



Medford Irrigation District
Joint System Canal Modernization Project
Water Resources Technical Report

Prepared for

U.S. Department of Agriculture Natural Resources Conservation Service, Lead Federal Agency, in cooperation with the Medford Irrigation District

February 2026

Parametrix

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U.S. Department of Agriculture Natural Resources Conservation Service, Lead Federal Agency, in cooperation with the Medford Irrigation District
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February 2026 | 273-8767-010

Citation

Parametrix. 2026. Medford Irrigation District Joint System Canal Modernization Project Watershed Plan–Environmental Impact Statement Water Resources Technical Report. Prepared for U.S. Department of Agriculture Natural Resources Conservation Service, Lead Federal Agency, in cooperation with the Medford Irrigation District by Parametrix, Portland, Oregon. February 2026.

Contents

Executive Summary ES-1

1. Introduction 1-1

2. Definitions 2-1

3. Legal Regulations and Standards 3-1
   - 3.1 Laws, Plans, Policies, and Regulations 3-1
     - 3.1.1 Federal 3-1
     - 3.1.2 State of Oregon 3-2
     - 3.1.3 Jackson County 3-4
   - 3.2 Design Standards 3-4
     - 3.2.1 NRCS Irrigation Guide, Part 652 3-4

4. Affected Environment 4-1
   - 4.1 Study Area 4-1
   - 4.2 Resource Identification and Evaluation Methods 4-6
     - 4.2.1 Published Sources and Databases 4-6
     - 4.2.2 Field Visits and Surveys 4-7
   - 4.3 Existing Conditions 4-7
     - 4.3.1 MID Water Rights and Operations 4-7
     - 4.3.2 Surface Water Hydrology 4-10
     - 4.3.3 Surface Water Quality 4-16
     - 4.3.4 Groundwater 4-21

5. Impact Assessment Methodology and Data Sources 5-1
   - 5.1 Long-Term Impact Assessment Methods 5-1
   - 5.2 Short-Term Impact Assessment Methods 5-1
   - 5.3 Indirect Impact Assessment Methods 5-2
   - 5.4 Cumulative Impact Assessment Methods 5-2

6. Environmental Consequences 6-1
   - 6.1 Long-Term Impacts 6-1
     - 6.1.1 No Action 6-1
     - 6.1.2 Modernization Alternative (Future with Federal Investment) 6-2

Contents *(continued)*

6.2 Construction Impacts 6-13
6.2.1 Impacts from Construction 6-13
6.2.2 Potential Off-Site Staging Areas 6-16
6.3 Cumulative Effects 6-17
6.3.1 No-Build Alternative 6-17
6.3.2 Modernization Alternative 6-17
6.4 Compliance with Laws, Regulations, and Standards 6-18
6.4.1 Federal 6-18
6.4.2 State 6-20
6.4.3 Jackson County 6-21
6.5 Conclusion 6-22

7. Mitigation Measures 7-1

8. Contacts and Coordination 8-1

9. Preparers 9-1

10. References 10-1

11. Appendix A A-1

FIGURES

Figure 1-1. Project area ..... **Error! Bookmark not defined.**
Figure 5-1 Waterbodies Associated with MID Operations and Infrastructure 4-4
Figure 5-2. Unnamed Drainages Associated with MID Operations 4-5
Figure 5-3. Average Canal Discharge from 2013 to 2023 4-9
Figure 5-4. Average Releases from Fish Lake and Fourmile Lake from 2013 to 2023 4-9
Figure 5-5. Average Streamflow from MID-Affected Waterbodies from 2013 to 2023 4-12
Figure 5-6. Average Streamflow of Rogue River from 2013 to 2023 4-16

TABLES

Table 5-1. Waterbodies Associated with MID Operations and that Could be Impacted by the Modernization Alternative 4-2

Contents *(continued)*

Table 5-2. Impaired Waterbodies Associated with MID Operations 4-16

Table 7-1. Impacts of the Modernization Alternative on Waterbodies Associated with MID Operations and Infrastructure 6-3

APPENDICES

A Modeled Changes in Surface Water Hydrology

Acronyms and Abbreviations

ac	acre
AF	acre-feet
AF/year	acre-feet per year
BMP	best management practice
cfs	cubic feet per second
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
JSC	Joint System Canal
MID	Medford Irrigation District
MWC	Medford Water Commission
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
ORS	Oregon Revised Statute
OWRD	Oregon Water Resource Department
RRVID	Rogue River Valley Irrigation District
TID	Talent Irrigation District
TMDL	total maximum daily load
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

The Modernization Alternative would result in minor temporary impacts to water resources along the Joint System Canal alignment during construction of the Joint System Canal Project. There would be no disruption to irrigation water conveyance, but construction adjacent to or within waterbodies could result in temporary impacts to water quality. Following completion of construction, the Project would result in minor long-term benefits to hydrology and water quality within waterbodies associated with Medford Irrigation District operations. Minor long-term decreases in groundwater input are not anticipated to have a detectable effect on groundwater resources. Because there would be a net benefit to water resources as a result of the Project, no mitigation is proposed for the Modernization Alternative. The Joint System Canal Project would comply with federal, state, and local land regulations.

1. Introduction

This technical report has been prepared as a part of the preparation of the Watershed Plan–Environmental Impact Statement (Plan-EIS) for the Joint System Canal Project (Project). The following sections identify and evaluate water resource conditions within the project area and the potential effects of the project alternatives on water resources.

2. Definitions

The following terminology is used when discussing geographic areas in this technical report.

Project area. The area within which improvements associated with the project alternatives would occur and the area needed to construct these improvements. The project area consists of the current JSC alignment; the footprint of all modernization improvements proposed under the alternatives, including proposed siphons, staging and storage, and temporary construction access.

Study area. This is the general geographic area within which physical impacts to the environment could occur with the project alternatives. The study area is resource-specific and differs depending on the environmental topic being addressed. For all resource topics, the study area encompasses the project area, and for some topics (such as soil resources), the geographic extent of the study area is the same as that for the project area. The study area for water resources is substantially larger to account for impact that could occur outside of the project area and is defined in Section 5.1.

3. Legal Regulations and Standards

The following sections list and briefly describe applicable federal, state, and local laws and regulations protecting the condition of surface waterbodies and groundwater resources, as well as permitting activities related to water quality, groundwater protection, and protection of aquatic resources and habitat.

3.1 Laws, Plans, Policies, and Regulations

3.1.1 Federal

3.1.1.1 Clean Water Act, 1977 as Amended, 33 U.S.C. 1251–1376

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The regulatory and permitting processes within the purview of the CWA are summarized below.

Section 303(d) Impaired Waters and Total Maximum Daily Loads

Section 303(d) requires states and territories to issue water quality status reports every 2 years. These reports identify water quality trends, prioritize polluted waters, and target waters for total maximum daily load (TMDL) development. TMDLs identify the pollutant load reductions that are necessary from point and nonpoint sources and guide implementation work by federal, state, tribal, territorial, and local water quality protection programs. In Oregon, the Oregon Department of Environmental Quality (DEQ) develops and maintains a Section 303(d) list for approval by the U.S. Environmental Protection Agency (EPA). No permit is required for Section 303(d) but the 303(d) list identifies impaired waterbodies within the project area and informs compliance with Section 401 of the CWA.

Section 401 Water Quality Certification

Section 401 of the CWA requires states to set water quality standards for all contaminants in surface waters based on the "beneficial" or "designated" uses for the waterbody and makes it unlawful for a person to discharge a pollutant from a point source into navigable waters unless a permit was obtained under its provisions. It also recognizes the need to address the problems posed by nonpoint source pollution. Section 401 requires an applicant for a federal license, or a Section 404 permit applicant planning to conduct an activity that may result in a discharge to waters of the state or United States, to obtain a certification that the activity complies with state water quality requirements and standards. Regulatory authority is given to states and tribes directly through Section 401 of the CWA; the regulatory authority in Oregon is DEQ. Because these permits are administered by a state regulatory agency, their applicability is discussed under state regulations in Section 4.1.2.5.

Section 402 National Pollutant Discharge Elimination System Permits

EPA requires National Pollutant Discharge Elimination System (NPDES) permits for industrial sites and construction activities, as well as for certain sizes of municipalities that discharge stormwater into waterways. In Oregon, these permits are administered through DEQ. Because these permits are administered by a state regulatory agency, their applicability is discussed under state regulations in Section 4.1.2. Construction stormwater management would likely require a 1200-CA Stormwater General Discharge Permit for projects that disturb more than 1 acre.

Section 404 for Permitting Discharges of Dredge or Fill Material

Section 404 requires a permit authorization from USACE for activities involving the discharge of dredge or fill material into waters of the United States, including wetlands. This permit would be required for work associated with project activities that would occur within a jurisdictional wetland or below the ordinary high-water mark of jurisdictional waterbodies.

3.1.1.2 Endangered Species Act of 1973 and Amendments, 16 U.S.C. 1531 et seq.

The Endangered Species Act (ESA) provides a framework to conserve and protect endangered and threatened species and designated critical habitats from effects such as those related to stormwater (e.g., water quality and hydromodification) and direct habitat impacts from construction and project design. The ESA is administered by the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS). Consultation with USFWS and NMFS would be required for work that may affect protected endangered and threatened species.

3.1.1.3 Fish and Wildlife Coordination Act of 1934 and Amendments, 16 U.S.C. 661 et seq.

The Fish and Wildlife Coordination Act protects fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. The applicant must coordinate with federal and state agencies during the environmental permitting process for a project, including during early coordination and by providing authorizations or comments on applications.

