minnow trap samples. Interestingly, at Lake MR1.080.L1 where a marshy grass band separates two halves of the lake, Coho Salmon and Dolly Varden juveniles were documented in the part of the lake that was isolated from the egress point at OCH3.0L-SS-1, having either navigated the grassy marsh, or arrived in the isolated portion of the lake during higher water. All lakes were too deep and had too much unstable, highly silted sediment for beach seining.

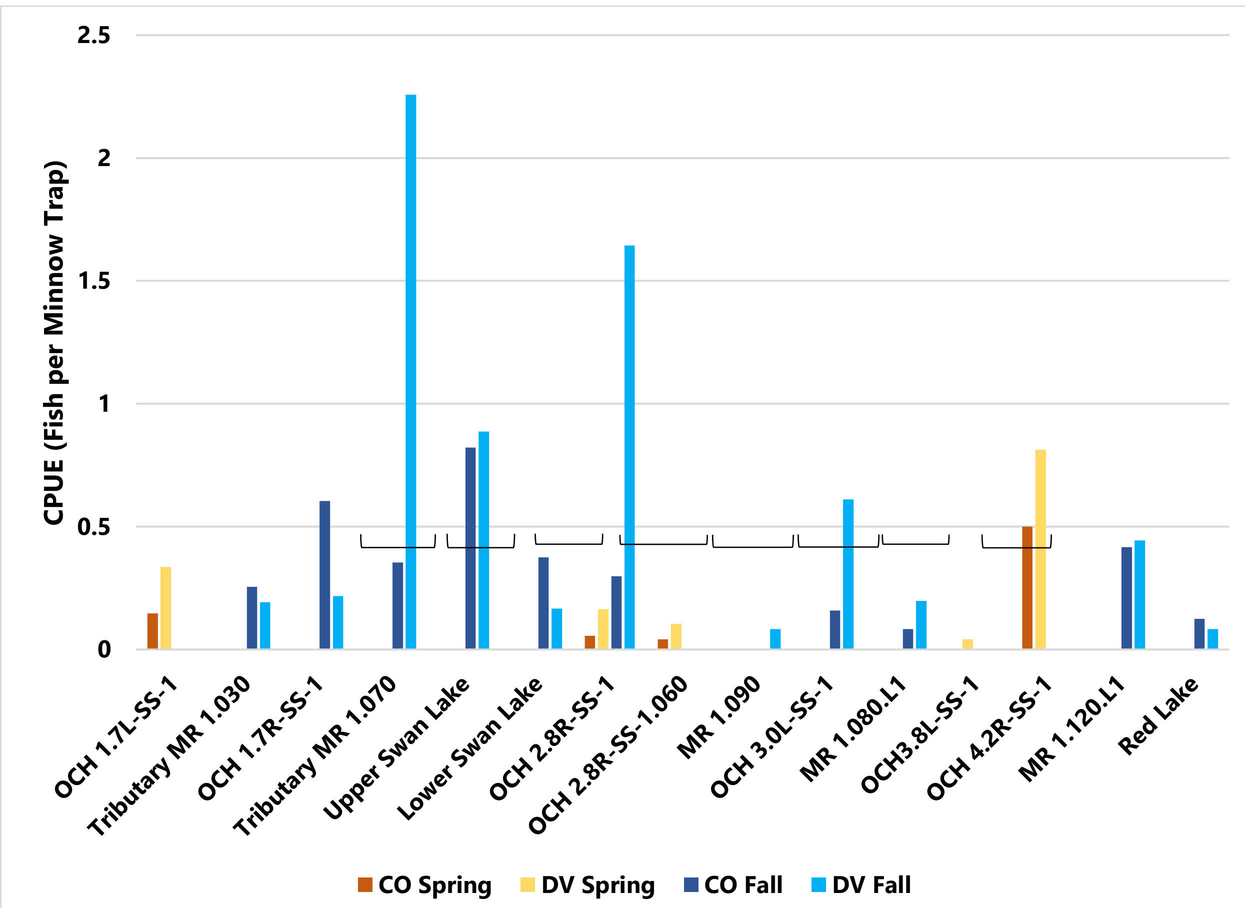

Figure 4-30 CPUE for minnow trapping efforts for Coho Salmon and Dolly Varden.

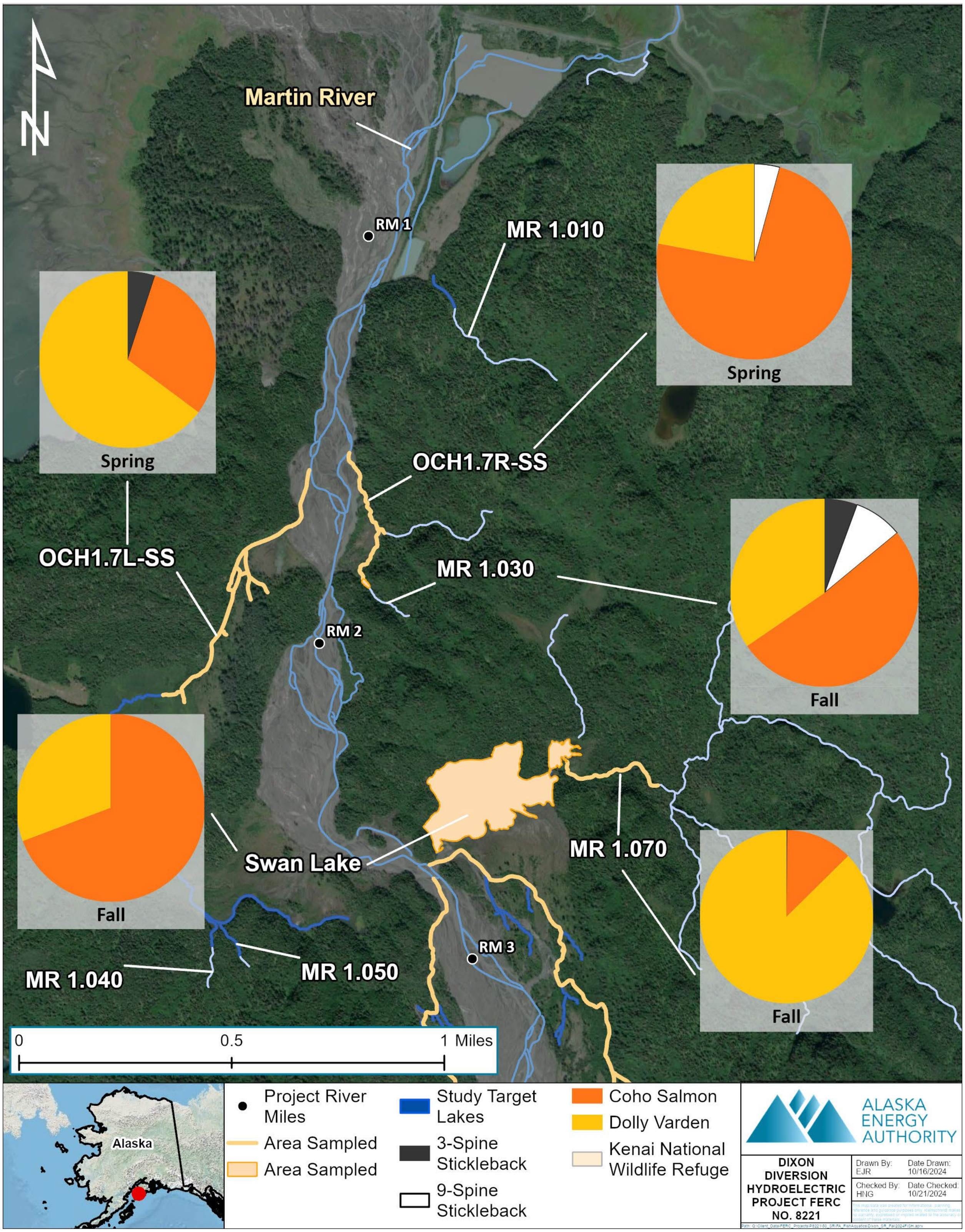

Figure 4-31 Species distribution and relative abundance by species at off-channel and tributary habitats of the Martin River downstream of RM 3.25 as documented during 2024 spring and fall sampling.

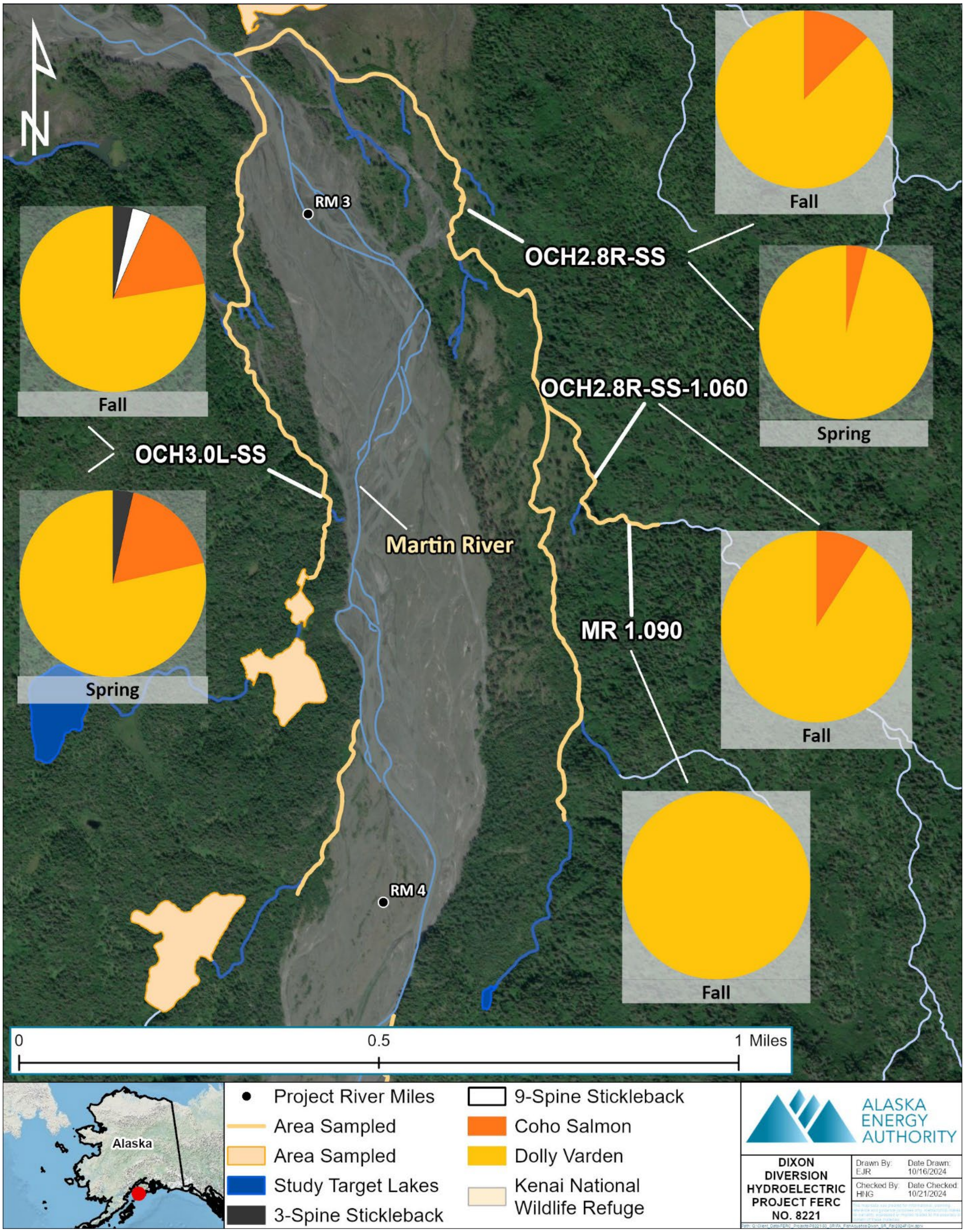

Figure 4-32 Fish species composition in two major Martin River off-channel complexes (OCH2.8R-SS-1 and OCH3.0L-SS-1) during 2024 spring and fall sampling.

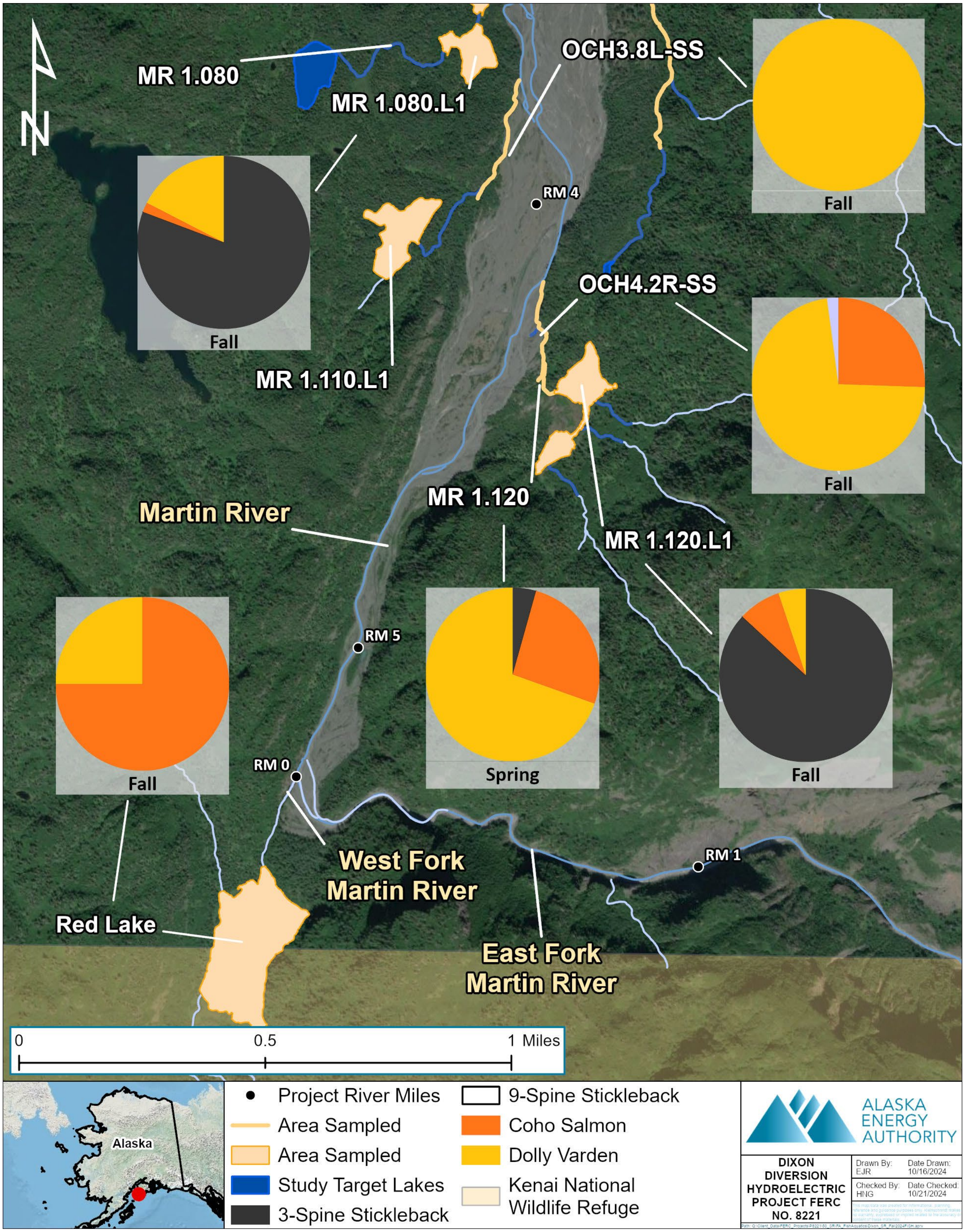

Figure 4-33 Fish species composition in Martin River off-channel complexes upstream of RM 3.25 during 2024 spring and fall sampling.