3.1.1.4 Safe Drinking Water Act, 1974, as amended, 42 U.S.C. 300f

The Safe Drinking Water Act requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. The act authorizes EPA to set national health-based standards for drinking water to protect against both naturally occurring and human-made contaminants. The legal limit for contaminants in drinking source water reflects what water systems can achieve using the best available technology to provide safe water for consumption. The Office of Ground Water and Drinking Water oversees implementation of the Safe Drinking Water Act. Projects that result in exceedance of health-based standards for drinking water may be subject to civil or criminal enforcement.

3.1.2 State of Oregon

3.1.2.1 OAR Division 412, Fish Passage

Oregon Administrative Rule (OAR) Division 412, Fish Passage, prohibits the construction, abandonment, or major replacement of an artificial obstruction across any waters in the state containing native migratory fish without fish passage. Fish passage regulations are administered by ODFW. Fish passage plans for artificial obstructions must have approval from ODFW and meet the requirement of OAR 635-412-0035.

3.1.2.2 ORS 468B, Water Quality

ORS 466B sets effluent limitations, describes the implementation of the CWA, and sets permit requirements. It prohibits any person from causing pollution of any waters of the state or placing or causing to be placed any wastes in a location where such wastes are likely to escape or be carried

into the waters of the state by any means. The statute also prohibits the discharge of any wastes into waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission. Additionally, this statute sets policies for preventing contamination of groundwater and guidance for any activity that may affect Oregon's groundwater resources.

3.1.2.3 ORS 196.795-990, Oregon Removal-Fill Law

Oregon's removal-fill law requires individuals or entities that plan to remove or fill material in wetlands or waterways of the state to obtain a removal-fill permit from the Oregon Department of State Lands (DSL). The removal-fill law applies to all landowners, whether private individuals or public agencies. The purpose of the law is to ensure protection and the best use of Oregon's water resources for home, commercial, wildlife habitat, public navigation, fishing, and recreational uses. A permit is required if an activity involves removing or filling 50 cubic yards or more of material in a wetland or waterway of the state. For activities in state-designated Essential Salmonid Habitat, State Scenic Waterways, and compensatory mitigation sites, a permit is required for any amount of removal or fill.

3.1.2.4 ORS 545, Oregon Irrigation District Law

ORS 545 provides the foundations for the formation, development, operation, and governance of irrigation districts in Oregon. The following are of particular relevance to the Project's potential effects on water resources:

- ORS 545.239, Right to enter upon and acquire lands and water rights.
- ORS 545.271, Furnishing water.
- ORS 545.315, Petition to construct improvements for irrigation.

3.1.2.5 Section 401 Water Quality Certification

Pursuant to Section 401 of the CWA, a 401 water quality certification by DEQ is required for compliance with federal licensing or permitting agencies (OAR 340-048). Oregon Revised Statutes (ORS) 468 and 468B contain the codified body of statutory law that pertains to environmental quality and water quality for DEQ. For certification, the applicant must show that the action will not result in exceedance of water quality standards set forth in OAR 340-041 and OAR 340-048.

Applicants must submit a prefiling meeting request to DEQ at least 1 month prior to submitting the Section 404 application to USACE. After the Section 404 application is submitted, DEQ certifies whether the project meets state water quality standards and does not endanger waters of the state or United States or wetlands and forwards the application to the EPA for review. Comments on the Section 404 application are addressed by the applicant. The DEQ water quality certification process requires a land use compatibility statement signed by the local government land use authority to ensure that permits affecting land use are compatible with local government comprehensive plans. Upon completion of EPA's review and signed land use compatibility statement, Section 401 certification is issued by DEQ.

3.1.2.6 1200-CA Construction Stormwater Permit

NPDES 1200-CA is issued pursuant to ORS 468B.050 and Section 402 of CWA. DEQ requires this permit for construction activities on sites that cover 1 or more acres and could potentially generate stormwater runoff into surface waters or conveyance systems leading to surface waters of the state

(OAR 40-045-0015). This permit requires a temporary erosion and sediment control plan, a list of selected best management practices (BMPs) for a project, and a schedule for implementing the BMPs. Guidance on preparing an erosion and sediment control plan is provided in the DEQ March 2022 Construction Stormwater Application and Forms Manual (DEQ 2022a).

3.1.2.7 OAR Division 660, Oregon Statewide Planning Goals and Guidelines

In Oregon, Goal 6 instructs local governments to consider protection of air, water, and land resources from pollution and pollutants when developing comprehensive plans (OAR 660-015). The relevant pollutants considered include (but are not limited to) solid waste, water waste, and thermal pollution. The goal asks cities and counties to designate areas suitable for use in controlling pollution. It calls on them to use a variety of market, zoning, and management tools in creating these outcomes.

3.1.3 Jackson County

3.1.3.1 Comprehensive Plan

The Jackson County Comprehensive Plan (Jackson County 2005) contains issues, goals, and policies to guide the County's long-range general land use planning decisions including goals and policies for water quality and the proper management of water areas, watersheds, and groundwater resources. DEQ is the lead agency referenced in the comprehensive plan for regulating and managing water quality in Jackson County.

3.2 Design Standards

3.2.1 NRCS Irrigation Guide, Part 652

The NRCS Irrigation Guide, Part 652 (NRCS USDA 1997), is a component of the larger NRCS National Engineering Handbook series. This guide describes the basics and process for planning, designing, evaluating, and managing irrigation systems. It also provides the process for states to supplement the guide with local soils, crops, and irrigation water requirement information needed to plan, design, evaluate, and manage irrigation systems.

4. Affected Environment

4.1 Study Area

The study area for water resources includes the project area and all waterbodies affected by MID operations and infrastructure. These waterbodies include North Fork Little Butte Creek; South Fork Little Butte Creek; Lake Creek; Osborne Creek; Wyant, Grasshopper, Owens, and Eagle Gulch drainages; unnamed drainages 1 to 10; Little Butte Creek; Rogue River; Fish Lake; and Fourmile Lake (see Table 5-1, Figure 5-1, and Figure 5-2).

The groundwater study area includes all areas within the Little Butte Creek Watershed that are influenced by seepage from the JSC into the groundwater resources. It is assumed this area is restricted to 1 mile downgradient from the JSC (see Figure 5-1).

Table 5-1. Waterbodies Associated with MID Operations and that Could be Impacted by the Modernization Alternative

Name	Associated River Miles	Size	Tributary To	Project Nexus
North Fork Little Butte Creek	Confluence with Little Butte Creek to outlet of Fish Lake (RM 16)	N/A	Little Butte Creek	Flow timing and quantity in North Fork Little Butte Creek is largely controlled by discharge from Fish Lake. Water is diverted from North Fork Little Butte Creek at RM 0.9 into the JSC for use by MID and RRVID. Water diversion cannot exceed 125 cfs.
South Fork Little Butte Creek	Confluence with Little Butte Creek to JSC diversion point (RM 1.1)	N/A	Little Butte Creek	Water is diverted from South Fork Little Butte Creek at RM 1.1 into the JSC for use by MID and RRVID. Water diversion cannot exceed 100 cfs.
Lake Creek	Mouth of creek to siphon (RM 0.25)	N/A	Little Butte Creek	The JSC traverses underneath Lake Creek via an existing concrete siphon.
Osborne Creek	Mouth of creek to siphon (RM 0.7)	N/A	Little Butte Creek	The JSC traverses underneath Osborne Creek via an existing concrete siphon.
Wyant Gulch	Mouth of creek to siphon (RM 0.27)	N/A	Little Butte Creek	The JSC traverses underneath Wyant Gulch via an existing concrete siphon.
Grasshopper Gulch and Eagle Gulch	Mouth of creek to JSC (RM 0.28/1.05)	N/A	Little Butte Creek	Grasshopper and Eagle gulches flow into the JSC. A headgate allows a mixture of stream and canal water to continue downslope.
Owens Gulch	Mouth of creek to JSC (RM 0.58)	N/A	Little Butte Creek	Owens Gulch flows into the JSC. No headgate is present. The waterbody begins 100+ feet downslope of the JSC due to groundwater discharge.
Unnamed Drainages 1–6, 8, and 9	Mouth of creek to JSC (RM 0.05 to 0.72)	N/A	Little Butte Creek	These unnamed drainages flow into the JSC. No headgate is present. The waterbodies begin 100+ feet downslope of the JSC due to groundwater discharge.
Unnamed Drainages 7 and 10	Mouth of creek to JSC (RM 0.48/1.45)	N/A	Little Butte Creek	These unnamed drainages flow into the JSC. A headgate allows a mixture of stream and canal water to continue downslope.
Little Butte Creek	Confluence with the Rogue River to confluence of North Fork Little Butte Creek and South Fork Little Butte Creek (RM 17.2)	N/A	Rogue River	Water diverted from North Fork Little Butte Creek and South Fork Little Butte Creek is diverted into the JSC which alters flow volume in Little Butte Creek.
Rogue River	Former Gold Ray Dam (RM 126) to confluence with Little Butte Creek (RM 132)	N/A	Pacific Ocean	Water diverted from North Fork Little Butte Creek and South Fork Little Butte Creek is diverted into the JSC which alters flow volume in Rogue River.

Name	Associated River Miles	Size	Tributary To	Project Nexus
Fish Lake	N/A	7,900 AF	Outlets into North Fork Little Butte Creek	MID and RRVID hold a water right of 7,900 AF of primary storage in Fish Lake. Water levels are controlled by MID.
Fourmile Lake	NA	15,600 AF	Outlets into Fish Lake	MID and RRVID hold a water right of 15,600 AF of primary storage in Fourmile Lake. Water levels are controlled by MID.