4.6.1.10 Summary of Size Distribution

The size distribution of juvenile salmonids across habitats in the Martin River is relevant to understanding how the extremely dynamic nature of the floodplain may affect seasonal fish use and potential isolation or dewatering of rearing habitats as geomorphic processes operate across the landscape. Differences in the size distribution between spring and fall sampling can also indicate movement of fish between accessible habitats as hydrologic conditions change.

Three off-channel side sloughs were sampled in both spring and fall of 2024. These include OCH1.7L-SS-1, OCH2.8R-SS-1, and OCH3.0L-SS-1 where both Coho Salmon juveniles and Dolly Varden were captured in sufficient quantities to plot seasonal size distribution.

Starting at the site downstream-most in the watershed, OCH1.7L-SS-1, a side slough about 2.0 miles long, is connected at the downstream end to the mainstem Martin River at about RM 1.7 and is fed by spring snow runoff from tributaries MR1.040, MR1.050, and MR1.060 and a small pond that appears to have groundwater influence. At the downstream end, egress into the mainstem is limited but not impossible at the lowest flow conditions observed in 2024. Coho Salmon juveniles in the spring (May 5) ranged from 60 to 100 mm and did not include any young-of-year individuals while fall samples (September 23) did include young-of-year fry as well as larger individuals, indicating both that Coho Salmon likely spawned successfully in OCH1.7L-SS-1, and that either emergence occurred after spring sampling in early May of 2024 or fish were too small for sampling equipment (Figure 4-8). Larger Dolly Varden juveniles (100-140 mm) and more individuals overall were documented in the spring at OCH1.7L-SS-1 than in the fall (all fish under 100 mm) indicating that larger individuals may have moved to other habitats between May and September.

OCH2.8R-SS-1 was a braided side slough about 2.4 km in length which was fed by a combination of glacial Martin River inflow at higher Martin River flows levels and clear water from Tributary MR1.090, OCH2.8R-SS-1.060, and headwater lakes. Under higher flow conditions, inflow from the Martin River enters OCH2.8R-SS-1 near RM 4.0. At the downstream end, OCH2.8R-SS-1 joins the mainstem at a backwatered lake complex known as Swan Lake, where egress into either the lakes or the Martin River mainstem was possible at all observed flows. Fish sampling occurred at this site in both spring (April 30) and fall (September 24) of 2024 and was mostly concentrated on the braided channel which was about 5 to 8 meters across and included swift water, a lot of large woody debris, and generally clear water. Coho Salmon size distribution did not change significantly between seasons although significantly more fish were captured in the fall than in the spring, likely due to longer minnow trap sets.

The last site where both spring and fall fish sampling occurred in 2024 was OCH3.0L-SS-1, a side slough about 1.5 km in length fed by the MR1.080 chain-lake complex. OCH3.0L-SS-1 enters the mainstem Martin River at ~RM 2.75 and is mostly a narrow (<2 m wide) shallow (<0.2 m deep) clearwater gravel stream with heavy vegetation and large quantities of large woody debris mostly comprised of alder and cottonwood. Multiple size classes of Coho Salmon juveniles were captured in both spring (May 10) and fall (September 27); individuals under 50 mm indicated that adult spawning may have occurred in the area, or young-of-year fish were transported into OCH3.0L-SS-1 during high water events. Fish of larger age classes were also present in both seasons.

The size distribution of Coho Salmon juveniles and Dolly Varden juveniles at sites with only fall sampling also documented the presence of multiple age classes which suggests either 1) there was multi-year survival within sampling sites; 2) there was transport or voluntary movement of age-classes among connected habitats; and/or 3) there was successful spawning in habitats where young-of-year were documented.

4.6.2 Run Timing of Sockeye and Coho Salmon

The escapement of Sockeye and Coho salmon spawners into Red Lake was monitored by ADF&G at the Red Lake outlet for the third year. Monitoring data from all years confirmed an early summer Sockeye Salmon run and a fall Coho Salmon run entering Red Lake (Figure 4-34 and Figure 4-35). Data from the study spawning surveys corroborate ADF&G's documentation of the presence of adult Sockeye and Coho Salmon spawners in September and October, though the study expanded the documented adult spawning to off-channel riverine habitats throughout the watershed (see Section 4.5.3).

The AVCT was operated by ADF&G May 28 through November 2, 2024 without any video interruptions (ADF&G *in progress*). As a result of the August 7 flood event, the underwater lights were lost and the turbidity of the lake and outlet increased. The lights were restored prior to the Coho Salmon run.

A total of 1,197 Sockeye Salmon were counted beginning on May 30, with a peak count of 253 adults on June 12, and the tail of the run occurring around July 6, 2024 (Figure

4-34). Approximately 46 percent of the Sockeye Salmon passed at night. A total of 182 Coho Salmon adults were counted from August 30 to October 20, with a peak count of 31 fish on October 6 (Figure 4-34). About 76 percent of the Coho Salmon passed at night. In addition, 88 Dolly Varden were counted at the AVCT site.

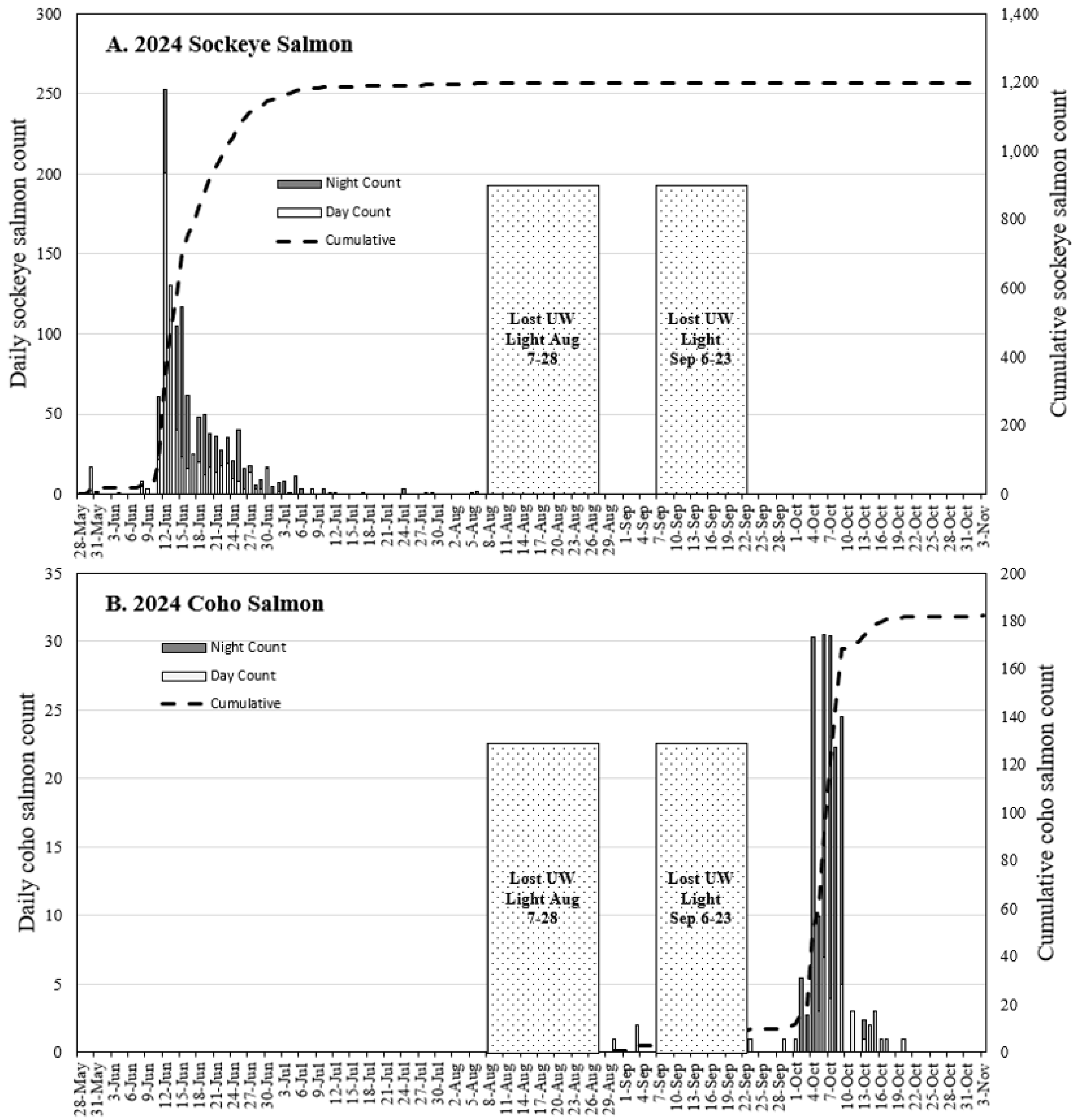

Figure 4-34 ADF&G adult Sockeye (A) and Coho (B) salmon video counts at the Red Lake outlet 2024 (ADF&G *in progress*).

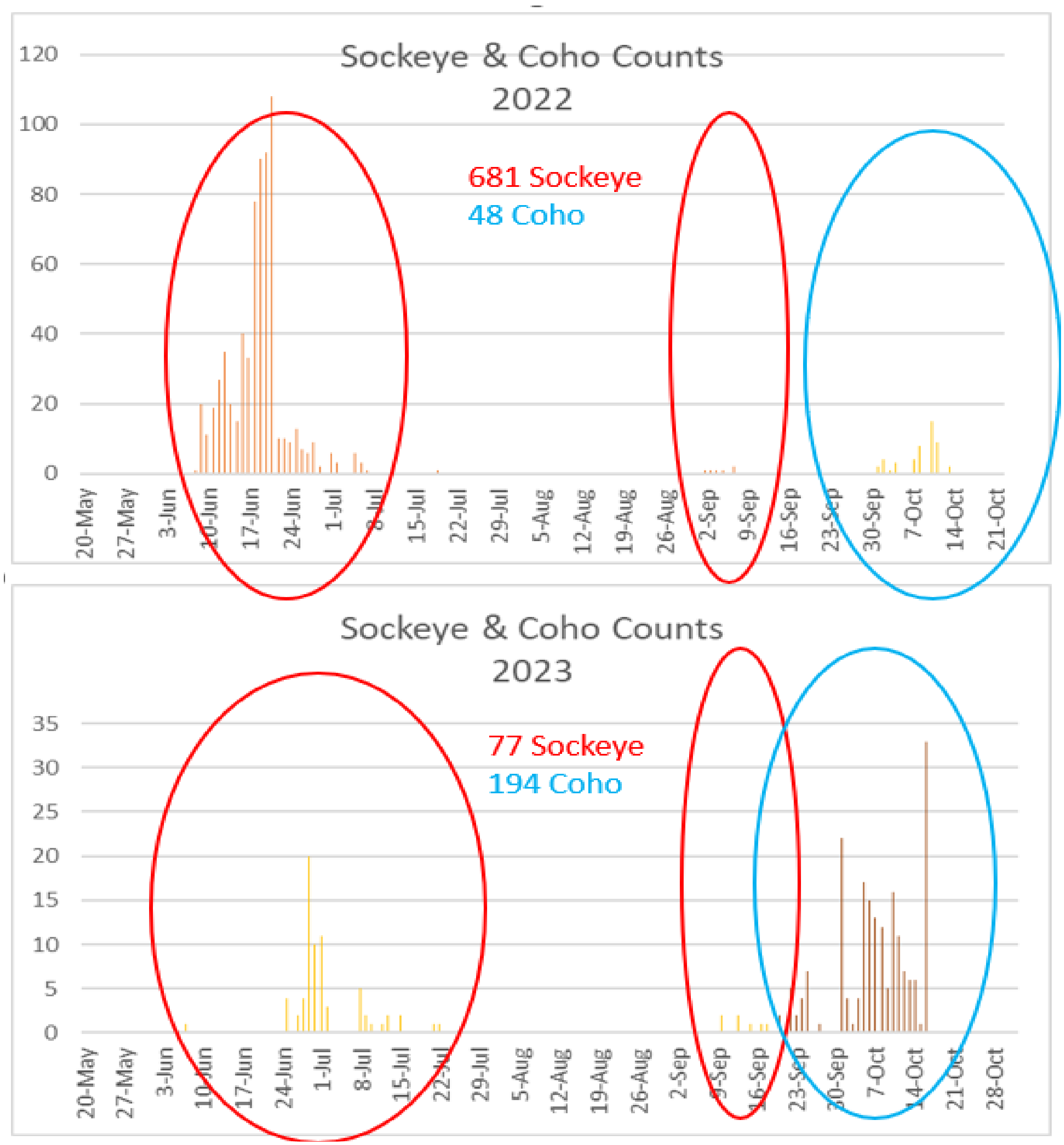

Figure 4-35 ADF&G adult Sockeye and Coho salmon video counts at the Red Lake outlet in 2022 and 2023 for periods when video results were available.

4.6.3 Fall 2024 Salmon Spawning Surveys

Spawning Sockeye Salmon were observed in OCHs beginning on September 24, 2024 when four post-spawned adults were documented in OCH2.8R-SS-1. On subsequent dates, additional Sockeye Salmon adults and carcasses were found throughout the upper portions of OCH2.8R-SS-1 and near the confluence with OCH2.8R-SS-1.060. Prior to the significant rain event on September 30, 2024 that dropped over 1 inch of rain on the watershed, no Coho Salmon were observed anywhere in the basin. After October 1, 2024, Coho Salmon were observed staging near the mouth of Tributary MR1.070, and in the lower portions of OCH2.8R-SS-1.

During three aerial surveys over the inlet to Red Lake, bright red fish were observed milling in the deeper areas of the stream beginning September 24, 2024. It was not possible to access this area by foot or land in the nearby Kenai National Wildlife Refuge Wilderness Area, so while the fish appeared to be Sockeye Salmon from the air, definitive identification was not made. On October 3, 2024, two Sockeye Salmon were documented along the Red Lake shoreline—one carcass and one fish still swimming. These fish were of similar size and coloration to those observed at the inlet to Red Lake from the helicopter.

The location of spawning adults observed throughout the sampling period is presented in Figure 4-36 and Figure 4-37 while the location of redds is presented in Figure 4-38 and Figure 4-39. Reference photographs of adult spawners are provided in Photo 4-6 through Photo 4-9, including adult Dolly Varden about 300 mm in length that were larger than any captured during sampling efforts (<150 mm) (Photo 4-10).