AF = acre-feet; cfs = cubic feet per second; RM = river mile; JSC = Joint System Canal; MID = Medford Irrigation District; RRVID = Rogue River Valley Irrigation District

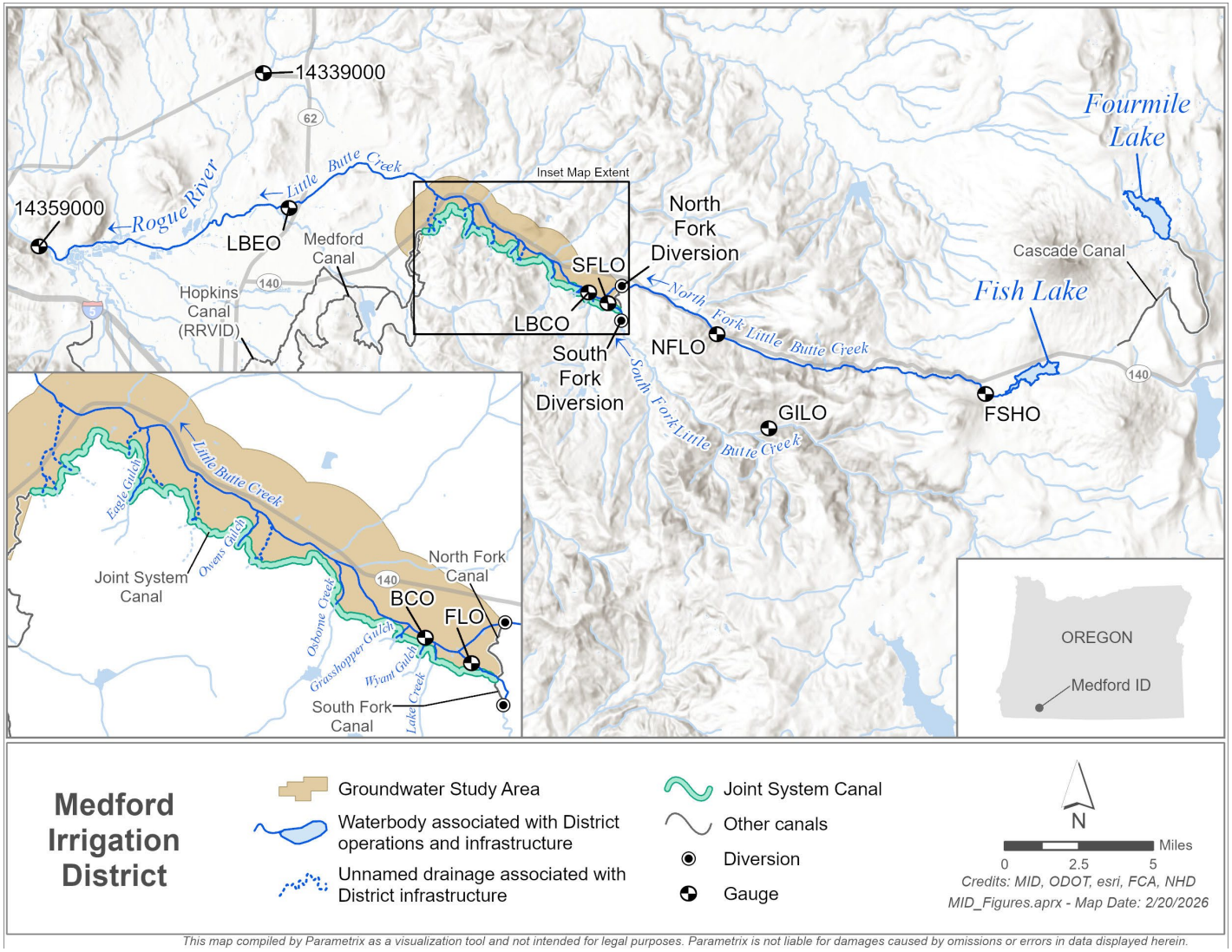


Figure 5-1 Waterbodies Associated with MID Operations and Infrastructure

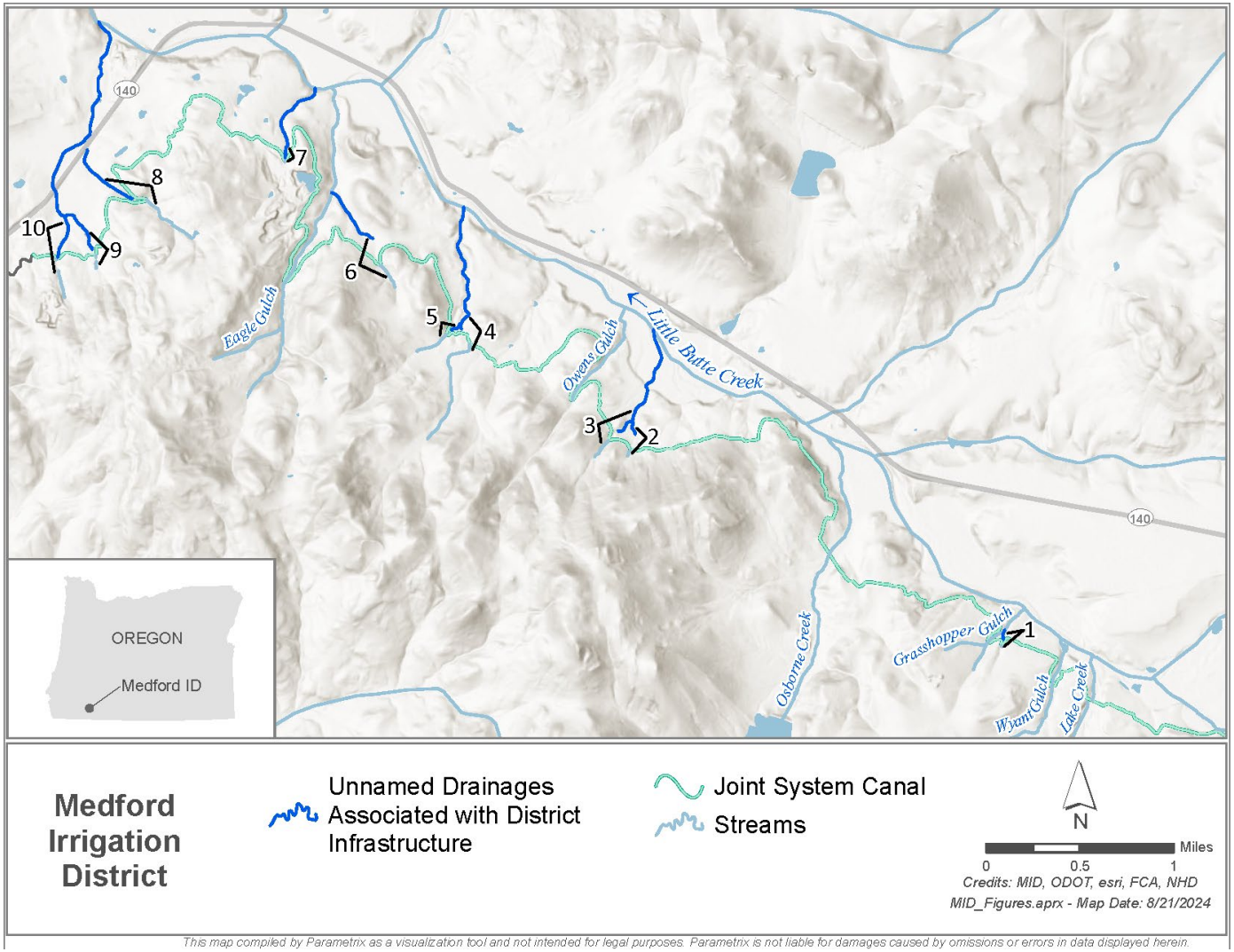


Figure 5-2. Unnamed Drainages Associated with MID Operations

4.2 Resource Identification and Evaluation Methods

The following data sources were used to identify existing conditions and provide the required information for analysis of the No Action Alternative (Future without Federal Investment) and the Modernization Alternative (Future with Federal Investment).

4.2.1 Published Sources and Databases

Sources used to conduct water rights and surface water resources analysis include the following:

- Google Earth Aerial Imagery.
- U.S. Bureau of Reclamation (Reclamation) Pacific Northwest Region Hydromet Bear Creek and Little Butte Creek Basins (Reclamation 2024).
- USFWS National Wetlands Inventory (2024).
- U.S. Geologic Service (USGS) National Water Information System (USGS 2024a).
- USGS The National Map (USGS 2024b).
- Medford Irrigation System Improvement Plan (FCA 2022).
- Oregon Water Resource Department (OWRD) Well Report Mapping Tool (2024a) and Groundwater Information System Mapping Tool (2024b).

4.2.1.1 Hydrologic Data

Information on flow volumes within MID-affected waterbodies was collected from Reclamation and USGS hydrologic monitoring stations depicted on Figure 5-1. Reclamation data were used to characterize North Fork Little Butte Creek (NFLO station above diversion point), South Fork Little Butte Creek (SFLO station below the diversion point), Little Butte Creek (LBCO and LBEO stations), Fish Lake (FIS station), and Fourmile Lake (FOR station). USGS data were used to characterize the Rogue River at the former Raygold Dam (station 14359000) and at Dodge Bridge (station 14339000). Information on diversion rates and timing was collected from Reclamation, which operates two hydrologic monitoring stations preceding diversions points on South Fork Little Butte Creek (SFBO station) and North Fork Little Butte Creek (NFBO station) in addition to one along the JSC (JCTO QC station). The JCTO QC station for the JSC does not have accurate data, particularly at high flows, due to moss accumulations in the JSC. Flows in the JSC depicted in Figure 5-3 are shown to illustrate relative flow patterns in the canal and not its absolute flow volumes. Information on the release of water from Fish Lake into North Fork Little Butte Creek and Fourmile Lake into Cascade Canal was also collected from Reclamation, which collects data from a hydrologic monitoring station on North Fork Little Butte Creek below Fish Lake (FSHO station) and on Fourmile Lake (FOR station).

All hydrologic data from Reclamation and USGS were collected from 2013 to 2023 for all stations.

4.2.1.2 Groundwater Data

There are no hydrogeologic studies of groundwater resources within the groundwater study area. Coarse-scale studies of hydrogeology have occurred at the scale of the Rogue River Basin, but they lack specifics on information within the groundwater study area (DEQ 2013). Information on groundwater resources was extrapolated from well report logs stored in the OWRD Well Report Mapping Tool (2024a). Well report logs provide information on depth at which water was first found,

water-bearing zones, static water level, and general characteristics of substrate material. No monitoring wells exist within the groundwater study area (OWRD 2024b). Nearby monitoring wells were used to characterize groundwater level fluctuations that may occur in the groundwater study area.

4.2.2 Field Visits and Surveys

Wetland and water delineation surveys were conducted by Parametrix scientists throughout the project area in April and May 2024. The surveys identified waterbodies within the project area and delineated their boundaries in addition to characterizing stream substrate, bank conditions, riparian communities, and natural or artificial (from canal seepage) wetlands. Methods and results of these surveys are described in more detail in the Terrestrial Ecology, Wetland, and Riparian Areas Technical Report.

4.3 Existing Conditions

4.3.1 MID Water Rights and Operations

4.3.1.1 MID Water Rights

The JSC directly conveys water to 783 acres of irrigated land and transports water to the Bradshaw Drop, where the conveyed water is split between MID and RRVID. According to their water rights and existing agreement, two-thirds of the water goes to MID and one-third goes to RRVID. Below the Bradshaw Drop, the Medford Canal supplies water to up to 8,303 acres of irrigated land within MID and the Hopkins Canal conveys water to over 9,500 acres of irrigated land in RRVID.

MID and RRVID divert live flow from South Fork Little Butte Creek and North Fork Little Butte Creek under Certificates 97557 and 97558, which carry 1909 and 1910 priority dates, respectively. Under these certificates, total diversion from the north and south forks of Little Butte Creek shall not exceed 140 cubic feet per second (cfs), of which 90 cfs is for MID and 50 cfs is for RRVID. Total diversion from North Fork Little Butte Creek and South Fork Little Butte Creek will not exceed 125 cfs and 100 cfs at any point, respectively. The districts also have water rights to drainages that flow into the JSC that contribute to irrigation water under Certificate S-4951. Thirteen intermittent drainages—including Grasshopper, Owens, and Eagle gulches—in addition to Unnamed Drainages 1 to 10, flow into the JSC and provide supplemental water. Multiple years of drought have prevented the districts from providing full water delivery for the last 4 years (2020–2023). Existing water loss data of the JSC indicate that up to approximately 5,057 acre-feet (AF) per year (AF/year) are lost from the JSC via canal seepage and evaporation (FCA 2024).

MID and RRVID hold primary storage water rights in Fourmile Lake and Fish Lake under Certificate 79911 which has a 1910 priority date. MID has 15,600 AF of primary water storage in Fourmile Creek which is held in Fourmile Lake. In addition, MID holds 7,900 AF of primary water storage in North Fork Little Butte Creek which is held in Fish Lake. Fourmile Lake is in the Klamath River Basin but is connected to the Little Butte Creek Watershed via the Cascade Canal which transports water from the lake into the Little Butte Creek Watershed near Fish Lake. Cascade Canal does not reach Fish Lake but terminates approximately 2.1 miles upgradient of the lake. The transferred water from Cascade Canal infiltrates into the highly permeable volcanic material in the area where it is believed to contribute to groundwater that discharges into Fish Lake (DEQ 2008).

4.3.1.2 MID Operations

Diversions occur at river mile (RM) 0.9 on North Fork Little Butte Creek and at RM 1.1 on South Fork Little Butte Creek, where water is transported into the North Fork Canal and South Fork Canal, respectively. At the convergence of the North and South Fork canals, a concrete junction diverts water into the JSC. At the junction, a headgate releases 7 cfs back into South Fork Little Butte Creek at RM 0.6 during dry years as part of the RRVID Bradshaw Drop Piping project and to meet instream flow requirements in Little Butte Creek associated with the biological opinion for the Rogue River Basin Project (NMFS 2012).

Five headgates are located along the JSC that release water to downslope streams, including Grasshopper and Eagle gulches. These headgates do not divert water to MID patrons but are used to regulate flows within the JSC to ensure flow capacity in the canal is not exceeded above design capacity and to prevent water accumulation during the non-irrigation season by acting as a drain. Headgates are 5- to 6-foot-wide structures that use headboards to regulate flow. Headboards are removed during the non-irrigation season to prevent pooling of water within the JSC.

The irrigation season for MID and RRVID occurs from April 15 to October 1, and diversion rates are highest from mid-May to the beginning of August. Diversions generally end by mid-October. Diversions periodically occur during the non-irrigation season to fill the RRVID Agate Reservoir and to serve frost protection water rights. The JSC is dry when diversions are not occurring except during high precipitation events that result in water incidentally being retained. Headgates along the JSC drain the canal during these precipitation events.

Water diversions from South Fork Little Butte Creek constitute most of the flow within the JSC until they peak in mid-May (Figure 5-3). Thereafter, water diversions from North Fork Little Butte Creek are the dominant source of water for the JSC. The ramping up of diversions from North Fork Little Butte Creek corresponds with the increased release of water from Fish Lake and Fourmile Lake (Figure 5-4). Releases from Fish Lake increase with the onset of the irrigation season and peak in early August. During the non-irrigation season, Fish Lake releases 10 to 18 cfs of water into Little Butte Creek. Fourmile Lake releases water into Cascade Canal from early May to early October with peak releases occurring in mid-June. On average, 6,200 AF of water are transported from Fourmile Lake into Fish Lake; however, an estimated 30 percent is assumed to be lost to seepage and evaporation and remains in the Klamath River Basin (RRVID 2023).

The filling of Fourmile and Fish lakes is restricted by flood control “space” reservations as these waterbodies are also used for flood control. Storage space within these lakes is reserved during the winter to retain runoff from storm events to prevent downstream flooding. Reservoir filling is restricted in Fourmile Lake from November 1 through March 31 and in Fish Lake from November 1 through February 28.