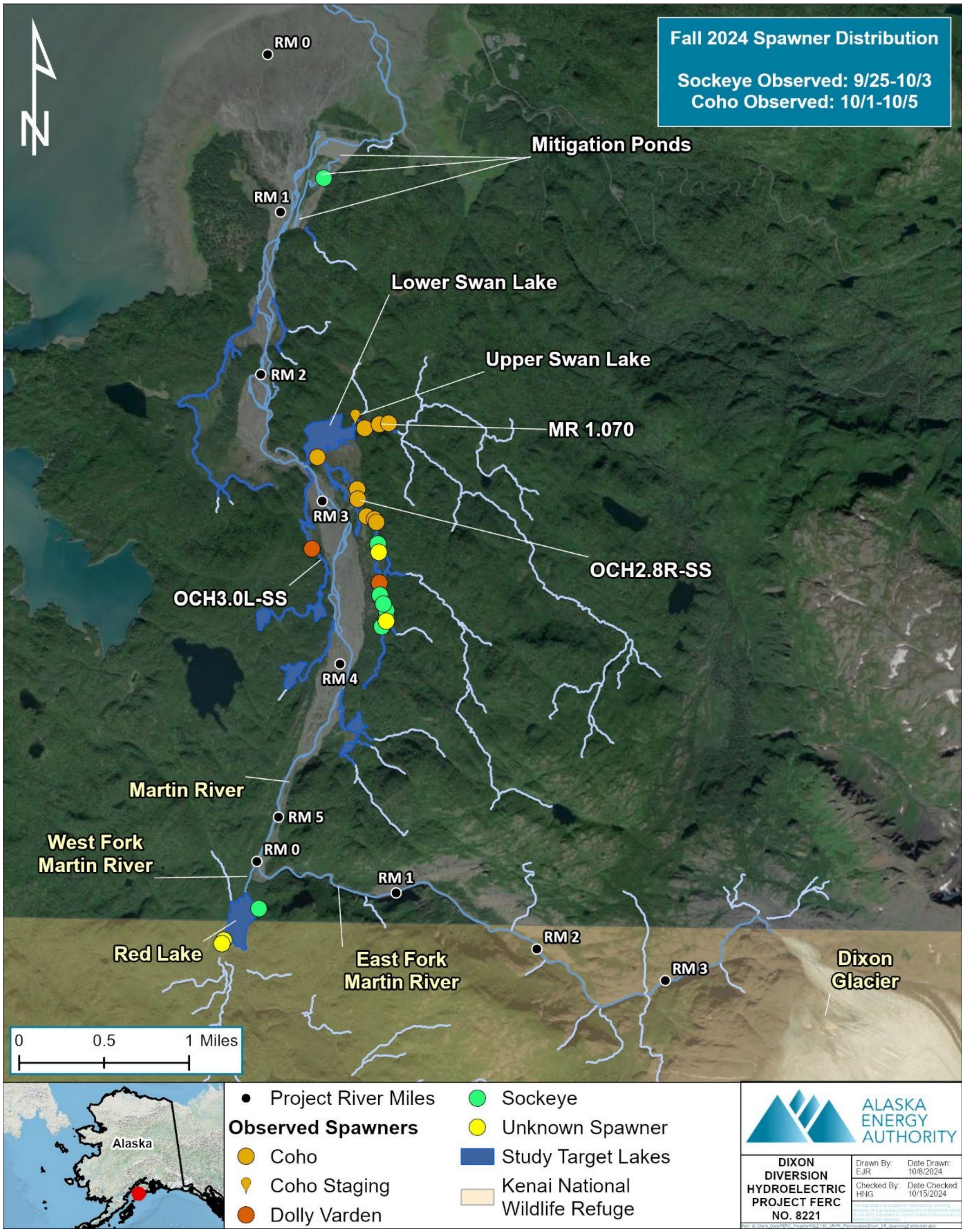

Figure 4-36 Location of observed spawning and staging behavior fall 2024.

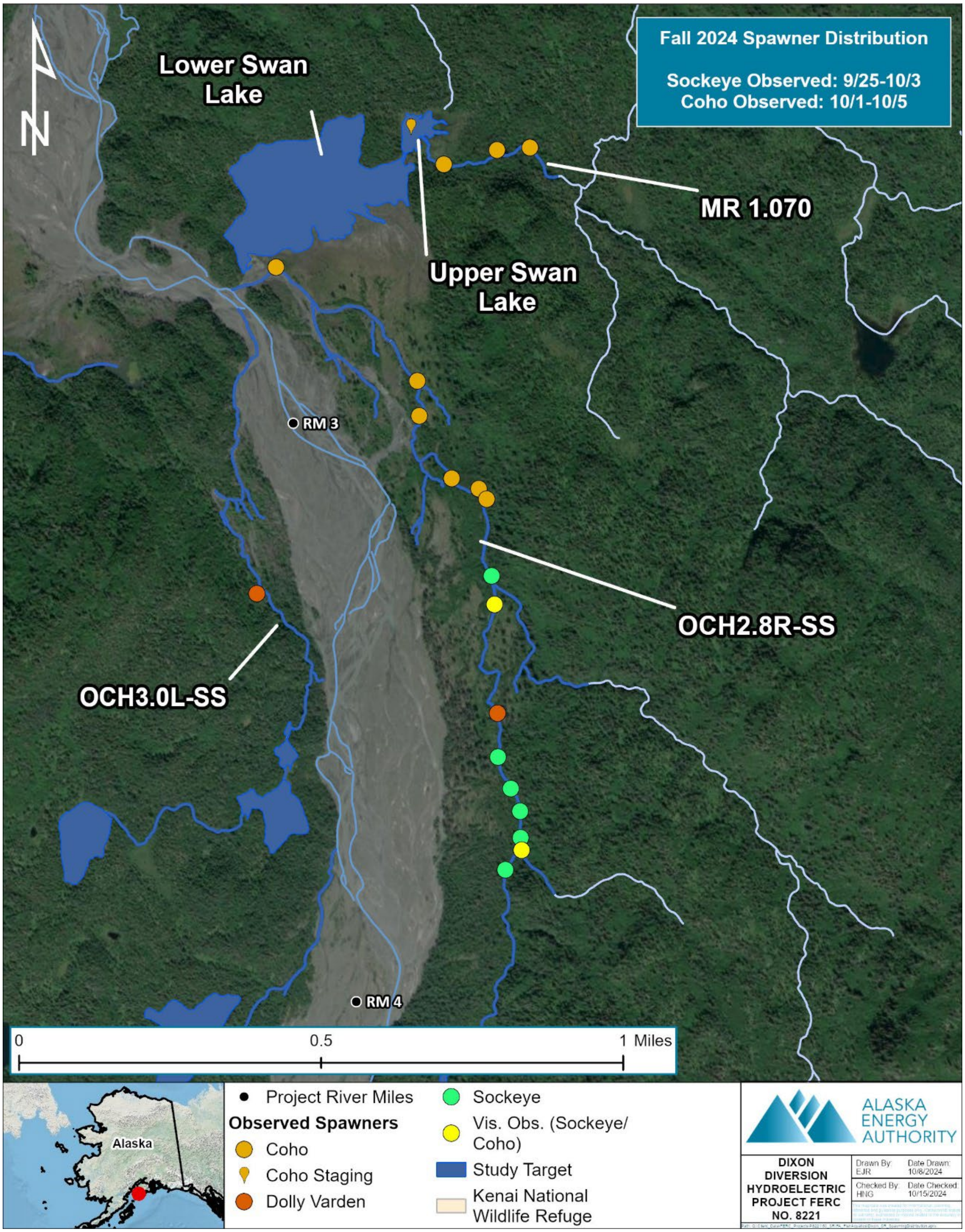

Figure 4-37 Sockeye and Coho salmon observed spawning at OCH and tributaries of the Martin River study area, fall 2024.

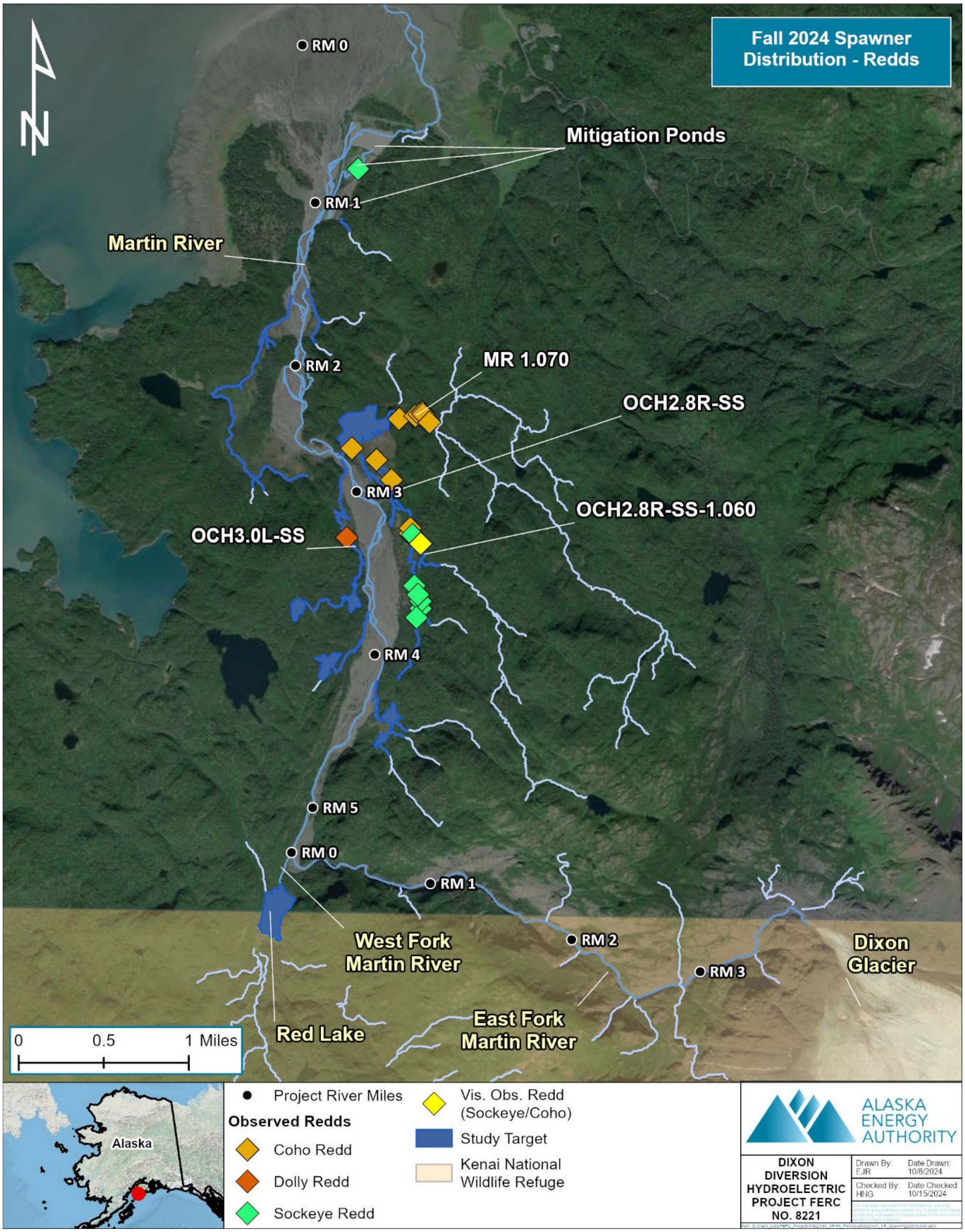

Figure 4-38 Locations of redds observed during fall 2024 spawning surveys.

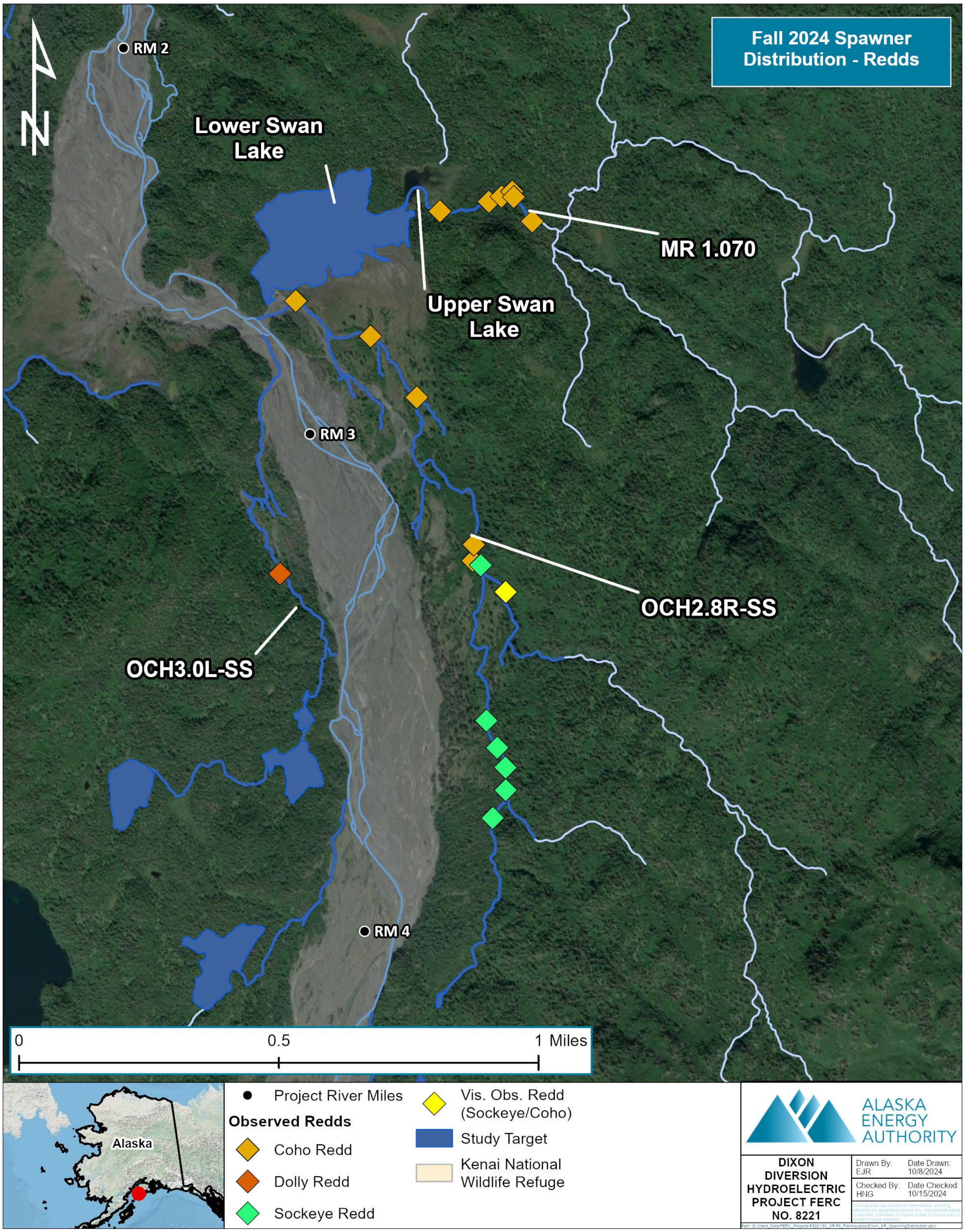

Figure 4-39 Observed salmon redds at OCH and tributaries of the Martin River study area near OCH2.8R and Tributary MR1.070.

Photo 4-6 WFMR (Red Lake) Sockeye Salmon September 30, 2024.

Photo 4-7 Sockeye Salmon female in OCH2.8R-SS-1 on September 24, 2024.

Photo 4-8 Coho Salmon adult female in OCH2.8R-SS-1 on October 1, 2024.

Photo 4-9 Coho Salmon adult male in Tributary MR1.070 on October 2, 2024.

Photo 4-10 Adult Dolly Varden male spawners in Tributary MR1.090 on October 2, 2024.

It was also noteworthy that adult spawners made use of all accessible OCH for spawning. Prior to the heavy rains on September 30, adult Coho Salmon were observed staging in the lake at the lower end of OCH2.8R-SS-1, and by October 1, had moved into OCH2.8R-SS-1 and MR1.070 and were observed digging and guarding redds in areas with quality spawning gravel and sufficient depth. Smaller-bodied Sockeye Salmon were documented further upstream in OCH2.8R-SS-1 than Coho Salmon and appeared in the system earlier. Sockeye Salmon spawning appears to have been complete prior to the arrival of the first Coho Salmon.

Sockeye Salmon were documented along shorelines of Red Lake and in the WFMR downstream of Red Lake, though in lower numbers than observed in OCH2.8R-SS-1 and MR1.070. It is possible that the 15-20 fish observed milling in the inlet to Red Lake were also Sockeye Salmon, though this could not be verified (Photo 4-11). Certainly, use of the watershed by both Sockeye and Coho salmon varies between lake and OCH, though no fish spawning or post-spawned carcasses were observed in the mainstem during fall 2024 sampling.

Photo 4-11 Aerial image from a helicopter of presumed Sockeye Salmon at the inlet to Red Lake on September 28, 2024.

4.6.4 Eulachon

From the upstream extent of tidewater influence, the gradient of three riffle habitats ranged from 3 to 4 percent in water that ranged from 0.2 to 0.3 m in depth.

4.7 Discussion

This study documented the distribution and relative abundance of fishes in clearwater habitats of the Martin River. Except Hawk Lake (MR1.110.L1), juvenile fish including Coho Salmon, Dolly Varden, and Sticklebacks were documented throughout the study area. Sticklebacks (Threespine and Ninespine) were abundant in warm, slow, pool and lake habitat with plenty of vegetative cover while Coho Salmon and Dolly Varden occupied riffle-glide-pool habitats with cooler temperatures, swifter flow, and instream habitat structures (e.g., large woody material).

Relative abundance based on fall minnow trapping data was highest for Dolly Varden in the MR1.030 tributary where multiple age classes were abundant. In OCH2.8R-SS-1 and OCH1.7R-SS-1, Dolly Varden of multiple age classes were also especially abundant relative to other sites. While Tributary MR1.030 appeared to become disconnected from downstream habitat at some flows, its upper reaches included a relict beaver pond with abundant refuge and foraging habitat able to support the high number of fish captured there. OCH2.8R-SS-1 and OCH1.7R-SS-1 appeared to have more accessible habitat and more access points to other habitats than the other clear-water habitats surveyed, indicating that fish rearing at these larger, more complex sites may be more successful than sites without as much refuge habitat, or protection from dewatering or isolation at low-flow conditions.

The fall 2024 sampling effort demonstrated the adaptability of juvenile Coho Salmon and Dolly Varden to access and exploit a wide range of aquatic habitat types throughout the watershed to support their life histories. Juveniles of both species were found in abundance in lakes, turbid off-channel, clear off-channel, coldwater tributaries, pocket water, isolated relict beaver ponds, and Red Lake. As noted above, the habitat in the entire watershed is highly dynamic and flow changes may result in periods of isolation or loss of access to habitats. Changes in the hydrograph associated with precipitation and/or snowmelt appeared to result in reconnection of isolated habitats in fall which enables fish to access appropriate overwintering habitat prior to freezing.

The abundance of Coho Salmon juveniles corresponded to habitat types where juvenile rearing would be expected—especially relict beaver ponds (i.e., Tributary MR1.030), accessible lakes such as MR1.070.L1, and MR1.070.L2, and pool habitat (Ebersole et al. 2006). Juveniles of multiple age classes were documented at these sites, and the highest recorded minnow trapping CPUE also occurred at these sites during the fall 2024. Coho Salmon juveniles were less abundant in shallow or isolated habitats such as OCH3.0L-SS-1 where access, egress, and deep pools for foraging were more limited than at larger and more complex off-channel sites. Interestingly, adult Coho Salmon spawning was only observed in the fall of 2024 in Tributary MR1.070 and OCH2.8R-SS-1, though juveniles were found throughout the watershed, even in habitats that appeared unsuitable for adult Coho Salmon spawning, or in lake habitats that lacked connectivity during 2024 surveys. Juvenile fishes moving across the floodplain to find suitable habitat is consistent with observations in other river systems including Coho Salmon juveniles using flood flows to find overwintering habitat (Giannico and Healey 1998), juveniles redistributing in response to habitat availability and connectivity (Anderson et al. 2008), and in response to water temperature variation (Armstrong and Schindler 2013).

Adult Coho Salmon and Sockeye Salmon were documented spawning in off-channel clearwater habitats in mid-September and October of 2024. Sockeye spawners, redds, and carcasses were observed in OCH2.8R-SS-1 and Tributary MR1.070 beginning on

September 25, 2024 following a slight rise in the hydrograph on September 19 (stage height of 6.42 feet at EFMR USGS Gage), followed by a continuous decline during which access points to this habitat became shallower or inaccessible associated with a USGS Gage height at EFMR of 5.0 feet. During this period, few new Sockeye Salmon spawners and no Coho Salmon spawners were observed in off-channel areas. A rain event on October 1, 2024 brought the EFMR back up to 6.5 feet and swelled OCH2.8R-SS-1 and other side sloughs and tributaries enough to allow spawners of both species that had been staging in pool habitat downstream to push into the off-channel areas and spawn beginning on October 2, 2024. Access to spawning habitat was linked to having adequate flows.

Although Sockeye Salmon spawners were observed both in off-channel clearwater habitats and Red Lake in 2024, no juvenile Sockeye Salmon were captured anywhere in 2024, possibly because out-migrants from river spawners left the system prior to spring fish sampling in May, and/or because sampling for juvenile Sockeye in Red Lake would require different methods than were employed to characterize fish community in off-channel riverine habitats. Sea-type Sockeye Salmon are a small subset of the species that can occur in glacial-fed streams including Alaska and generally outmigrate as subyearlings to rear in estuarine habitats (Gustafson and Winans 1999). If river spawning Sockeye Salmon in the Martin River are of this ecotype, it would explain why juveniles have not been observed in spring or fall samples to date.

4.8 References

Alaska Department of Fish and Game (ADF&G). 2022. Cook Inlet Personal Use Herring and Hooligan Fisheries permits and regulations. Accessed online, September 2022. https://www.adfg.alaska.gov/index.cfm?adfg=PersonalUsebyAreaSouthcentralHerringandHooligan.regs.

Alaska Energy Authority (AEA). 2022a. Initial Consultation Document, Proposed Dixon Diversion. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), April 27, 2022.

Alaska Energy Authority (AEA). 2022b. Draft Study Plan. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Proposed Dixon Diversion. November 2, 2022. Available online: https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2022.11.02%20Dixon%20Diversion%20Draft%20Study%20Plan.pdf.

Alaska Energy Authority (AEA). 2024. Joint Agency and Public Meeting Presentation. Dixon Diversion. March 5, 2024. Available online: https://www.akenergyauthority.org/Portals/0/Bradley%20Lake%20Hydroelectric%20Project/2024.03.05%20AEA%20Dixon%20Diversion%20JAM%20Presentation%20(Final).pdf.

Anderson, J.H., P.M. Kiffney, G.R. Pess, and T.P. Quinn. 2008. Summer distribution and growth of juvenile coho salmon during colonization of newly accessible habitat. *Transactions of the American Fisheries Society*, *137*(3), 772-781.

Armstrong, J.B. and D.E. Schindler. 2013. Going with the flow: spatial distributions of juvenile coho salmon track an annually shifting mosaic of water temperature. *Ecosystems*, *16*, 1429-1441.

Blackmon, T.J. and E.O. Otis. 2023. Red Lake remote video salmon escapement monitoring project, 2022. Alaska Department of Fish and Game, Fishery Data Series No. 23-25, Anchorage.

Blackmon, T.J. and E.O. Otis. 2024. Red Lake remote video salmon escapement monitoring project, 2023. Alaska Department of Fish and Game, Fishery Data Series No. 24-10, Anchorage.

Bryant, M.D. 2000. Estimating Fish Populations by Removal Methods with Minnow Traps in Southeast Alaska Streams. North American Journal of Fisheries Management 20:923-930.

Ebersole, J.L., P.J. Wigington, Jr., J.P. Baker, M.A. Cairns, M.R. Church, B.P. Hansen, and S.G. Leibowitz. 2006. Juvenile coho salmon growth and survival across stream network seasonal habitats. *Transactions of the American Fisheries Society*, *135*(6): 1681-1697.

Giannico, G.R. and M.C. Healey. 1998. Effects of flow and food on winter movements of juvenile coho salmon. *Transactions of the American Fisheries Society*, *127*(4), 645-651.

Gustafson, R.G. and G.A. Winans. 1999. Distribution and population genetic structure of river-and sea-type sockeye salmon in western North America. *Ecology of Freshwater Fish*, *8*(3), 181-193.

Hahn, P.K.J, R.E. Bailey, and A. Ritchie. 2007. Electrofishing: Beach Seining. In Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations. State of the Salmon. Portland, Oregon. pp.95-132.

Spangler, R.E. 2020. Spawning Migration Characteristics and Ecology of Eulachon (*Thaleichthys pacificus*). University of Alaska Fairbanks.

Temple, G.M. and T.N. Pearsons. 2007. Electrofishing: Backpack and Drift Boat. In Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations. State of the Salmon. Portland, Oregon. pp 95-132.

Watershed GeoDynamics. 2024. 2023 Geomorphology Observations. Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221), Proposed Dixon Diversion. Prepared by Watershed GeoDynamics for the Alaska Energy Authority. February 2024. Available online: https://www.akenergyauthority.org/Portals/0/BradleyLakeHydroelectricProject/2024.02.01DixonDiversionGeomorphologyObservationsReport.pdf.

APPENDIX A

MESOHABITAT SURVEYING FOR MARTIN RIVER CLEARWATER HABITATS

MR 1.010																					
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	9/23/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxPDep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCV RCde	ISCV RPer	RipVeg Cde	RipVeg CVR	LWDNo

OCH1.7R-SS-1

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	9/23/2024	RI	L	2	7.5	7.5		0.5		0.5	3.8		2.7		2.7		0.50		0.50	
2	9/23/2024	P	L	0	3.0	10.5		1.5		1.5	4.5		2.9		2.9		0.28		0.28	
3	9/23/2024	RI	L	1	8.5	19.0		0.6		0.6	4.7		0.1		0.1		3.00		3.00	

HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1					NAP	0	0	0	0	100	0	0	0	20	20	DJ	30	NSA	90	2
2			0.28	0.10	M	0	0	0	0	100	0	0	0	20	20	OV	40	NSA	20	1
3					NAP	0	0	0	0	100	0	0	0	20	20	DJ	20	NSA	40	3

OCH1.7R-SS-1.010

HabUnit No	Survey Date	Meso HabType	Flow Level	Grad Per	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	9/23/2024	P	L	0	7.2	7.2		3.3		3.3	23.8		5.3		5.3		0.30		0.30	
2	9/23/2024	P	L	0	16.5	23.7		4.3		4.3	71.0		9.0		9.0		0.35		0.35	

HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1			0.30	0.12	M	0	0	0	0	100	0	0	0	20	20	SL	10	NSA	20	2
2			0.35	0.17	M	0	0	0	0	100	0	0	0	20	20	NSA	60	OV	40	7

MR 1.020																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**Grad Per**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
	9/23/2024																			
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**

MR 1.030																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**Grad Per**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
	9/23/2024	P	L	0	99.0	99.0		13.5	13.5					3.8	3.8					
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
			3.00	0.10	BV	0	0	0	0	100	0	5	0	0	0	AV	80	NSA	80	3

OCH1.7L-SS-1

HabUnit No	Survey Date	MesoHab Type	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Bankful Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/3/2024	P	M	0	19.3	19.3	1.5	6.1	7.5	5.0	97.1					0.78	0.39	0.71	0.63	
2	5/3/2024	RI	M	1	4.7	24.0	2.9	3.8	2.5	3.1	14.4					0.41	0.30	0.20	0.30	
3	5/3/2024	P	M	0	9.1	33.1	2.4	2.4	2.9	2.6	23.4					1.00	0.93	0.49	0.81	
4	5/3/2024	G	M	0	345.0	378.1	6.1	8.9	13.4	9.5	3266.0					0.71	0.70	0.52	0.64	
5	5/3/2024	G	M	0	106.3	484.4														
6	5/3/2024	G	M	0	167.3	651.7	11.2	12.8	17.0	13.7	2286.4	13.4	13.2	21.2	15.9	1.00	1.20	1.00	1.07	
7	5/3/2024	P	M	0	42.6	694.3	4.8	4.0	5.2	4.7	198.8					0.56	0.52	1.04	0.71	
8	5/3/2024	RI	M	1	76.8	771.1	5.6	5.5	7.3	6.1	471.0					0.18	0.23	0.12	0.18	
9	5/3/2024	G	M	0	25.3	796.4	8.6	9.3	9.7	9.2	232.8					0.20	0.23	0.13	0.19	
10	5/3/2024	RI	M	3	46.5	842.9	7.4	8.3	3.1	6.3	290.6					0.16	0.17	0.20	0.18	
11	5/3/2024	G	M	0	35.3	878.2	4.5	4.5	4.6	4.5	160.4					0.32	0.34	0.36	0.34	
12	5/3/2024	RI	M	1	4.9	883.1	1.7	1.8	1.3	1.6	7.8					0.24	0.22	0.30	0.25	

	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFlPer	ORPer	UndctLB Per	UndrctRB Per	ErosnLB Per	Erosn RBPer	ISCVRCde	ISCVRPer	RipVegCde	RipVeg CVR	LWD No
1			0.78	0.18	O	0	0	0	15	0	85	0	0	0	15	SL	5	NSA	100	0
2					NAP	0	0	0	70	0	30	0	0	0	10	DJ	60	NSA	100	0
3			1	0.15	M	0	0	0	20	30	50	0	0	20	0	SL	70	NSA	100	0
4					NAP	0	0	5	5	0	90	0	0	5	5	OV	15	NSA	100	10
5					NAP	0	0	0	0	100	0	0	0	5	5	OV	15	NSA	100	10
6					NAP	0	0	0	0	100	0	0	0	0	0	DJ	20	NSA	100	16
7			1.04	0.64	BK	0	0	0	20	80	0	70	0	0	0	UB	10	NSA	50	0
8					NAP	0	0	10	80	10	0	0	0	0	0	IC	0	CFO	50	0
9					NAP	0	0	5	90	5	0	0	0	0	0	IC	0	CFO	50	0
10					NAP	0	0	90	10	0	0	0	0	0	0	IC	0	CFO	50	0
11					NAP	0	0	75	15	10	0	0	0	0	0	IC	0	CFO	50	0
12					NAP	0	0	5	90	5	0	0	0	0	0	IC	0	CFO	50	0

OCH1.7L-SS-1.010

HabUnit No	Survey Date	MesoHab Type	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Bankful Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	5/3/2024																			

	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFlPer	ORPer	UndctLB Per	UndrctRB Per	ErosnLB Per	Erosn RBPer	ISCVRCde	ISCVRPer	RipVegCde	RipVeg CVR	LWD No

OCH1.7L-SS-1.010.10																			
HabUnit No	Survey Date	MesoHab Type	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Bankful Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	5/3/2024																			
	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	UndctLB Per	UndrctRB Per	ErosnLB Per	Erosn RBPer	ISCVRC de	ISCVRP er	RipVegC de	RipVeg CVR	LWD No

OCH1.7L-SS-1.030																				
HabUnit No	Survey Date	MesoHab Type	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Bankful Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	5/3/2024																			
	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	UndctLB Per	UndrctRB Per	ErosnLB Per	Erosn RBPer	ISCVRC de	ISCVRP er	RipVegC de	RipVeg CVR	LWD No

OCH1.7L-SS-1.040																				
HabUnit No	Survey Date	MesoHab Type	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Bankful Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/3/2024	G	L	0	19.6	19.6	0.8	1.0	1.0	0.9	18.0					0.03	0.05	0.05	0.04	
	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	UndctLB Per	UndrctRB Per	ErosnLB Per	Erosn RBPer	ISCVRC de	ISCVRP er	RipVegC de	RipVeg CVR	LWD No
						0	0	0	0	0	100	0	0	20	0	SL	100	NSA	100	8