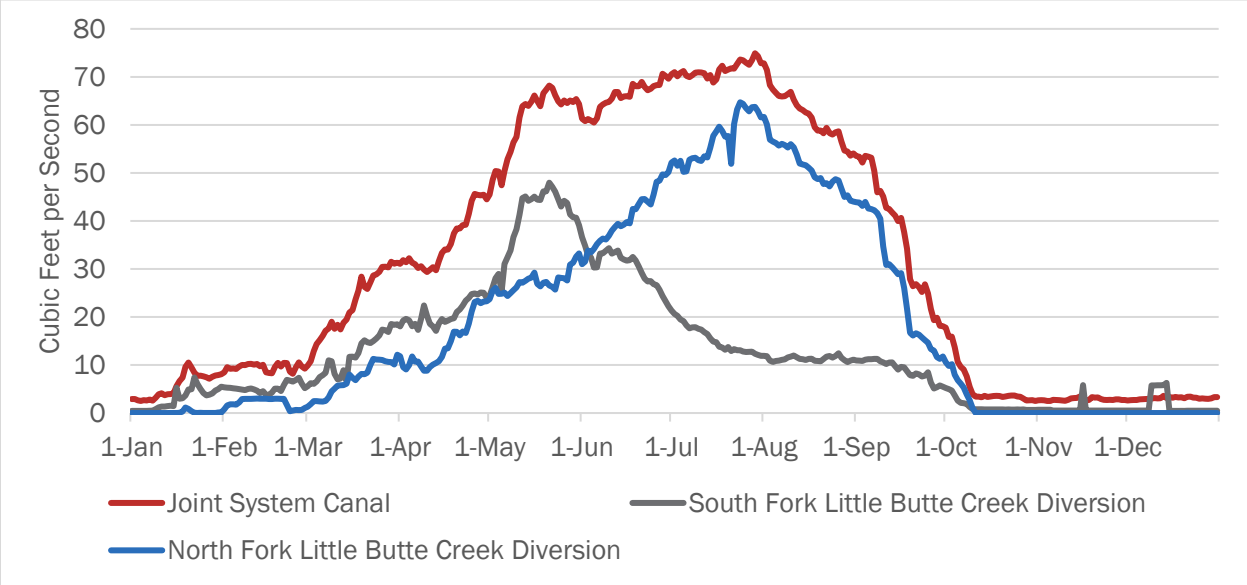


Figure 5-3. Average Canal Discharge from 2013 to 2023

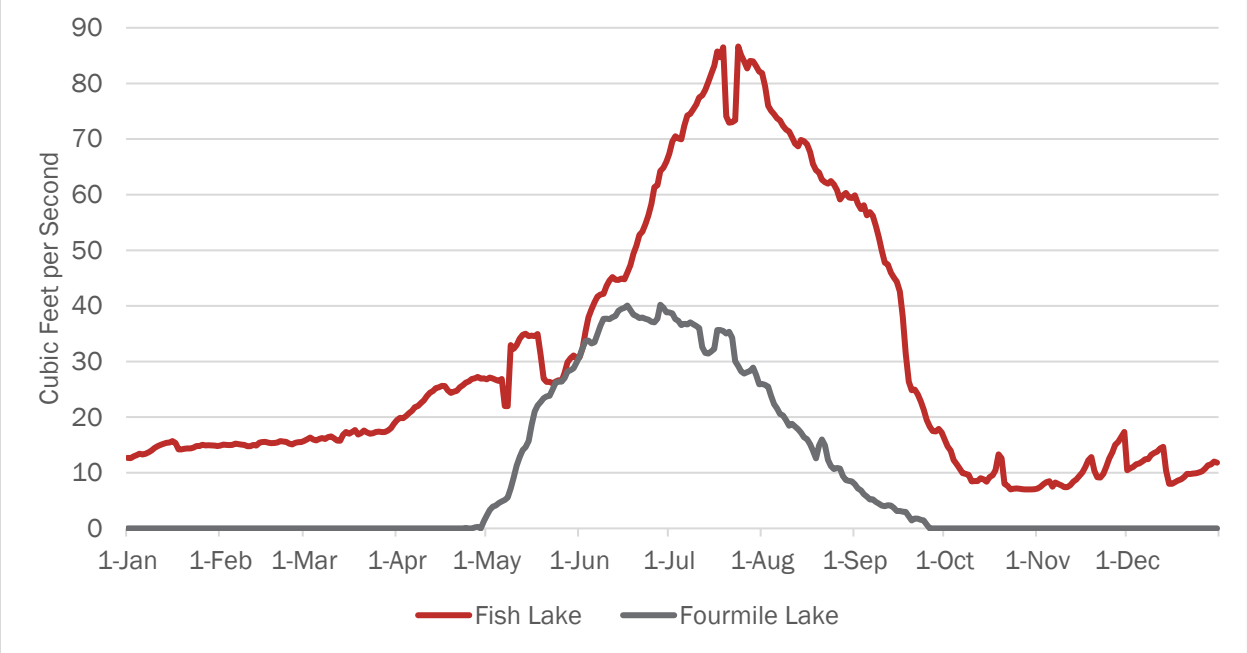


Figure 5-4. Average Releases from Fish Lake and Fourmile Lake from 2013 to 2023

4.3.1.3 Klamath Adjudication

The process to adjudicate Klamath River Drainage Basin water rights prior to the effective date of Oregon Water Rights Codes in 1909 began in 1977 and concluded in 2013. Since then, OWRD has regulated junior (post 1909) water rights within the Klamath Basin, including Fourmile Creek and Fourmile Lake. Fourmile Creek is a tributary to Upper Klamath Lake, and subsequently the Klamath

River, and is thus subject to senior surface water rights within the Klamath Basin. However, the current infrastructure at Fourmile Lake lacks the ability to release water into the Fourmile drainage. Water movement from Fourmile Lake into Fourmile Drainage can only be conveyed through groundwater seepage. Consequentially, OWRD in 2013 issued a headgate order requiring MID and RRVID to install a bypass facility to allow conveyance of water from Fourmile Lake into the Fourmile Drainage. Furthermore, the Klamath Basin adjudicator granted large senior priority claims by the federal government on behalf of Reclamation, USFWS, and the Klamath Tribes. In March of 2023, the Klamath Tribes asserted its Claim 622 which led to a call on Fourmile Lake by OWRD. The surface water uses and regulation notice issued by OWRD to MID and RRVID prohibited releasing any water from Fourmile Lake. This, along with low reservoir levels within the Rogue River Basin, prompted a drought declaration in Jackson County (OWRD 2023). However, this call did not last throughout the irrigation season and did not impact total diversions from Fourmile Lake into the Little Butte Creek Drainage. Releases from Fourmile Lake in 2023 began on May 8, a month later than typical, and continued at a higher-than-normal conveyance rate throughout the remainder of the season resulting in no significant difference in total water conveyed, but the timing of water conveyance was shifted. RRVID received funding from the state of Oregon in 2024 to construct a new headgate at the reservoir outfall to allow for stored water in Fourmile Lake to discharge into Fourmile Creek and into the Klamath Basin. Design of the headgate structure began in fall 2024, but the construction timeline is not known.

The impact of Klamath Basin water users' senior rights to Fourmile Creek on water delivery and reliability within MID and RRVID is yet to be determined. During low water years, it is likely that these senior water rights within Fourmile Creek will further prevent the ability of MID to provide full water delivery to patrons. Calling of stored water by senior water rights holders may occur with greater frequency when the new headgate is installed at the outfall of the dam. However, the relative volume of water within Fourmile Lake may limit the utility of the water resource to senior water users within the Klamath Basin which may limit calls on Fourmile Creek. Overall, the Klamath Basin senior water rights within Fourmile Creek adds uncertainty to the amount of stored water in Fourmile Lake available to MID and RRVID in future years.

4.3.2 Surface Water Hydrology

4.3.2.1 General Hydrologic Conditions

Within the Rogue River Basin, streamflow generally follows seasonal precipitation patterns. Generally, in unregulated systems low flows normally occur from July through September or October. Higher flows occur throughout the remainder of the year with peak flow timing fluctuating widely with storm events and snowmelt. Storm events are generally 3 to 5 days in duration. Precipitation is generally quickly routed to streams resulting in peak flows within hours of a storm event occurring. Rapid runoff results in a higher magnitude of flooding conditions but for a shorter duration (OWRD 1985). However, extensive pumice deposits and fractured lava flows in the eastern portion of the watershed result in longer flow paths for rain and melting snow that help to maintain flows during the summer months (OWRD 1985).

Hydrologic conditions within the Rogue River Basin have changed significantly since 1900 with the construction and operation of reservoirs, dams, and diversions. Reservoirs and dams retain runoff and reduce peak flow events within regulated streams which limit geomorphic processes that support and create instream and riparian habitats. Release of retained water from reservoirs during the drier months artificially increases flow within portions of downstream waterbodies. From 1941 to 2010, winter streamflow decreased and summer streamflow increased within regulated waterbodies, reflecting the management of reservoirs and dams (Dalton et al. 2015). Retention of

water during high precipitation months and release during drier months can create an inverted hydrograph where high flow within these regulated systems occurs during summer and low flows occur during winter. Diversions during the irrigation season cause high flow conditions downstream of the diversions to begin declining as early as mid-April and cause base flow conditions to have reduced flow.

4.3.2.2 Mandated Instream Flows

NMFS issued a biological opinion in 2012 for Southern Oregon/Northern California Coast coho salmon (*Oncorhynchus kisutch*) for the Reclamation Rogue River Basin Project (NMFS 2012) which included the operations of MID, RRVID, and Talent Irrigation District (TID). In the opinion, NMFS provides an incidental take statement which provided conservation measures necessary to minimize the impact of the take which altered hydrology within South Fork Little Butte Creek and Little Butte Creek. These conservation measures included minimization of diversion ramping, reduced TID diversions within the headwaters of South Fork Little Butte Creek, and minimum flows within Little Butte Creek and South Fork Little Butte Creek; minimum flows are set according to dry and wet seasons.

Instream water rights are present within Little Butte Creek, North Fork Little Butte Creek, South Fork Little Butte Creek, and Lake Creek (RRWC 2018). These instream water rights have priority dates ranging from 1959 to 1991 and retain water within these waterbodies from mid-summer to early fall.

4.3.2.3 Anticipated Changes to Baseline Hydrologic Conditions

Climatological changes have, and will continue, to alter hydrologic conditions within the Rogue River Basin. Precipitation has increased throughout much of the basin, but with warming temperatures more of this precipitation has come in the form of rain resulting in reduced snowpack (Dalton et al. 2015). Climatic projections anticipate the basin will continue to warm and result in warmer, wetter winters with reduced snowpacks, as well as drier summers. Extreme precipitation events are also anticipated to become more common and result in higher peak flow events. Alterations in precipitation patterns will have commensurate impacts on streamflow regime. Streamflows in winter are anticipated to increase, whereas summer streamflows are projected to decrease (Dalton et al. 2015). Projections of warmer, drier summers with reduced snowpack will likely contribute to increased potential for drought conditions. Drought declarations have occurred for the last 4 years in Jackson County (OWRD 2023).

4.3.2.4 North Fork Little Butte Creek

North Fork Little Butte Creek begins at the outfall of Fish Lake and flows 16 miles to its confluence with South Fork Little Butte Creek and the beginning of Little Butte Creek. Flows within North Fork Little Butte Creek are largely controlled by dam releases from Fish Lake. Flow timing is inverted with low flow periods occurring during winter, high flow periods occurring between early June and mid--September, and peak flows occurring in early August (Figure 5-5), which coincides with peak releases from Fish Lake (Figure 5-4). In addition to releases from Fish Lake, North Fork Little Butte Creek receives inflow from tributaries and groundwater. Water is diverted from North Fork Little Butte Creek into the JSC at RM 0.9. Smaller private diversions occur along the lower portions of North Fork Little Butte Creek. Flow gauges for North Fork Little Butte Creek are not present below the JSC diversion point at RM 0.9. However, flow conditions within this reach during the irrigation season can be estimated by subtracting JSC diversion flow from measured flow in North Fork Little Butte Creek at RM 5. Doing this estimation, North Fork Little Butte Creek's flow below the JSC diversion is high December through April early spring with average maximum flow estimated as 49.8 cfs. Flow

declines in May and remains consistent until the following December with an average flow of 31.6 cfs and a minimum of 24.1 cfs.