OCH1.7L-SS-1.050																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/3/2024	G	L		44.3	44.3	3.2	1.5	1.9	2.2	97.5					0.38	0.23	0.40	0.34	
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
						0	0	0	0	0	100	0	0	20	0	SL	90	NSA	100	0

MR 1.040																					
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	5/3/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

MR 1.050																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	5/3/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

MR 1.070

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/3/2024	G	H		31.2	31.2	7.4	6.3	7.0	6.9	215.3					0.47	0.41	0.43	0.44	
2	5/3/2024	P	H		12.0	43.2	9.0	6.6	2.0	5.9	70.4						0.40		0.40	
3	5/3/2024	RI	H		20.0	63.2	4.6	4.9	4.8	4.8	95.3					0.25	0.70	0.50	0.48	
4	5/3/2024	G	H		15.0	78.2	2.0	2.3	2.1	2.1	32.0					0.85	0.85	0.90	0.87	
5	5/3/2024	RI	H		55.6	133.8	3.0	4.0	4.0	3.7	203.9					0.30	0.75	0.70	0.58	
6	5/3/2024	P	H		11.0	144.8	4.8	6.2	5.5	5.5	60.5					0.60	0.80	0.65	0.68	
7	5/3/2024	RI	H		45.0	189.8	5.3	7.1	6.0	6.1	276.0					0.25	0.30	0.55	0.37	
8	5/3/2024	G	H		15.0	204.8	3.0	4.5		3.8	56.3					0.55	0.70	0.90	0.72	
9	5/3/2024	RI	H		20.0	224.8	5.0	4.0	6.0	5.0	100.0					0.25	0.60	0.25	0.37	
10	5/3/2024	G	H		10.0	234.8	2.5	2.5	2.5	2.5	25.0					0.30	0.60	0.70	0.53	
11	5/3/2024	P	H		12.0	246.8	3.2	5.7	4.0	4.3	51.6					0.40	0.35	0.70	0.48	
12	5/3/2024	RI	H		20.0	266.8	3.0	5.2	4.1	4.1	82.0					0.30	0.40	0.60	0.43	
13	5/3/2024	P	H		7.0	273.8	5.3	5.4	4.0	4.9	34.3	0.8	1.8	1.3	1.3	0.30	0.60	0.50	0.47	
14	5/3/2024	RI	H		38.0	311.8	4.0	5.2	5.3	4.8	183.7	0.7	1.3	1.3	1.1	0.20	0.30	0.20	0.23	
15	5/3/2024	P	H		8.6	320.4	4.7	5.0	7.0	5.6	47.9	0.7	1.0		0.9	0.37	0.60		0.49	
16	5/3/2024	RI	H		27.6	348.0	6.0	6.9	6.3	6.4	176.6	0.8	0.8	0.8	0.8	0.28	0.40	0.25	0.31	
17	5/3/2024	P	H		14.0	362.0	6.0	5.3	4.8	5.4	75.1	1.6	1.9	1.3	1.6	0.35	0.50	0.40	0.42	
18	5/3/2024	RI	H		45.0	407.0	4.0	4.0	5.1	4.4	196.5	0.6	0.8	0.7	0.7	0.30	0.30	0.25	0.28	
19	5/3/2024	G	H		23.0	430.0	4.8	4.0	5.0	4.6	105.8	0.7	0.9	0.8	0.8	0.35	0.60	0.35	0.43	
20	5/3/2024	RI	H		30.0	460.0	4.0	4.0	5.0	4.3	130.0	0.7	0.9	0.8	0.8	0.35	0.35	0.22	0.31	
21	5/3/2024	P	H		15.0	475.0	4.2	3.2	3.2	3.5	53.0	0.9	1.0	1.0	1.0	0.40	0.53	0.40	0.44	
22	5/3/2024	RI	H		15.0	490.0	4.6	4.7	4.8	4.7	70.5	0.7	0.7	0.8	0.7	0.30	0.30	0.35	0.32	
23	5/3/2024	P	H		7.0	497.0	4.5	4.0	4.8	4.4	31.0	0.4	0.9	0.9	0.7	0.35	0.50	0.40	0.42	
24	5/3/2024	RI	H		20.0	517.0	4.2	5.0	4.0	4.4	88.0	0.7	0.8	0.8	0.8	0.25	0.35	0.50	0.37	

MR 1.070 (continued)																				
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1					NAP	0	0	0	30	50	20	50	50	0	0	OV	80	NSA	90	0
2			0.80	0.22	LW	0	0	0	60	40	0	0	0	0	0	DJ	20	NSA	100	3
3					NAP	0	0	0	60	40	0	0	0	0	0	UB	10	NSA	100	4
4					NAP	0	0	0	80	20	0	0	0	0	0	OV	50	CFO	100	0
5					NAP	0	0	0	80	20	0	0	0	0	0	OV	50	CFO	100	6
6			0.60	0.30	LW	0	0	0	70	30	0	30	0	0	0	OV	100	CFO	100	1
7					NAP	0	0	0	90	10	0	0	0	0	0	OV	100	CFO	100	5
8					NAP	0	0	0	85	15	0	0	0	0	0	OV	40	NSA	100	4
9					NAP	0	0	0	85	15	0	0	0	0	0	OV	60	NSA	100	2
10					NAP	0	0	5	85	10	0	0	0	0	0	OV	10	NSA	100	0
11			0.68	0.33	M	0	0	10	80	10	0	0	0	0	0	OV	20	NSA	100	6
12					NAP	0	0	0	80	20	0	0	0	0	0	DJ	5	NSA	100	3
13			0.55	0.35	LW	0	0	0	80	20	0	0	0	0	0	DJ	10	NSA	100	4
14					NAP	0	0	5	75	20	0	10	10	0	0	DV	15	NSA	100	0
15			0.70	0.28	M	0	0	0	80	20	0	20	40	0	0	RJ	30	BFO	100	6
16					NAP	0	0	0	95	5	0	0	0	0	0	OV	30	BFO	100	9
17			0.85	0.30	LW	0	0	0	20	80	0	0	0	0	0	DJ	20	CFO	100	6
18					NAP	0	0	0	25	75	0	50	30	0	0	DJ	35	BFO	100	9
19					NAP	0	0	0	90	10	0	0	25	0	0	DJ	20	CFO	100	7
20					NAP	0	0	5	85	10	0	0	100	0	0	DJ	30	CFO	100	3
21			0.95	0.32	BK	0	0	5	25	70	0	0	75	0	0	UB	50	CFO	100	0
22					NAP	0	0	30	40	30	0	60	30	0	0	UB	30	CFO	100	0
23			0.58	0.25	LW	0	0	20	60	20	0	50	0	0	0	UB	30	CFO	100	5
24					NAP	0	0	20	50	30	0	100	0	0	0	DJ	15	CFO	100	6

OCH2.8R-SS-1

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024	RI	H	0	42.7		3.6	2.5	3.6	3.2	138.1					0.25	0.30	0.30	0.28	
2	5/1/2024	P	H	0	5.4	48.10	3.5	2.9	1.7	2.7	14.6					0.35	0.57	0.50	0.47	
3	5/1/2024	G	H	0	43.4	91.50	6	4.5	4.5	5.0	217.0					0.32	0.38	0.30	0.33	
4	5/1/2024	RI	H		10	101.50	4	4.7	4.4	4.4	43.7					0.26	0.15	0.18	0.20	
5	5/1/2024	G	H	1	70	171.50	12.6	12.5	11.9	12.3	863.3					0.26	0.26	0.21	0.24	
6	5/1/2024	RI	H	1	39.3	210.80	4.3	5.3	5.3	5.0	195.2					0.12	0.20	0.21	0.18	
7	5/1/2024	G	H	1	29.6	240.40	6.6	9	6.2	7.3	215.1					0.16	0.20	0.26	0.21	
8	5/1/2024	RI	H		11.6	252.00	6.4	4.6	5.4	5.5	63.4					0.20	0.24	0.21	0.22	
9	5/1/2024	P	H	0	31.3	283.30	6.3	5.7	10.2	7.4	231.6					0.48	0.47	0.37	0.44	
10	5/1/2024	G	H		31.2	314.50	12.8	10.1	13.2	12.0	375.4					0.40	0.50	0.48	0.46	
11	5/1/2024	P	H		41.8	356.30	10.1	6	5.1	7.1	295.4					0.32	0.60	0.44	0.45	
12	5/1/2024	RI	H		6.5	362.80	5.1	3.7	3.3	4.0	26.2					0.20	0.20	0.20	0.20	
13	5/1/2024	G	H		109.7	472.50	6.7	7.6	7.1	7.1	782.5					0.32	0.42	0.40	0.38	
14	5/1/2024	P	H		10.1	482.60	4.7	4.8	4.8	4.8	48.1					0.52	0.81	0.46	0.60	
15	5/1/2024	G	H		13.1	495.70	5	4.5	4.6	4.7	61.6					0.25	0.43	0.44	0.37	
16	5/1/2024	RI	H		6.8	502.50	4.8	5.1	4.5	4.8	32.6					0.43	0.22	0.26	0.30	
17	5/1/2024	P	H	0	11.8	514.30	3.8	3.9	6.8	4.8	57.0					0.70	0.59	0.43	0.57	
18	5/1/2024	RI	H		7.2	521.50	4.5	5.5	4.4	4.8	34.6					0.26	0.25	0.28	0.26	
19	5/1/2024	P	H	0	10.5	532.00	4.2	4	4.5	4.2	44.5					0.72	0.73	0.51	0.65	
20	5/1/2024	RI	H		5.3	537.30	3.2	3	4.5	3.6	18.9	6.9	5.1	7.0	6.3	0.30	0.29	0.35	0.31	
21	5/1/2024	G	H		7.3	544.60	4.8	4.7	4.5	4.7	34.1	6.5	5.4	7.0	6.3	0.50	0.40	0.45	0.45	
22	5/1/2024	RI	H	5	5.5	550.10	5.9	5.6	4.6	5.4	29.5	7.2	6.1	5.2	6.2	0.28	0.23	0.23	0.25	
23	5/1/2024	G	H		200	750.10	5.8	5	3.3	4.7	940.0	7.1	7.4	4.6	6.4	0.35	0.43	0.47	0.42	
24	5/1/2024	RI	H		4.6	754.70	4.1	3.7	4.44	4.1	18.8	5.4	4.2	4.6	4.7	0.34	0.36	0.40	0.37	
25	5/1/2024	P	H		17.4	772.10	4.8	4.6	3	4.1	71.9	4.4	5.3	5.1	4.9	0.52	0.32	0.56	0.47	
26	5/1/2024	RI	H		12.7	784.80	5.4	4.6	3.8	4.6	58.4	5.9	6.5	5.8	6.1	0.28	0.19	0.28	0.25	
27	5/1/2024	P	H	0	9	793.80	4.6	3.6	3.2	3.8	34.2	3.5	5.3	5.3	4.7	0.48	0.95	0.78	0.74	
28	5/1/2024	Step Pool	H		18.6	812.40	3	3.7	3.1	3.3	60.8	7.4	8.3	11.4	9.0	0.58	0.56	0.49	0.54	0.93
29	5/2/2024	RI	H		21.6	834.00	4.5	5.1	4.4	4.7	100.8	1.3	12.8	6.1	6.7	0.38	0.25	0.26	0.30	
30	5/2/2024	P	H	0	4.9	838.90	3.2	4.2	4.5	4.0	19.4	9.6	12.8	12.4	11.6	0.50	0.47	0.38	0.45	0.76
31	5/2/2024	G	H		54.5	893.40	5.6	3.7	5.9	5.1	276.1	7.9	8.1	8.6	8.2	0.40	0.30	0.24	0.31	
32	5/2/2024	RI	H	1	96	989.40	4.9	3.9	3.85	4.2	404.8	10.0	10.4	7.1	9.2	0.29	0.20	0.31	0.27	
33	5/2/2024	G	M		16.4	1,005.80	4.44	4.5	4.5	4.5	73.5	7.6	13.2		10.4	0.23	0.46	0.49	0.39	0.78
34	5/2/2024	RI	H	3	12.2	1,018.00	3.54	4.3	4.6	4.1	50.6	6.5	6.4	7.3	6.7	0.26	0.25	0.23	0.25	
35	5/2/2024	G	M		3.82	1,021.82	5.9	5.3	4.7	5.3	20.2	4.6	13.2	19.8	12.5	0.12	0.35	0.29	0.25	
36	5/2/2024	RI	M		20.9	1,042.72	4.65	4.71		4.7	97.8	14.3	11.2	12.3	12.6	0.23	0.19		0.21	0.92
37	5/2/2024	P	M	0	9.1	1,051.82	5.3	5.2	5.7	5.4	49.1	8.8	12.3	15.7	12.3	0.45	0.54	0.55	0.51	
38	5/2/2024	RI	M		62.9	1,114.72	3.2	5.4	2.9	3.8	241.1	13.6	14.2	14.8	14.2	0.44		0.32	0.38	1.03
39	5/2/2024	G	M		25.6	1,140.32	5.7	4.9	4.7	5.1	130.6	12.6	10.2	15.4	12.7	0.27	0.52	0.50	0.43	
40	5/2/2024	RI	H	1	20.4	1,160.72	5.4	3.5	4.7	4.5	92.5	7.5	7.7	6.3	7.2	0.22	0.34	0.21	0.26	0.47
41	5/2/2024	G	M		34.2	1,194.92	7.1	6.3	6.3	6.6	224.6	7.4	9.0	8.5	8.3	0.21	0.38	0.38	0.32	

OCH2.8R-SS-1 (continued)																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
42	5/2/2024	RI	H	0.5	78.1	1,273.02	7.1	7.0	6.4	6.8	533.7	7.0	6.1	6.5	6.5	0.30	0.28	0.26	0.28	
43	5/9/2024	P	M	0	27.2	1,300.22	5.6	6.5	5.6	5.9	160.3	5.7	5.9	7.3	6.3	0.64	1.06	0.55	0.75	
44	5/9/2024	G	M		11.2	1,311.42	5.5	4.8	4.6	5.0	55.6	6.1	5.2	3.2	4.8	0.26	0.32	0.39	0.32	1.25
45	5/9/2024	RI	M		50.2	1,361.62	4.5	4.5	4.5	4.5	226.2	15.2	15.2	8.0	12.8	0.39	0.32	0.40	0.37	
46	5/9/2024	G	M		13.4	1,375.02	4.6	4.7	5.5	4.9	66.1	10.9	7.8	8.9	9.2	0.28	0.31	0.39	0.33	0.78
47	5/9/2024	P	L		10	1,385.02	4.3	5.4	4.2	4.6	46.3	10.1	10.7	7.1	9.3	0.45	0.45	0.56	0.49	
48	5/9/2024	RI	H	1	30.3	1,415.32	4.4	4.4	4.4	4.4	133.3	10.1	8.4	8.2	8.9	0.24	0.30	0.34	0.29	
49	5/9/2024	G	M		11.3	1,426.62	6.6	6.2	6.1	6.3	71.2	7.5	8.0	8.2	7.9	0.25	0.30	0.28	0.28	0.86
50	5/9/2024	RI	H	1	9	1,435.62	6.9	6.4	7.0	6.8	60.9	9.5	9.4	7.4	8.8	0.06	0.11	0.12	0.10	
51	5/9/2024	G	L		59.2	1,494.82	5.9	6.2	5.1	5.7	339.4	7.7	7.4	8.0	7.7	0.33	0.37	0.29	0.33	
52	5/9/2024	RI	H	1	24.5	1,519.32	4.1	5.6	5.9	5.2	127.4	9.0	9.5	11.2	9.9	0.29	0.18	0.10	0.19	
53	5/9/2024	G	L		11	1,530.32	8.0	8.8	9.8	8.9	97.5	8.3	9.2	10.1	9.2	0.52	0.53	0.48	0.51	
54	5/9/2024	P	L	0	11.6	1,541.92	5.9	5.2	5.2	5.4	63.0	6.8	10.2	10.2	9.1	0.84	1.14	1.09	1.02	1.38
55	5/9/2024	RI	H	1	29.3	1,571.22	4.2	4.0	4.4	4.2	123.1	13.2	15.5	9.3	12.7	0.28	0.20	0.27	0.25	
56	5/9/2024	G	M		15.2	1,586.42	5.9	6.3	6.8	6.3	96.3	5.5	5.6	5.6	5.6	0.26	0.44	0.67	0.46	0.22
57	5/11/2024	P	L	0	9.6	1,596.02	5.3	4.6	3.9	4.6	44.2	7.1	7.4	7.0	7.2	0.59	0.72	0.61	0.64	
58	5/11/2024	RI	H	1	10.3	1,606.32	7.5	8.7	9.5	8.6	88.2	8.5	10.2	12.6	10.4	0.12	0.13	0.15	0.13	
59	5/11/2024	P	L	0	9.2	1,615.52	1.7	4.8	4.8	3.8	34.7	10.2	11.6	3.9	8.6	1.03	1.80	1.30	1.38	1.16
60	5/11/2024	RI	H	0.5	24.1	1,639.62	2.8	3.2	3.8	3.3	78.9	5.9	6.8	5.6	6.1	0.28	0.26	0.27	0.27	
61	5/11/2024	P	L	0	22.2	1,661.82	3.7	2.3	5.3	3.8	83.6	11.3	9.8	12.6	11.2	0.50	0.70	0.84	0.68	
62	5/11/2024	RI	H	2	6.1	1,667.92	6.1	8.2	10.9	8.4	51.2	6.7	6.5	6.5	6.6	0.21	0.32	0.18	0.24	1.45
63	5/11/2024	G	M		46.2	1,714.12	5.3	6.5	5.6	5.8	268.0	3.2	3.4	4.5	3.7	0.38	0.42	0.28	0.36	
64	5/11/2024	RI	H	1	34.6	1,748.72	4.2	4.4	4.3	4.3	148.8	5.6	5.0	5.0	5.2	0.38	0.22	0.22	0.27	1.27
65	5/11/2024	P	L	0	10.3	1,759.02	5.6	5.1	3.9	4.9	50.1	8.0	6.3	5.3	6.5	0.53	0.57	0.51	0.54	
66	5/11/2024	RI	H	1	9	1,768.02	1.9	2.8	3.4	2.7	24.3	4.7	5.1	5.2	5.0	0.10	0.23	0.30	0.21	1.25
67	5/11/2024	P	L	0	6.9	1,774.92	2.9	2.8	3.2	3.0	20.4	8.0	8.2	6.4	7.5	0.42	0.72	0.64	0.59	
68	5/11/2024	G	M		8.1	1,783.02	4.6	3.4	2.6	3.5	28.6	8.3	9.5	10.3	9.4	0.51	0.72	0.44	0.56	1.52
69	5/11/2024	C	H	3	6.1	1,789.12	3.8	3.5	3.4	3.6	21.8	17.0	18.5	17.6	17.7	0.32	0.43	0.57	0.44	
70	5/11/2024	RI	H	2	14.2	1,803.32	3.2	4.8	7.5	5.2	73.4	17.0	17.5	16.5	17.0	0.15	0.12	0.14	0.14	0.80
71	5/11/2024	G	M		106	1,909.32	9.8	6.8	10.1	8.9	943.4	17.0	17.5	15.0	16.5	0.70	0.70	0.40	0.60	
72	5/11/2024	RI	H	1	12.5	1,921.82	4.7	3.2	3.1	3.7	45.8	8.0	7.0	8.5	7.8	0.15	0.19	0.18	0.17	
73	5/11/2024	G	L		9.2	1,931.02	3.3	3.2	3.5	3.3	30.7	6.0	8.7	11.2	8.6	0.32	0.42	0.43	0.39	
74	5/11/2024	RI	H	1	13	1,944.02	2.1	3.0	3.7	2.9	38.1	7.0	10.6	9.5	9.0	0.14	0.18	0.13	0.15	1.64
75	5/11/2024	G	M		24.7	1,968.72	6.6	4.8	5.6	5.7	140.0	5.0	4.9	4.5	4.8	0.21	0.25	0.26	0.24	
76	5/11/2024	RI	M	0.5	11.8	1,980.52	4.8	5.7	7.2	5.9	69.6	7.0	7.3	7.9	7.4	0.18	0.31	0.50	0.33	1.40
77	5/11/2024	G	L		69.4	2,049.92	5.4	6.6	4.8	5.6	388.6	8.1	9.8	8.3	8.7	0.39	0.40	0.32	0.37	
78	5/11/2024	P	L	0	7.7	2,057.62	4.5	4.4	3.3	4.1	31.3	8.8	6.0	8.4	7.7	0.40	0.82	0.83	0.68	1.09
79	5/11/2024	RI	H	1	2.8	2,060.42	2.9	3.4	3.7	3.3	9.3	9.8	10.1	11.2	10.4	0.14	0.12	0.17	0.14	
80	5/11/2024	G	M		17.9	2,078.32	4.7	5.1	4.7	4.8	86.5	7.7	6.6	8.0	7.4	0.24	0.36	0.23	0.28	1.29
81	5/11/2024	RI	H	1	52	2,130.32	4.6	7.4	6.3	6.1	317.2	6.2	6.0	7.8	6.7	0.22	0.17	0.07	0.15	
82	5/11/2024	P	L	0	16.2	2,146.52	4.6	5.5	5.0	5.0	81.5		3.3		3.3	0.70	0.86	1.14	0.90	

OCH2.8R-SS-1 (continued)

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
83	5/11/2024	RI	M	0.5	4.2	2,150.72	3.2	3.3	3.5	3.3	14.0		3.3		3.3	0.23	0.18	0.20	0.20	1.22
84	5/11/2024	G	M	0	27.6	2,178.32	4.5	4.0	5.0	4.5	124.2		2.5		2.5	0.23	0.41	0.32	0.32	
85	9/24/2024	RI	M	4	2	2,180.32		3.0		3.0	6.0		6.2		6.2		0.30		0.30	1.36
86	9/24/2024	G	M		3	2,183.32		3.0		3.0	9.0		6.0		6.0		0.30		0.30	
87	9/24/2024	RI	M	6	12.5	2,195.82		2.0		2.0	25.0		7.0		7.0		0.20		0.20	1.12
88	9/24/2024	C	M	11	8	2,203.82		6.0		6.0	48.0						0.10		0.10	
89	9/24/2024	RI	M	3	10	2,213.82		5.0		5.0	50.0		5.5		5.5		0.20		0.20	
90	9/24/2024	G	M	1	25	2,238.82		3.0		3.0	75.0		11.1		11.1		0.20		0.20	
91	9/24/2024	P	M	0									4.0		4.0					
92	9/24/2024	G	M	3	10.2	2,249.02		4.5		4.5	45.9						0.30		0.30	
93	9/24/2024	RI	M	3	4.8	2,253.82		2.5		2.5	12.0		4.0		4.0		0.20		0.20	
94	9/24/2024	G	M	2	7.5	2,261.32		7.1		7.1	53.3						0.10		0.10	
95	9/24/2024	RI	M	1	10	2,271.32														
96	9/24/2024	G	M	1	18	2,289.32		3.0		3.0	54.0						0.10		0.10	

OCH2.8R-SS-1 (continued)																				
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFlPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1						0	0	0	90	10	0	0	0	90	0	HL	15	NSA	40	0
2			0.58	0.28	M	0	0	0	80	20	0	0	0	0	0	HL	20	NSA	30	0
3						0	0	5	5	90	0	0	0	0	0	OV	15	NSA	30	0
4						0	0	0	80	20	0	0	0	100	0	OV	30	NSA	100	0
5						0	0	0	85	15	0	0	0	5	0	IC	0	NSA	95	0
6						0	0	0	85	15	0	0	0	5	5	OV	5	NSA	100	0
7						0	0	0	85	15	0	0	0	0	0	OV	10	NSA	100	0
8						0	0	0	90	10	0	0	0	0	0	OV	50	NSA	100	0
9			0.54	0.20	M	0	0	0	85	15	0	0	0	0	0	OV	30	NSA	100	0
10						0	0	0	80	20	0	0	0	0	0	OV	30	NSA	100	0
11			0.68	0.25	M	0	0	0	70	30	0	0	0	0	0	OV	50	NSA	100	0
12						0	0	0	90	10	0	0	0	0	0	OV	15	NSA	100	0
13						0	0	0	30	70	0	0	0	0	0	OV	20	NSA	100	0
14			0.90	0.34	M	0	0	0	5	95	0	0	0	0	0	DJ	20	NSA	100	5
15						0	0	0	80	20	0	0	0	0	0	DJ	10	NSA	100	1
16						0	0	0	85	15	0	0	0	0	0	OV	5	NSA	100	0
17			0.61	0.19	LW	0	0	0	10	90	0	0	0	0	0	OV	30	NSA	100	3
18						0	0	0	90	10	0	0	0	0	0	DJ	15	NSA	100	2
19			0.79	0.30	M	0	0	0	80	20	0	50	0	0	0	OV	10	CFO	100	1
20						0	0	0	80	20	0	0	0	0	0	IC	0	CFO	100	1
21						0	0	0	80	20	0	40	0	0	0	OV	60	NSA	100	3
22						0	0	0	90	10	0	0	0	0	0	DJ	5	NSA	100	2
23						0	0	0	80	20	0	100	0	0	0	OV	10	NSA	90	4
24						0	0	5	75	20	0	100	0	100	100	OV	30	CFO	80	2
25			0.62	0.25	M	0	0	0	80	20	0	30	60	0	0	DJ	35	CFO	100	6
26						0	0	5	75	20	0	50	0	0	0	DJ	20	NSA	100	4
27			1.00	0.30	M	0	0	0	5	95	0	50	60	0	0	DJ	10	NSA	50	3
28	0.97	0.94	0.58	0.15	LW	0	0	5	80	15	0	15	0	0	0	DJ	25	CFO	70	7
29						0	0	10	80	10	0	0	0	0	0	DJ	10	BFO	40	2
30	0.50	0.86	0.51	0.25	LW	0	0	5	80	15	0	0	0	0	0	DJ	5	NSA	100	2
31						0	0	0	20	80	0	0	5	0	0	OV	10	NSA	95	1
32						0	0	40	35	25	0	0	0	0	0	SL	40	NSA	90	7
33	0.76	0.71				0	0	20	50	30	0	0	0	0	0	SL	40	NSA	90	2
34						0	0	60	30	10	0	0	0	0	0	SL	40	NSA	90	1
35						0	0	30	50	20	0	0	0	0	0	SL	40	NSA	90	1
36	0.90	0.81				0	0	40	50	10	0	0	0	0	0	SL	40	NSA	90	1
37			0.67	0.27	LW	0	0	5	90	5	0	0	0	0	0	SL	40	NSA	90	2
38	1.14	1.09				0	0	30	60	10	0	0	0	0	0	SL	40	NSA	90	0
39						0	0	20	70	10	0	0	0	0	0	SL	40	NSA	90	0
40	0.97	1.45				0	0	80	20	0	0	0	0	0	0	SL	50	NSA	50	0
41						0	0	30	60	10	0	0	0	0	0	SL	50	NSA	50	1

OCH2.8R-SS-1 (continued)																				
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFlPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
42						0	0	30	70	0	0	0	0	0	0	SL	50	NSA	50	0
43			1.06	0.24	LW	0	0	0	70	30	0	0	0	0	0	SL	40	NSA	40	3
44	1.08	1.18				0	0	0	70	30	0	0	0	0	0	SL	30	NSA	30	0
45						0	0	0	70	30	0	0	0	0	0	SL	40	NSA	40	5
46	0.52	0.33				0	0	0	70	30	0	0	0	0	0	SL	40	NSA	40	0
47			0.61	0.36	LW	0	0	0	50	50	0	0	0	0	0	SL	40	NSA	40	3
48						0	0	50	40	10	0	5	0	0	0	SL	40	NSA	40	3
49	0.81	0.79										0	0	0	0	SL	20	NSA	30	0
50						0	0	60	30	10	0	0	0	0	0	SL	20	NSA	30	0
51						0	0	50	35	15	0	0	0	0	0	SL	20	NSA	30	1
52						0	0	60	30	10	0	0	0	0	0	SL	10	NSA	20	2
53						0	0	0	30	70	0	0	0	0	0	SL	10	NSA	20	2
54	1.07	1.13	1.12	0.24	LW	0	0	20	10	70	0	0	0	0	0	SL	30	NSA	30	2
55						0	0	70	20	10	0	0	0	0	0	SL	30	NSA	30	2
56	0.85	1.11				0	0	20	40	40	0	0	0	0	0	SL	30	NSA	30	2
57			0.73	0.32	LW	0	0	0	30	70	0	5	0	0	0	SL	20	BFO	30	3
58						0	0	80	15	5	0	0	0	0	0	SL		BFO	20	0
59	1.19	1.11	1.80	0.21	LW	0	0	0	60	40	0	15	5	0	0	SL	30	BFO	20	2
60						0	0	70	15	15	0	0	0	0	0	SL	40	BFO	50	4
61			0.86	0.23	LW	0	0	5	80	15	0	0	20	0	5	SL	40	BFO	50	20
62	1.54	1.48				0	0	85	15	0	0	0	5	0	0	SL	40	BFO	50	5
63						0	0	70	15	15	0	0	5	0	0	SL	50	BFO	60	4
64	1.34	1.25				0	0	75	25	0	0	5	0	0	0	SL	50	BFO	60	3
65			0.59	0.13	LW	0	0	40	45	15	0	5	0	0	0	SL	50	BFO	60	1
66	1.37	1.28				0	0	90	10	0	0	0	0	0	0	SL	50	BFO	60	2
67			0.77	0.30	LW	0	0	80	20	0	0	5	0	0	0	SL	50	BFO	60	5
68	1.64	1.68				0	0	40	50	10	0	5	0	0	0	SL	50	BFO	60	3
69						0	0	90	10	0	0	5	0	0	0	SL	50	BFO	60	4
70	0.73	0.82				0	0	90	10	0	0	0	0	0	0	SL	40	BFO	30	3
71						0	0	0	70	30	0	0	0	0	0	SL	30	BFO	30	5
72						0	0	80	20	0	0	0	0	0	0	SL	50	BFO	40	0
73						0	0	10	10	80	0	0	0	0	0	SL	50	BFO	50	1
74	1.61	1.62				0	0	80	20	0	0	0	0	0	0	SL	50	BFO	50	1
75						0	0	0	30	70	0	0	0	0	0	SL	30	BFO	60	1
76	1.49	1.47				0	10	50	40	0	0	0	0	0	0	SL	30	CFO	70	1
77						0	0	0	60	40	0	0	0	0	0	SL	30	CFO	70	4
78	1.14	1.09	0.91	0.21	LW	0	0	0	40	60	0	5	0	0	0	SL	20	CFO	80	1
79						0	0	80	20	0	0	0	0	0	0	SL	20	CFO	80	0
80	1.16	1.16				0	0	0	40	60	0	0	0	0	0	SL	20	CFO	80	1
81						0	0	80	20	0	0	0	0	0	0	SL	20	CFO	80	5
82			1.14	0.23	LW	0	0	5	5	90	0	0	0	0	0	SL	20	CFO	80	2