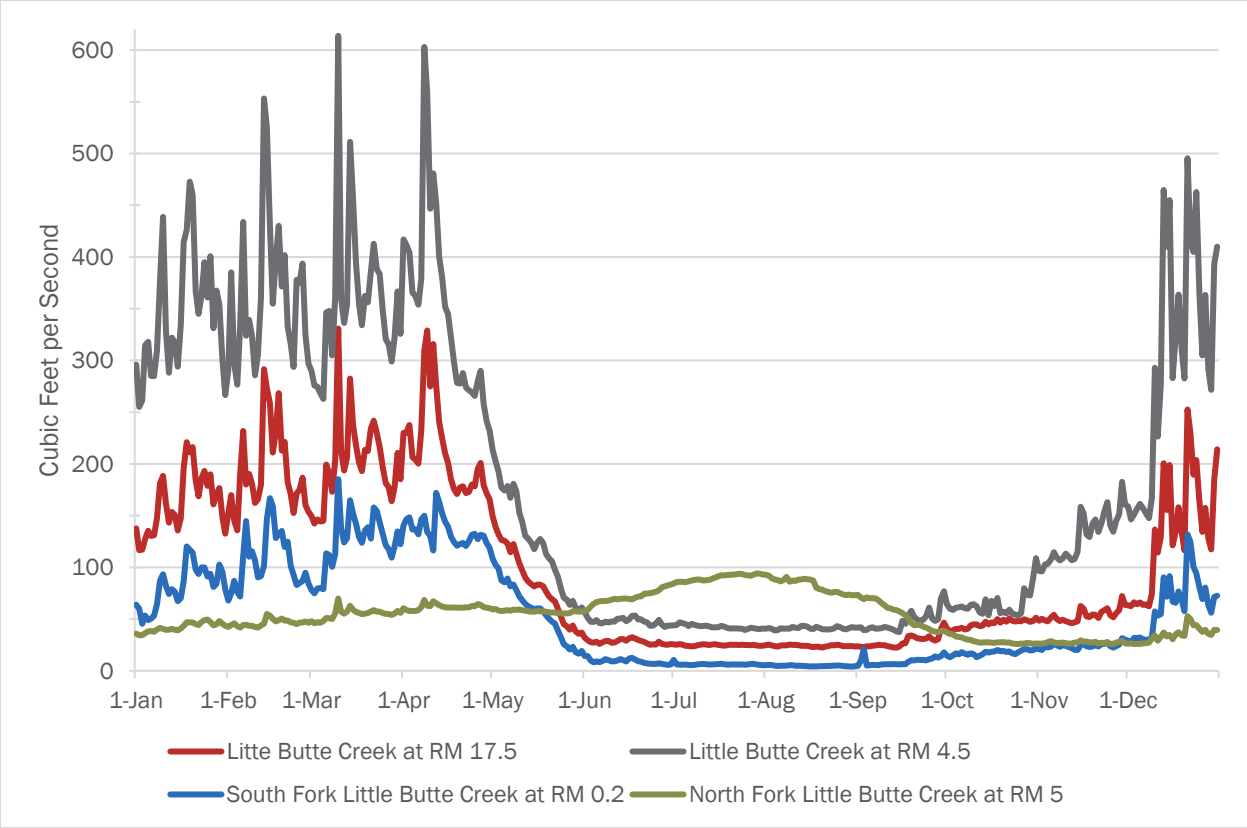


Figure 5-5. Average Streamflow from MID-Affected Waterbodies from 2013 to 2023

4.3.2.5 South Fork Little Butte Creek

South Fork Little Butte Creek begins in the headwaters of the watershed and ends at its confluence with North Fork Little Butte Creek and the beginning of Little Butte Creek. Peak flows occur during periodic storm events during winter and in spring during snowmelt (Figure 5-5). Inflow into South Fork Little Butte Creek includes tributaries and groundwater discharge. There are no reservoirs present within South Fork Little Butte Creek. Following spring melt and commencement of the irrigation season (April 15), flows in South Fork Little Butte Creek steadily decline until they reach base flow in early June. Diversions within South Fork Little Butte Creek reduce peak flows, shorten high flow periods, and lessen base flow. Major diversions (greater than 40 cfs) occur up in the headwaters associated with TID and at RM 1.1 associated with MID and RRVID into the JSC. Smaller private diversions occur along the lower portion of South Fork Little Butte Creek.

TID's average annual diversion from headwater tributaries of South Fork Little Butte Creek into the Klamath River Basin Howard Prairie Reservoir is 14,800 AF (NMFS 2012). Minimum flows in South Fork Little Butte Creek as part of the NMFS 2012 biological opinion are set for the GILO Hydromet station located 7.5 miles upstream of the TID diversion point. Median minimum flows vary from 18 to 40 cfs in June through December and 41 to 145 cfs in January through May (NMFS 2012).

4.3.2.6 Lake Creek

The JSC traverses underneath Lake Creek at RM 0.25. Lake Creek flows into Little Butte Creek at RM 16.9. No hydrologic data are available for Lake Creek. Lake Creek's hydrology is likely similar to that of South Fork Little Butte Creek which is driven by rain and snowmelt. High flow likely occurs from mid-December to mid-April, with baseflow conditions occurring in early June through December. Private reservoirs in the headwaters of Lake Creek and its tributaries retain and divert water likely resulting in dampened peak flows and a lower base flow. Lake Creek is a 14-foot-wide perennial system that receives inflow from tributaries and groundwater which is supplemented by tailwater from flood irrigation.

4.3.2.7 Osborne Creek

The JSC traverses underneath Osborne Creek at RM 0.7. Osborne Creek flows into Little Butte Creek at RM 14.9. No hydrologic data are available for Osborne Creek. The entirety of flow within Osborne Creek is captured in its upper watershed by Osborne Reservoir, a privately owned reservoir, and is diverted to agricultural fields for flood irrigation. Osborne Creek within the study area is below the reservoir and is supported by groundwater discharge, precipitation runoff, and flood irrigation runoff. Osborne Creek within the study area is a 7-foot-wide perennial system with highest flows likely occurring during precipitation events in winter and spring.

4.3.2.8 Wyant Gulch

The JSC traverses underneath Wyant Gulch at RM 0.27. Wyant Gulch flows into Little Butte Creek at RM 16.7. No hydrologic data are available for Wyant Gulch. The stream is likely intermittent upslope of the JSC and perennial downslope of the JSC. The stream receives inflow from groundwater. The downslope portion of Wyant Gulch below the JSC likely receives greater input of groundwater owing to its lower watershed position and due to canal seepage. The creek is, on average, 3 feet wide. Private dams are located along Wyant Gulch up- and downslope of the JSC.

4.3.2.9 Grasshopper and Eagle Gulches

Grasshopper and Eagle gulches flow into the JSC at RM 0.28 and 1.05, respectively. In both locations, a headgate allows a mixture of stream and canal water to continue downslope. Grasshopper Gulch and Eagle Gulch flow into Little Butte Creek at RM 16.5 and 11.4, respectively. No hydrologic data are available for Eagle or Grasshopper gulches. During the timing of field work in April and June 2024, these streams upslope of the JSC did not contain flowing water. These streams downslope of the JSC contained flowing water due to incidental headgate release of canal water into the stream and groundwater inputs which are augmented by canal seepage. Thus, Eagle and Grasshopper gulches are likely intermittent upslope of the JSC and perennial downslope of the JSC. The stream widths of these systems are, on average, 6 feet.

4.3.2.10 Owens Gulch

Owens Gulch flows into the JSC at RM 0.58. No headgate is present, and the waterbody begins 100+ feet downslope of JSC due to groundwater discharge which is augmented by canal seepage. Owens Gulch flows into Little Butte Creek at RM 13.6. No hydrologic data are available for Owens Gulch. During the timing of field work in April and June 2024, Owens Gulch did not have flow upslope of the JSC but contained flow downslope of the canal. Thus, the stream is likely intermittent upslope of the JSC and perennial downslope of the canal. Owens Gulch has an average stream width of 5 feet. The creek receives inflow from groundwater and precipitation, which is augmented by canal

seepage in its downslope portion. Highest flows likely occur during precipitation events in winter and spring.

4.3.2.11 Unnamed Drainages 1-6, 8, and 9

Unnamed Drainages 1 to 6, 8, and 9 flow into the JSC. No headgate is present, and the waterbody begins 100+ feet downslope of the JSC due to groundwater discharge which is augmented by canal seepage. These waterbodies flow into Little Butte Creek from RM 10.1 to 16.5. No hydrologic data are available for these unnamed drainages. During the timing of field work in April and June 2024, these streams upslope of the JSC did not contain flowing water. Due to their small watersheds, these systems are intermittent. Downslope portions of these drainages below the JSC likely have a higher frequency of flow due to higher rates of groundwater discharge that are augmented by canal seepage. Downslope portions of these unnamed drainages have estimated lengths that vary from 0.05 to 0.72 miles. The average width of these streams is 3 feet. These drainages receive inflow from groundwater and precipitation, which is augmented by canal seepage in its downslope portion. Highest flows likely occur during precipitation events in winter and spring.

4.3.2.12 Unnamed Drainages 7 and 10

Unnamed Drainages 7 and 10 flow into the JSC at RM 0.48 and 1.45, respectively. A headgate allows a mixture of stream and canal water to continue downslope. Unnamed Drainages 7 and 10 flow into Little Butte Creek at RM 11.3 and 10.1, respectively. No hydrologic data are available for these unnamed drainages. During the timing of field work in April and June 2024, these streams upslope of the JSC did not contain flowing water. Due to their small watersheds, these systems are intermittent. Downslope portions of these drainages below the JSC likely have a higher frequency of flow due to incidental headgate release of canal water and higher rates of groundwater discharge that are augmented by canal seepage. Estimated downslope lengths for these waterbodies are 0.48 and 1.45 miles for Unnamed Drainages 7 and 10, respectively. The average width of these streams is 3 feet. These drainages receive inflow from groundwater, which is augmented by canal seepage and incidental headgate releases in its downslope portion. Highest flows likely occur during precipitation events in winter and spring.