OCH2.8R-SS-1 (continued)																					
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFlPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
83	1.07	1.04				0	0	90	10	0	0	0	0	0	0	SL	20	CFO	80	1
84						0	0	15	15	70	0	0	5	0	0	SL	50	CFO	80	2
85	1.34	1.35				0	0	5	5	90	0	0	0	0	0	OV	30	NSA	100	1
86						0	0	5	5	90	0	0	0	0	0	OV	30	NSA	100	0
87	1.16	1.17				0	0	5	15	80	0	0	0	0	0	OV	15	NSA	100	1
88						0	0	5	25	70	0	0	0	0	0	OV	20	NSA	90	4
89						0	0	10	20	70	0	0	0	0	0	OV	50	NSA	100	0
90						0	0	5	10	85	0	0	0	0	0	OV	100	NSA	100	0
91						0	0	0	10	90	0	0	0	0	0	DJ	30	NSA	100	5
92						0	0	10	20	70	0	0	0	0	0	DJ	90	CFO	90	2
93						0	0	10	20	70	0	0	0	0	0	OV	100	CFO	60	1
94						0	0	5	15	80	0	0	0	0	0	OV	100	NSA	100	4
95						0	0	0	20	80	0	0	0	0	0	OV	100	NSA	100	3
96						0	0	0	20	80	0	0	0	0	0	OV	100	NSA	100	0

OCH2.8R-SS-1.010																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024	RI	M		29.0		3.2	3.1	2.4	2.9	84.1					0.12	0.12	0.03	0.09	
2	5/1/2024	G	M		36.2	65.2	5.2	5.9	4.3	5.1	185.8					0.14	0.19	0.14	0.16	
3	5/1/2024	P	M		13.6	78.8	4.9	3.7	5.7	4.8	64.8					0.64	0.60	0.36	0.53	
4	5/1/2024	RI	M		15.5	94.3	7.8	5.6	7.1	6.8	105.9					0.13	0.10	0.10	0.11	
5	5/1/2024	G	M		35.0	129.3	6.8	5.4	5.9	6.0	211.2					0.19	0.28	0.35	0.27	
6	5/1/2024	RI	M	3	30.3	159.6	2.4	1.9	3.0	2.4	73.7					0.10	0.08	0.10	0.09	
7	5/1/2024	G	M	0	45.6	205.2	4.3	3.0	4.2	3.8	174.8					0.20	0.14	0.34	0.23	
8	5/1/2024	RI	M	2	23.4	228.6	2.9	1.1	5.4	3.1	73.3					0.11	0.10	0.03	0.08	
9	5/1/2024	G	M		26.7	255.3	3.8	3.0	2.2	3.0	80.1					0.31	0.20	0.17	0.23	
10	5/1/2024	RI	M		9.3	264.6	4.7	5.5	4.6	4.9	45.9					0.11	0.11	0.07	0.10	
11	5/1/2024	G	M		48.0	312.6	2.9	2.0	3.4	2.8	132.8					0.25	0.16	0.28	0.23	
12	5/1/2024	P	M		24.9	337.5	2.7	2.8	2.0	2.5	62.3					0.59	0.53	0.44	0.52	
13	5/1/2024	G	M		17.9	355.4	1.9	2.2	1.3	1.8	32.2					0.29	0.25	0.20	0.25	
14	5/1/2024	RI	L		4.7	360.1	0.8	0.8	0.8	0.8	3.8					0.05	0.05	0.05	0.05	
15	5/1/2024	G	L		7.2	367.3	1.3	1.8	1.6	1.6	11.3					0.30	0.34	0.44	0.36	
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1						0	0	5	90	5	0	0	0	0	0	IC	0	NSA	5	0
2						0	0	0	70	30	0	0	0	0	0	IC	0	NSA	50	0
3			0.74	0.20	M	0	0	0	10	90	0	0	0	0	0	OV	40	NSA	50	0
4						0	0	5	90	5	0	0	0	0	0	IC	0	NSA	100	0
5						0	0	0	10	90	0	0	0	0	0	DJ	10	NSA	60	2
6						0	0	5	90	5	0	0	0	0	0	IC	0	NSA	50	0
7						0	0	0	30	70	0	0	0	0	0	IC	0	NSA	100	0
8						0	0	0	95	5	0	0	0	0	0	OV	10	NSA	40	0
9						0	0	0	90	10	0	0	0	0	0	OV	30	NSA	50	2
10						0	0	0	95	5	0	0	0	0	0	IC	0	NSA	80	0
11						0	0	0	95	5	0	0	0	0	0	OV	10	NSA	100	0
12			0.65	0.20	M	0	0	0	0	100	0	0	5	0	0	DJ	20	NSA	100	3
13						0	0	0	5	95	0	0	0	0	0	DJ	25	NSA	100	2
14						0	0	5	90	5	0	0	0	0	0	IC	0	NSA	100	0
15						0	0	5	10	85	0	0	0	0	0	DJ	30	NSA	100	0

OCH2.8R-SS-1.010.10

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024	G	M		35.9	35.9	1.6	1.5	2.0	1.7	61.0					0.18	0.08	0.24	0.17	
2	5/1/2024	RI	L	4	19.9	55.8	0.8	2.1	1.7	1.5	30.5					0.04	0.50	0.20	0.25	
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	0	0	10	90	0	0	0	0	0	OV	10	NSA	80	1
2						0	0	0	70	30	0	0	0	0	0	DJ	20	NSA	100	7

OCH2.8R-SS-1.010.20

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024	G	L		56.9	56.9	0.9	1.2	2.1	1.4	79.7					0.05	0.16	0.17	0.13	
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
						0	0	0	10	90	0	0	0	0	0	DJ	5	NSA	100	5

OCH2.8R-SS-1.020

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024	G	L		65.5	65.5	9.6	2.5	2.2	4.8	312.2					0.04	0.20	0.40	0.21	
2	5/1/2024	RI	L		14.4	79.9	2.0	0.9	0.5	1.1	16.3					0.09	0.60	0.04	0.24	
3	5/1/2024	P	L	0	9.6	89.5	2.0	2.0	2.5	2.2	20.8					0.50	0.70	0.33	0.51	
4	5/1/2024	NAP	PUDDLED		8.7	98.2	0.8	0.7	0.7	0.7	6.4									
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	0	0	0	100	0	0	0	0	0	OV	5	NSA	100	0
2						0	0	0	0	100	0	0	0	0	0	OV	15	NSA	100	0
3			0.43	0.04	M	0	0	0	0	100	0	10	10	0	0	OV	15	NSA	100	0
4						0	0	0	0	100	0					NAP		NAP		

OCH2.8R-SS-1.030

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/1/2024				13.5	13.5			1.3	1.3	17.6							0.18	0.18	
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
						0	0	0	0	80	20	0	0	0	0	NAP		NAP		

OCH2.8R-SS-1.040

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/2/2024		L		8.0	8.0	0.7	1.0	1.1	0.9	7.5					0.05	0.06	0.12	0.08	
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
						0	0	0	80	20	0	0	0	0	0	DJ	40	NSA	100	1

OCH2.8R-SS-1.050

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/2/2024	G	L		85	85														
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	0	0	40	20	40	0	0	0	0	DJ	50	NSA	100	6

OCH2.8R-SS-1.050.10																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
1	5/2/2024	G	L		36.3	36.3	4.3	3.4	3.4	3.7	134.3	5.3	4.7	4.4	4.8	0.49	0.40	0.43	0.44	
2	5/2/2024	RI	L		38.8	75.1	2.4	2.5	1.6	2.2	84.1	4.1	4.5	4.7	4.4	0.22	0.12	0.08	0.14	0.61
3	5/2/2024	G	L		11.6	86.7	2.3	1.3	2.0	1.9	21.7	4.6	4.7	5.2	4.8	0.18	0.15	0.20	0.18	
4	5/2/2024	RI	L		18.3	105.0	2.2	2.7	1.6	2.2	39.7	6.0	5.5	4.6	5.4	0.10	0.10	0.11	0.10	0.54
5	5/2/2024	P	L		14.4	119.4	2.9	2.5	1.6	2.3	33.6	4.6	4.6	3.8	4.3	0.31	0.25	0.28	0.28	
6	5/2/2024	G	L		63.3	182.7	2.0	1.6	1.2	1.6	101.3	4.6	4.4	4.0	4.3	0.17	0.16	0.13	0.15	
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	0	15	40	45	0	0	0	0	0	IC	0	NSA	100	1
2	0.62	0.58				0	0	15	60	15	0	0	0	0	0	OV	60	NSA	100	1
3						0	0	5	85	10	0	0	0	0	0	IC	0	NSA	100	1
4	0.55	0.52				0	0	5	80	15	0	0	0	0	0	IC	0	NSA	70	0
5			0.33	0.10	M	0	0	0	80	20	0	0	0	0	0	IC	0	NSA	100	1
6						0	0	0	20	70	10	0	0	0	0	DJ	10	NSA	100	6

OCH2.8R-SS-1.050.20																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
1	5/2/2024		L		50.2	50.2														
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	0	0	10	40	50	0	0	0	0	OV	50	NSA	100	4

OCH2.8R-SS-1.060																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/10/2024	RI	H	2	5.2	5.2	7.4	6.5	5.8	6.6	34.1					0.16	0.13	0.14	0.14	
2	5/10/2024	G	L		67.8	73.0	5.1	5.6	6.1	5.6	379.9	7.0	6.8	7.7	7.2	0.60	0.15	0.49	0.41	
3	5/10/2024	RI	M		7.3	80.3	5.5	5.3	5.6	5.5	39.9	9.1	9.2	8.0	8.8	0.45	0.45	0.39	0.43	0.75
4	5/10/2024	G	M		17.4	97.7	4.4	4.5	4.2	4.4	76.0	9.4	6.5	5.6	7.2	0.40	0.22	0.43	0.35	
5	5/10/2024	RI	H	0.5	10.3	108.0	4.7	4.9	8.0	5.9	60.4	7.4	8.2	11.7	9.1	0.42	0.52	0.26	0.40	0.91
6	5/10/2024	G	M		16.1	124.1	5.2	5.0	4.8	5.0	80.5	9.9	9.6	10.9	10.1	0.31	0.47	0.38	0.39	
7	5/10/2024	RI	H	1	53.3	177.4	4.1	4.3	4.7	4.4	232.7	6.9	9.1	6.8	7.6	0.38	0.38	0.23	0.33	0.71
8	5/10/2024	G	M		12.7	190.1	4.5	4.9	4.5	4.6	58.8	11.2	9.7	9.1	10.0	0.21	0.30	0.32	0.28	
9	5/10/2024	RI	H	0.5	8.1	198.2	6.8	8.0	6.9	7.2	58.6	9.4	11.5	11.7	10.9	0.29	0.22	0.24	0.25	1.02
10	5/10/2024	G	M		7.4	205.6	8.3	5.9	6.2	6.8	50.3	10.8	11.2	8.0	10.0	0.50	0.40	0.42	0.44	
11	5/10/2024	RI	H	0.5	113.3	318.9	5.3	4.2	4.7	4.7	536.3	11.2	4.7	6.2	7.4	0.51	0.21	0.38	0.37	0.72
12	5/10/2024	P	M	0	6.1	325.0	2.3	3.0	2.2	2.5	15.3	5.5	5.1	5.1	5.2	0.40	0.52	0.47	0.46	
13	5/10/2024	RI	H	1	8.9	333.9	5.3	5.0	5.0	5.1	45.4	5.4	5.1	5.2	5.2	0.20	0.20	0.18	0.19	1.14

HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
1						0	0	70	30	0	0	0	0	0	0	SL	20	NSA	20	0
2						0	0	0	0	20	80	0	0	0	0	SL	40	NSA	40	7
3	0.00	0.71				0	0	0	20	40	40	5	0	0	0	SL	50	NSA	50	1
4						10	0	0	10	70	10	0	0	0	0	SL	50	NSA	50	1
5	1.36	1.37				0	0	5	15	80	0	0	0	0	0	SL	60	NSA	50	1
6						0	0	0	20	80	0	5	5	0	0	SL	30	NSA	40	3
7	0.99	0.89				0	0	10	10	80	0	0	0	0	0	SL	30	NSA	40	4
8						0	0	5	5	90	0	0	0	0	0	SL	40	CFO	60	1
9	0.00	1.65				0	0	0	80	20	0	5	5	0	0	SL	40	CFO	60	4
10						0	0	0	10	70	20	0	5	0	0	SL	50	CFO	50	3
11	0.76	0.40				0	0	10	30	60	0	5	5	0	0	SL	80	CFO	50	25
12			0.65	0.32	LW	0	0	0	70	30	0	10	0	0	0	SL	70	BFO	50	2
13	0.66	1.05				0	0	40	60	0	0	15	15	0	0	SL	40	BFO	40	4

OCH2.8R-SS-1.060.10																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/10/2024	G	L	0	100	100														

HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
												0	0	0	0	SL	80	BFO	40	3

MR 1.090																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	10/3/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

MR 1.100																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	9/28/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

OCH3.0L-SS-1																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
1	5/7/2024	RI	M		140.4	140.4	8.8	6.6	4.1	6.5	912.6					0.19	0.28	0.29	0.25	
2	5/7/2024	G	M		19.3	159.7	6.1	5.9	4.7	5.6	107.4					0.18	0.33	0.36	0.29	
3	5/7/2024	RI	M	1	41.8	201.5	3.9	4.6	6.0	4.8	201.3					0.15	0.14	0.13	0.14	
4	5/7/2024	G	M		38.0	239.5	3.3	7.4	7.5	6.1	230.2					0.49	0.23	0.32	0.35	
5	5/7/2024	RI	M		24.0	263.5	3.0	4.0	5.9	4.3	103.2	7.4	5.4	6.8	6.5	0.27	0.57	0.55	0.46	0.50
6	5/7/2024	P	M	0	13.4	276.9	2.5	2.7	5.2	3.5	46.5	4.4	4.6	7.0	5.3	0.52	0.46	0.70	0.56	
7	5/7/2024	RI	M	1	18.0	294.9	4.9	4.4	4.5	4.6	82.8	13.4	13.8	12.3	13.2	0.22	0.25	0.24	0.24	0.74
8	5/7/2024	G	M		26.4	321.3	4.8	4.9	3.6	4.4	117.0	9.1	6.3	5.6	7.0	0.27	0.28	0.37	0.31	
9	5/7/2024	RI	M	1	18.4	339.7	2.9	2.6	8.1	4.5	83.5	3.2	3.4	4.9	3.8	0.29	0.65	0.28	0.41	0.60
10	5/7/2024	G	M		69.7	409.4	5.6	4.6	3.7	4.6	322.9	9.8	7.0	7.9	8.2	0.27	0.25	0.33	0.28	
11	5/7/2024	P	L	0	4.8	414.2	0.4	0.4	0.4	0.4	2.0	7.3	7.2	7.9	7.5	0.50	0.48	0.60	0.53	
12	5/7/2024	G	M		97.6	511.8	2.7	3.0	3.7	3.1	305.8	7.2	5.5	9.8	7.5	0.31	0.23	0.21	0.25	
13	5/7/2024	RI	M		16.3	528.1	3.5	3.0	2.5	3.0	48.9	15.2	13.0	13.2	13.8	0.30	0.25	0.22	0.26	0.73
14	5/7/2024	G	M		130.0	658.1	7.0	5.6	2.8	5.1	667.3	10.0	15.7	11.3	12.3	0.31	0.28	0.24	0.28	
15	5/7/2024	RI	M	1	214.0	872.1	4.6	5.2	1.1	3.6	780.4	12.6	8.3	8.0	9.6	0.20	0.23	0.33	0.25	0.75
16	5/7/2024	G	M		20.8	892.9	3.2	4.7	6.5	4.8	99.8	6.7	9.1	8.0	7.9	0.21	0.26	0.20	0.22	
17	5/7/2024	P	L	0	7.0	899.9	4.7	4.3	3.4	4.1	28.9	5.7	6.8	6.7	6.4	0.30	0.36	0.59	0.42	
18	5/7/2024	RI	M	1	12.8	912.7	2.8	2.0	2.9	2.6	32.9					0.18	0.22	0.28	0.23	
19	5/7/2024	G	M		18.3	931.0	4.6	3.2	3.0	3.6	65.9					0.28	0.40	0.24	0.31	
20	5/7/2024	RI	M	1	38.4	969.4	3.6	2.1	3.4	3.0	116.5					0.14	0.26	0.17	0.19	
21	5/7/2024	G	M		25.9	995.3	4.0	4.4	3.1	3.8	99.3					0.38	0.32	0.16	0.29	
22	5/7/2024	RI	M	1	108.6	1103.9	3.9	3.0	4.7	3.9	419.9					0.16	0.17	0.16	0.16	
23	5/7/2024	G	M		149.1	1253.0	4.7	5.8	5.4	5.3	790.2	8.1	8.2	12.5	9.6	0.76	0.83	1.30	0.96	
24	5/7/2024	RI	M	5	118.0	1371.0	1.8	2.0	1.3	1.7	199.4	4.8	4.9	6.7	5.5	0.23	0.20	0.17	0.20	1.26

OCH3.0L-SS-1 (continued)																				
HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFlPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
1					NAP	0	0	30	50	20	0	0	0	0	0	IC	0	CFO	0	0
2					NAP	0	0	10	15	75	0	0	0	0	0	IC	0	CFO	0	0
3					NAP	0	0	85	10	5	0	0	0	0	0	IC	0	CFO	0	0
4					NAP	0	0	0	5	95	0	0	0	0	0	IC	0	CFO	0	0
5	0.32	0.62			NAP	0	0	0	85	15	0	0	0	0	0	IC	0	CFO	0	0
6			0.70	0.17	BR	0	0	0	10	90	0	0	0	0	0	IC	0	CFO	0	0
7	0.72	0.71			NAP	0	0	90	5	5	0	0	0	0	0	IC	0	CFO	0	0
8					NAP	0	0	15	5	80	0	0	0	0	0	IC	0	CFO	0	0
9	0.78	0.74			NAP							5	0	5	0	IC	0	CFO	0	1
10					NAP	0	0	0	10	90	0	10	0	10	0	SL	40	CFO	20	10
11			0.63	0.31	LW	0	0	0	0	100	0	30	0	15	0	SL	25	CFO	20	3
12					NAP	0	0	0	10	90	0	5	0	0	0	SL	25	CFO	20	1
13	0.86	0.87			NAP	0	0	0	10	90	0	0	0	0	0	SL	15	CFO	25	1
14					NAP	0	0	0	80	20	0	0	0	0	0	SL	40	NSA	50	10
15	0.76	0.88			NAP	0	0	0	70	30	0	0	0	0	5	SL	60	NSA	60	22
16					NAP	0	0	0	20	80	0	0	0	0	0	SL	50	NSA	60	1
17			0.70	0.12	LW	0	0	0	20	80	0	0	0	0	0	SL	50	NSA	50	2
18					NAP	0	0	0	30	70	0	0	0	0	0	SL	50	NSA	50	3
19					NAP	0	0	0			0	0	0	0	0	SL	50	NSA	50	2
20					NAP	0	0	40	50	10	0	0	0	0	0	SL		NSA	40	1
21					NAP	0	0	0	70	30	0	0	0	5	0	SL	50	CFO	50	0
22					NAP	0	0	40	40	20	0	0	0	0	0	SL	60	CFO	60	6
23					NAP	0	0	0	0	100	0	10	10	0	0	SL	70	CFO	70	11
24	1	1.045			NAP	0	0	0	40	60	0	0	0	0	0	SL	75	BFO	60	20

OCH3.0L-SS-1.010

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	RI	M	1	53.1		2.5	4.1	1.1	2.6	135.4					0.05	0.07	0.04	0.05	
2	5/8/2024	G	M		8.9	62.0	1.4	1.5	0.8	1.2	10.9					0.16	0.17	0.06	0.13	
3	5/8/2024	G	L		37.7	99.7														

HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
1																				
2																				
3																				

OCH3.0L-SS-1.020

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	G	M	0	53.9															

HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
1																				

OCH3.0L-SS-1.030

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	G	M	0	23.2															

HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRC de	ISCVRP er	RipVeg Cde	RipVeg CVR	LWD No
1																				

OCH3.0L-SS-1.040																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	G	M	0	35.7		3.9	5.5	5.8	5.07	180.88	26.7	39.3	36.3	34.1	0.47	0.38	0.45	0.433333333	
HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1						0	0	0	0	90	10	0	0	0	0	SL	30	CFO	20	0

OCH3.0L-SS-1.050																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	RI	P		85.6															
HabUnit No	BFD50 (avg)	BFD75 (avg)	Max PDep (m)	Pcres Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1																				

OCH3.0L-SS-1.060																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	5/8/2024	RI	M	1.5	46.7															
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1																				5

MR 1.080																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	9/27/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

OCH3.8L-SS-1																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
1	4/30/2024	G	M	0	44.3	44.3	10.7	9.8	7.3	9.3	410.5					0.59	0.58	0.40	0.52	
2	4/30/2024	P	M	0	12.3	56.6	3.6	4.2	6.5	4.8	58.6	5.3	7.5	9.1	7.3	0.43	0.52	0.55	0.50	
3	4/30/2024	RI	M		150.3	206.9	2.6	3.7	1.8	2.7	405.8	12.1	7.4	6.9	8.8	0.17	0.17	0.16	0.17	0.58
4	4/30/2024	G	M	-1	16.9	223.8	1.3	1.5	3.9	2.2	37.5	6.4	4.7	5.1	5.4	0.10	0.19	0.13	0.14	
5	4/30/2024	RI	M		8.9	232.7	1.8	1.9	1.6	1.8	15.7	6.4	7.3	7.3	7.0	0.10	0.09	0.10	0.10	0.40
6	4/30/2024	G	M	-1	25.1	257.8	2.0	1.9	2.4	2.1	52.7	6.7	6.9	4.6	6.1	0.15	0.14	0.12	0.14	
7	4/30/2024	P	M	0	6.8	264.6	1.5	1.5	2.2	1.7	11.8	4.8	4.9	4.8	4.8	0.12	0.21	0.23	0.19	
8	4/30/2024	G	M	-1	23.1	287.7	1.4	1.5	1.2	1.4	31.6	4.2	4.7	5.3	4.7	0.16	0.70	0.14	0.33	
9	4/30/2024	P	M	0	12.4	300.1	1.5	2.7	4.5	2.9	36.0	5.3	7.4	7.1	6.6	0.26	0.15	0.54	0.32	
10	4/30/2024	G	M	-1	32.8	332.9	1.5	2.4	1.5	1.8	59.0	4.7	6.3	7.1	6.0	0.14	0.22	0.21	0.19	
11	4/30/2024	G	L		15.3	348.2	0.6	1.9	1.5	1.3	20.4	5.2	6.8	6.1	6.0	0.12	0.07	0.14	0.11	
12	4/30/2024	NAP	P		30.7	378.9														
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1					NAP	0	0	5	0	90	5	0	0	0	0	HL	5	NSA	90	1
2			0.70	16.00	BK	0	5	10	15	35	35	0	0	0	0	IC	0	NSA	65	0
3	0.53	0.49			NAP	0	5	5	70	15	5	0	0	0	0	HB	10	NSA	95	0
4					NAP	0	0	5	10	85	0	0	0	0	0	HL	5	NSA	100	1
5	0.44	0.50			NAP	0	0	5	60	35	0	0	0	0	0	IC	0	NSA	100	1
6					NAP	0	0	3	12	85	0	0	0	0	0	OV	5	NSA	100	7
7			0.25	0.10	M	0	2	10	6	20	5	0	0	0	0	DJ	15	NSA	100	2
8					NAP	0	5	10	25	60	0	0	0	0	0	HL	15	NSA	100	4
9			0.68	0.05	LW	0	0	0	10	90	0	0	0	0	0	HL	10	CFO	100	3
10					NAP	0	0	5	20	70	5	0	0	0	0	OV	70	CFO	100	0
11					NAP	0	0	5	0	5	90	0	0	0	0	OV	100	NSA	100	1
12					NAP											NAP		NAP		

MR 1.110																				
HabUnit No	**Survey Date**	**Meso HabType**	**Flow Level**	**GradPer**	**Length (m)**	**Total Length (m)**	**Wet Width 1**	**Wet Width 2**	**Wet Width 3**	**Average Wetted Width (m)**	**Feature Area (m2)**	**Bankful Width 1**	**Bankful Width 2**	**Bankful Width 3**	**Average Wetted Width (m)**	**TWD1M**	**TWD2M**	**TWD3M**	**Average Thalweg Depth (m)**	**BFD25 (avg)**
	4/30/2024																			
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFIPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**

OCH4.2R-SS-1

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	4/29/2024	RI	M	5.5	30.4	30.4	2.6	2.62	3	2.7	83.3	3	3.52	7	4.5	0.25	0.50	0.23	0.33	0.60
2	4/29/2024	P	M	0	16.6	47	5.8	5.6	4.4	5.3	87.4	7.5	7.4	7.2	7.4	0.30	0.52	0.67	0.50	0.31
3	4/29/2024	G	M	2.5	24.9	71.9	5.6	11.4	12.5	9.8	244.9	12.9	13.4	14.6	13.6	0.24	0.30	0.28	0.27	0.46
4	4/29/2024	RI	M	2	40.0	111.9	9.9	10.5	10.7	10.4	414.7	11.7	15.6	11.9	13.1	0.13	0.14	0.25	0.17	0.44
5	4/29/2024	P	M	0	29.9	141.8	7	6.6	4.25	6.0	177.9	8.2	7.2	5.7	7.0	0.35	0.43	0.49	0.42	0.70
6	4/29/2024	RI	M	10	31.1	172.9	7.2	7.6	2.45	5.8	178.8	14.3	9.4	3.64	9.1		0.30	0.26	0.28	0.40
7	4/29/2024	G	M	0	68.3	241.18	1.6	2.8	3.3	2.6	175.3	2.4	4.8	4.7	4.0	0.31	0.40	0.20	0.30	0.48
8	4/29/2024	P	M		7.2	248.36	3.1	3	2.6	2.9	20.8	3.9	3.2	3.3	3.5	0.49	0.42	0.20	0.37	0.56
9	4/29/2024	RI	M		12.2	260.6	1.9	2.1	3.2	2.4	29.4	2.9	3.7	4.9	3.8	0.29	0.30	0.20	0.26	0.43
10	4/29/2024	G	M		16.5	277.1	2.8	2.8	2.9	2.8	46.8	3.7	3.7	3.6	3.7	0.32	0.30	0.30	0.31	0.50
11	4/29/2024	RI	M		15.7	292.8	2.4	2.1	2.1	2.2	34.5	8.3	8.3	3.5	6.7	0.55	0.30	0.25	0.37	0.51
12	4/29/2024		M		36.5	329.25														
13	4/29/2024	G	M		31.4	31.4	2.5	2.1	1.5	2.0	63.8	3.4	3.7	2.3	3.1	0.20	0.24	0.26	0.23	0.46
14	4/29/2024	P	M		7.1	38.5	3.3	1.4	1.2	2.0	14.0	4.9	2.5	3	3.5	0.26	0.37	0.18	0.27	0.38
15	4/29/2024	G	L		26.7	65.2	2.4	1.7	1.3	1.8	48.1	4	3.1	2.1	3.1	0.27	0.32	0.32	0.30	0.62

HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No
1	0.59	0.56				5	10	60	10	5	0	0	0	0	0	HB	10	NSA	25	1
2	0.48	0.63	0.64	0.19	BK	5	0	5	15	75	0	0	0	0	0		0	CFO	30	0
3	0.53	0.42				0	0	15	45	40	0	0	0	0	0		0	CFO	50	0
4	0.42	0.47				0	5	60	30	5	0	0	0	0	0		0	CFO	50	0
5	0.73	0.62	0.69	0.23	RK	0	0	2	7	90	0	0	0	0	0		0	CFO	50	0
6	0.24	0.55				0	20	50	20	10	0	0	0	0	0	IC	0	NSA	100	0
7	0.54	0.51				0	0	5	50	45	0	0	0	0	0	HL	10	CFO	100	14
8	0.61	0.50	0.50	0.20	M	0	0	20	50	30	0	0	0	0	0	OV	100	NSA	100	
9	0.47	0.46				0	0	10	80	10	0	0	0	0	0	OV	100	NSA	100	0
10	0.63	0.59				0	0	0	80	20	0	0	0	0	0	OV	100	NSA	100	0
11	0.51	0.46				0	0	5	90	5	0	0	0	0	0	OV	90	NSA	95	0
12																		NAP		
13	0.51	0.47				0	0	5	80	15	0	0	0	0	0	OV	100	NSA	100	0
14	0.45	0.38	0.38	0.16	O	0	0	5	90	5	0	0	0	0	0	OV	100	NSA	95	0
15	0.59	0.52				0	0	0	20	80	0	0	0	0	0	OV	100	NSA	85	0

OCH4.2R-SS-1.010

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	4/29/2024		L	0	35.8	35.8	4.5	4.1	4.1							0.15	0.18			
2	4/29/2024		P	0	11.8	47.6														
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFlPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1						0	5	10	35	50	0	0	0	0	0		0		0	0
2																				

MR 1.120

HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
1	4/29/2024	G	M	0	32.8	32.8	2.6	7.0	7.3	5.6	184.8	9.8	7.9	9.1	8.9	0.52	0.31	0.46	0.43	0.64
HabUnit No	**BFD50 (avg)**	**BFD75 (avg)**	**MaxP Dep (m)**	**Pcrest Dep (m)**	**Pool FrmFac**	**BRPer**	**BOPer**	**CBPer**	**GRPer**	**SDFlPer**	**ORPer**	**Undct LBPer**	**Undrct RBPer**	**Erosn LBPer**	**Erosn RBPer**	**ISCVRCde**	**ISCVRPer**	**RipVeg Cde**	**RipVeg CVR**	**LWD No**
1	0.55	0.67				0	0	0	5	95	0	0	0	0	0	HL	15	CFO	75	7

MR 1.120.10																			
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	9/28/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No

MR 1.120.20																				
HabUnit No	Survey Date	Meso HabType	Flow Level	GradPer	Length (m)	Total Length (m)	Wet Width 1	Wet Width 2	Wet Width 3	Average Wetted Width (m)	Feature Area (m2)	Bankful Width 1	Bankful Width 2	Bankful Width 3	Average Wetted Width (m)	TWD1M	TWD2M	TWD3M	Average Thalweg Depth (m)	BFD25 (avg)
	9/28/2024																			
HabUnit No	BFD50 (avg)	BFD75 (avg)	MaxP Dep (m)	Pcrest Dep (m)	Pool FrmFac	BRPer	BOPer	CBPer	GRPer	SDFIPer	ORPer	Undct LBPer	Undrct RBPer	Erosn LBPer	Erosn RBPer	ISCVRCde	ISCVRPer	RipVeg Cde	RipVeg CVR	LWD No