4.3.2.13 Little Butte Creek

Little Butte Creek begins at the confluence of the south and north forks of Little Butte Creek and flows 17.2 miles until its confluence with the Rogue River. Little Butte Creek is a rain-snowmelt-driven system with highest flows occurring from mid-December to mid-April (Figure 5-5). Peak flows occur during periodic storm events during winter and in spring during snowmelt. Following the spring melt and commencement of the irrigation season (April 15), flows in Little Butte Creek steadily decline until they reach base flow in early June. The creek receives inflow from tributaries, such as North Fork Little Butte Creek and South Fork Little Butte Creek, in addition to groundwater discharge. Diversion points along North Fork Little Butte Creek and South Fork Little Butte Creek and tributaries to Little Butte Creek influence flow within the creek. Smaller diversions along Little Butte Creek further influence flow quantity. Numerous tributaries of Little Butte Creek are regulated by reservoirs in their headwaters which impact flow timing and quantity within the creek.

Minimum flows in Little Butte Creek as part of the NMFS 2012 biological opinion are set for the LBEO and LBCO Hydromet stations at RM 3.5 and 17, respectively. Median minimum flows at LBCO vary from 29 to 73 cfs in June through November and 122 to 295 cfs in December through May. Median minimum flows at LBEO vary from 36 to 162 cfs in June through November and 231 to 408 cfs in December through May.

4.3.2.14 Rogue River

From the confluence of Little Butte Creek and the Rogue River, the Rogue River flows 132 miles to the Pacific Ocean. Rogue River flows are orders of magnitude larger than Little Butte Creek flows and thus Little Butte Creek's effect on flows and water quality within the Rogue River are limited to a few river miles (RM 132 to 126). The Rogue River is a rain-snowmelt-driven system with highest flows occurring from mid-December to mid-April (Figure 5-6). Lost Creek Lake, a reservoir with 465,000 AF of storage on RM 157 of the Rogue River, dampens peaks flows on the river and increases flows during late spring and summer from dam releases. Base flow in the Rogue River is not reached until mid-September. Flows in the Rogue River begin to rise again in November with increased precipitation and reach high flows by mid-December. The river receives inflow from tributaries such as Little Butte Creek, in addition to groundwater discharge.

4.3.2.15 Fish Lake

Fish Lake is a 483-acre lake with a maximum depth of 31 feet and an average depth of 18 feet. The lake was enlarged in 1908 with the construction of a non-fish-passable dam. Fish Lake relies on snowmelt, precipitation, tributary inflows, groundwater input, and the Cascade Canal for inflow. Fish Lake and its dam are operated in coordination with Fourmile Lake for water demands in MID and RRVID. Fish Lake Dam is owned by MID and RRVID and operated by MID. Storage and releases are directed by OWRD and are executed by MID. Average water storage varies from 6,000 AF in mid-June to 2,770 AF in late September. Oscillations in storage capacity result in lake levels varying, on average, by 9.7 feet in surface elevation (Reclamation 2024).

Water is released from the dam to maintain water levels in North Fork Little Butte Creek and to transport water to downstream water users. During the non-irrigation season, 7 to 18 cfs are released, whereas releases during the irrigation season peak, on average, at 86 cfs (Figure 5-4).

4.3.2.16 Fourmile Lake

Fourmile Lake is a 740-acre reservoir constructed in 1922 (NMFS 2012) with a maximum depth of 170 feet. Fourmile Lake relies on tributary input, precipitation, and snowmelt for inflow. Fish Lake and its dam are operated in coordination with Fourmile Lake for water demands in MID and RRVID. Fourmile Lake dam is owned by MID and RRVID and operated by MID. Storage and releases are directed by OWRD and are executed by MID personnel. Average water storage varies from 7,800 AF in late May and 1,400 AF in early September. Oscillations in storage capacity result in lake levels varying, on average, by 9.3 feet.

Water is released from the Fourmile Lake dam beginning in late April and ending in late September with a peak release of 40 cfs occurring from mid- to late June (Figure 5-4).

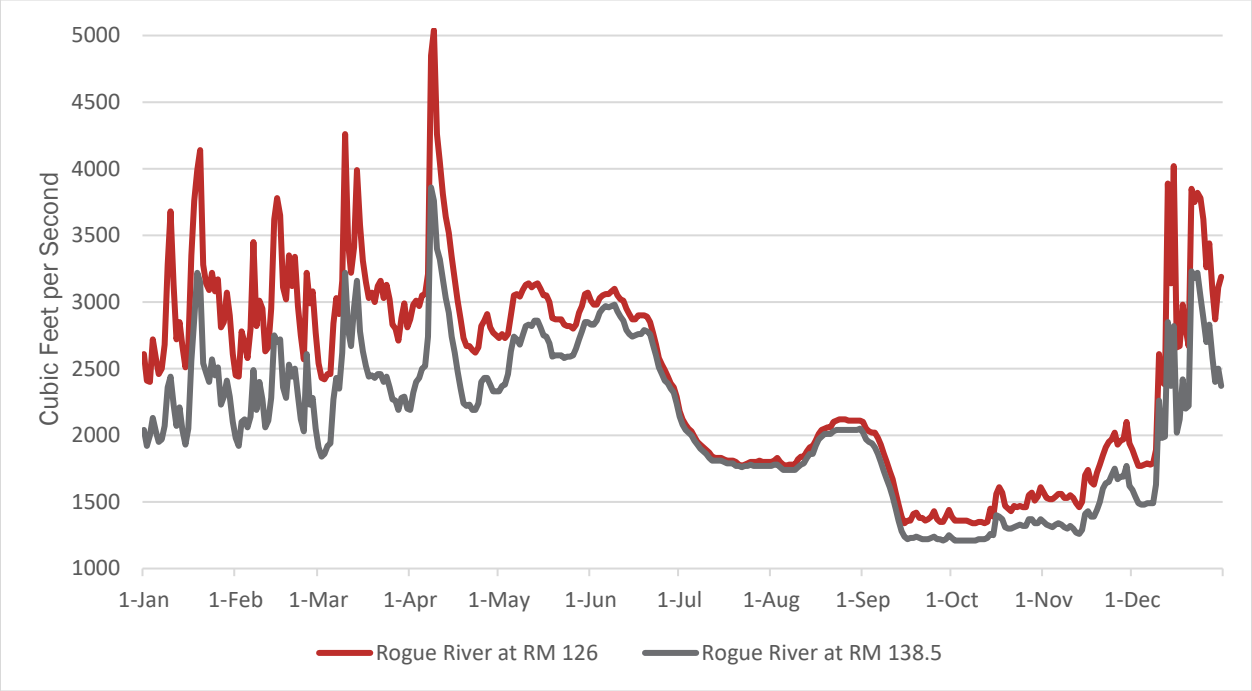


Figure 5-6. Average Streamflow of Rogue River from 2013 to 2023

4.3.3 Surface Water Quality

DEQ maintains a list of all surface waters in the state that are identified as impaired because they do not meet water quality standards under Section 303(d) of the CWA (33 United States Code [U.S.C.] 1251 et seq.). All waterbodies associated with MID operations are included on Oregon's Section 303(d) impaired list, per the DEQ 2022 integrated report on surface water quality and list of water quality–limited waters (DEQ 2022b). Table 5-2 lists the water quality impairment parameters that each waterbody exceeds.

Table 5-2. Impaired Waterbodies Associated with MID Operations

Waterbody	River Miles Associated with MID Operations	Parameters Included on Oregon's Section 303(d) List
North Fork Little Butte Creek	Mouth of creek to RM 5.5	Temperature
South Fork Little Butte Creek	Mouth of creek to JSC diversion point (RM 1.1)	Temperature Flow Modification Habitat Modification
Lake Creek	Mouth of creek to JSC siphon (RM 0.25)	Temperature Sedimentation *E. coli* Habitat Modification

Waterbody	River Miles Associated with MID Operations	Parameters Included on Oregon's Section 303(d) List
Little Butte Creek	Confluence with the Rogue River and creek beginning at the confluence of North Fork Little Butte Creek and South Fork Little Butte Creek (RM 17.2)	Temperature Dissolved Oxygen Sedimentation *E. coli* Phosphorus
Rogue River	Former Gold Ray Dam (RM 126) and confluence with Little Butte Creek (RM 132)	Temperature Biological criteria Methylmercury
Fish Lake	N/A	Chlorophyll *a* pH Harmful Algal Blooms

Source: DEQ, 2022, EPA Approved Integrated Report.

N/A = not applicable; RM = river mile

4.3.3.1 General Contributing Factors to Water Quality Impairment

Water management in the study area has altered seasonal streamflow patterns, largely reducing streamflow above historical levels. Low streamflow affects water quality by exacerbating temperature and dissolved oxygen problems. Agricultural land use has also contributed to poor water quality owing to reduced riparian areas and tailwater discharge from flood irrigation. The majority of agricultural lands surrounding study area waterbodies are irrigated using flood irrigation. Flood irrigation is inefficient and results in tailwater exiting the irrigated land and potentially entering waterbodies. Studies within the Little Butte Creek Watershed have shown tailwater has elevated temperature, turbidity, and concentrations of *Escherichia coli* (*E. coli;* JSWCD 2017). Tailwater has also been shown to have elevated concentrations of nitrogen and phosphorus (McHugh et al. 2008). Thus, tailwater interception with waterbodies can further degrade water quality.

The JSC likely acts as a point and nonpoint source of pollution to nearby waterbodies. Preliminary water quality data collected by Jackson Soil and Water Conservation District show that *E. coli* concentrations in the JSC are elevated and that turbidity levels increase within the JSC, which is likely due to canal erosion and runoff from upslope areas. Furthermore, irrigation canals generally have elevated temperatures due to thermal loading from a lack of riparian cover. Impaired water within the JSC is able to enter nearby waterbodies through canal seepage and incidental headgate release, degrading water quality in the receiving streams. Incidental headgate release into tributaries of Little Butte Creek (Grasshopper Gulch, Eagle Gulch, Unnamed Drainages 7 and 10) during the irrigation season likely elevates temperatures and turbidity levels within these waterbodies which may have an associated effect on downstream waterbodies. Similarly, canal seepage may also be influencing water quality to streams whose groundwater discharge is augmented by this artificial source. Canal seepage water may also be further impaired along its groundwater flow path to receiving streams. Canal seepage downslope of the JSC was observed in several locations to result in a slow moving sheet flow that may result in further impairment of water quality by elevating temperature, *E. coli* concentrations, and turbidity levels as is observed for flood irrigation tailwater in the area. Thus, it is likely that canal seepage may act as a nonpoint pollution source to tributaries of Little Butte Creek that are adjacent to the JSC such as Lake Creek, Wyant Gulch, Grasshopper Gulch, Owens Gulch, Eagle Gulch, and Unnamed Drainages 1 to 10.

4.3.3.2 Municipal Drinking Water and Water Quality Management

The Medford Water Commission (MWC) provides drinking water to 140,000 customers from numerous municipalities within the region including Medford, Eagle Point, White City, Central Point, Ashland, Jacksonville, Phoenix, and Talent. The MWC sources drinking water from the Big Butte Springs Watershed in addition to the Rogue River. During the months of peak season (May to September), the MWC diverts water from the Rogue River at RM 131 where it is treated at the MWC Duff Treatment Plant. Currently, water rights at this diversion point are approximately 70 cfs (GSI 2020). However, to account for projected demands in water consumption MWC and its partner cities have a strategic plan to increase water rights allocation at the diversion point and expand the capacity of the Duff Treatment Plant (GSI 2020).

Litte Butte Creek flows into the Rogue River 1 mile upstream from the Duff Treatment Plant. Little Butte Creek heavily influences water quality within Rogue River and thus can affect the source drinking water for MWC during the summer. Water quality impairments—such as turbidity and *E. coli* in Little Butte Creek have a direct effect on municipal drinking water by increasing the treatment requirements of water diverted from the Rogue River. To ensure the protection of water quality for these municipalities, the Rogue Valley Council of Governments, in partnership with the Rogue River Watershed Council and the Jackson Soil and Water Conservation District, prepared the Rogue National Water Quality Initiative Plan (Stabach and Seidlecki 2024). The plan outlines contaminants of concerns and their sources, currently applied treatments, and plans for future treatments. Within the study area in the Little Butte Creek Watershed, Jackson Soil and Water Conservation District has coordinated with landowners to improve and modernize irrigation systems to prevent tailwater runoff, develop management plans for cattle grazing to improve pastureland health, and restore riparian areas by removing noxious weeds, planting native vegetation, and installing fencing (Stabach and Seidlecki 2024). Future plans for water quality improvements are outlined in the Little Butte Creek Watershed Plan which calls for funding projects to restore riparian areas, install fencing to prevent or limit cattle access into streams, and promote the conversion of flood irrigation to sprinkler systems (RRWC 2018).

4.3.3.3 Anticipated Changes to Water Quality Parameters

Climate change is anticipated to put further stress on water quality within the study area. Projected increases in air temperature may result in higher water temperatures and declines in dissolved oxygen (Dalton et al. 2015). Increased temperatures and drought conditions may result in increased wildland fire activity which can increase loading of sediment and nutrients into waterbodies (Dalton et al. 2015).

DEQ is required to develop TMDLs for rivers and streams in the Upper Rogue River Basin (these impairments may extend upstream or downstream of the reaches identified in Table 5-2). The following sections describe existing Section 303(d)-listed impairments in the waterbodies associated with MID operations.

4.3.3.4 Temperature

North Fork Little Butte Creek, South Fork Little Butte Creek, Lake Creek, Little Butte Creek, and Rogue River are designated as core cold-water habitat (OAR 340-041-0271). Little Butte Creek, South Fork Little Butte Creek, and the Rogue River within the study area have a salmon and steelhead spawning use time frame of September 15 to June 15, whereas Lake Creek and North Fork Little Butte Creek from RM 0 to 8.2 have a salmon and steelhead spawning use time frame of

October 15 to June 15 (OAR 340-041-0271). The upper reaches of North Fork Little Butte Creek have a salmon and steelhead spawning use time frame of January 1 to June 15. During the spawning time frame, water temperature cannot exceed 55.4°F. During the remainder of the year in core cold-water habitat, water temperature cannot exceed 60.8°F. North Fork Little Butte Creek, South Fork Little Butte Creek, and Lake Creek within the study area do not meet the stream temperature criterion for year-round use by aquatic organisms (DEQ 2022b; Table 5-2). The Rogue River and Little Butte Creek within the area of MID operations do not meet the stream temperature criterion for year-round use by aquatic organisms, in addition to during salmonid and steelhead spawning (DEQ 2022b; Table 5-2). Elevated stream temperatures affect aquatic species, including native fish, by exacerbating conditions that cause stress and disease, raise their metabolism, and reduce growth rates. A TMDL for temperature has also been established for Little Butte Creek, North Fork Little Butte Creek, South Fork Little Butte Creek, Lake Creek, and the Rogue River (DEQ 2008). Reduced streamside vegetation and shading, reduced hyporheic exchange, irrigation return flow, dam operations, or water withdrawal contribute to higher temperatures within the study area (DEQ 2008).

4.3.3.5 Dissolved Oxygen

Little Butte Creek does not meet Oregon standards for dissolved oxygen (DEQ 2022b; Table 5-2). Dissolved oxygen concentrations within Little Butte Creek fall below the minimum threshold of 11.0 mg/L during salmonid spawning and below 8.0 mg/L during the remainder of the year for a cold-water system (OAR 340-041-0271). Low dissolved oxygen levels can affect aquatic life by reducing habitat quality and quantity, changing behavior, or reducing growth rates. Excess nutrient inputs associated with algae growth and die-off, loss of structural complexity that creates turbulence in streams, and elevated stream temperatures can all contribute to lower dissolved oxygen levels.

4.3.3.6 pH

A waterbody's pH is a measure of its acidity or basicity. Fish Lake exceeds Oregon pH standards for Cascades lakes above 3,000 feet with pH values above 8.5 (DEQ 2022b; Table 5-2). Higher pH can affect aquatic life by changing the solubility or biological availability of chemicals in the water.

4.3.3.7 Sedimentation

Sedimentation refers to the deposition of silt, sand, and other small particles within a river system. Little Butte Creek and Lake Creek within the study area do not meet Oregon standards for sedimentation; sediment accumulation can be harmful to aquatic life or injurious to public health, recreation, or industry (DEQ 2022b). Excess fines were observed in 7 out of 11 reaches within Little Butte Creek in 1998; this prompted the listing of the system as impaired for sedimentation (DEQ 2022b; Table 5-2). In Little Butte Creek, agricultural encroachment of the riparian zone has accelerated bank erosion resulting in an increased number of fine sediments within the channel. Tailwater interception within Little Butte Creek and Lake Creek likely further contributes to fine sediment inputs into the system. Deposited sediment can affect fish and aquatic life by reducing the quantity and quality of available habitat.

4.3.3.8 Phosphorus

Little Butte Creek does not meet standards for phosphorus with recorded concentrations above 0.1 µg/L (DEQ 2022b; Table 5-2). High concentrations of phosphorus may result from poor agricultural practices, runoff from urban areas and lawns, leaking septic systems, or discharges from sewage treatment plants. Too much phosphorus can cause increased growth of algae and large

aquatic plants, which can result in decreased levels of dissolved oxygen—a process called eutrophication. High levels of phosphorus can also lead to algae blooms that produce algal toxins which can be harmful to human and animal health (EPA 2023b).

4.3.3.9 Harmful Algal Blooms

Fish Lake does not meet Oregon standards for harmful algal blooms (DEQ 2022b; Table 5-2). Certain environmental conditions in waterbodies can intensify algae growth and cause algal blooms. Blooms with the potential to harm human health or aquatic ecosystems are referred to as harmful algal blooms (HABs). In freshwater systems, cyanobacteria (previously known as blue-green algae) are microorganisms that can produce HABs. Some cyanobacterial HABs, or cyanoHABs, can produce toxins. CyanoHABs and their toxins can harm people, animals, aquatic ecosystems, the economy, drinking water supplies, property values, and recreational activities including swimming and commercial and recreational fishing (EPA 2023a).

4.3.3.10 Chlorophyll *a*

Chlorophyll *a* is a molecule found within a chloroplast that is responsible for photosynthesis. Measurements of chlorophyll *a* concentrations within a waterbody are a proxy measurement for the density of phytoplankton within the water column. Fish Lake does not meet Oregon standards for chlorophyll *a* resulting in nuisance phytoplankton growth (DEQ 2022b; Table 5-2). Nuisance phytoplankton growth reduces the aesthetic quality of the waterbody for recreation.

4.3.3.11 *E. coli*

Lake Creek, within the study area, and Little Butte Creek do not meet Oregon standards for *E. coli* (DEQ 2022b; Table 5-2). *E. coli* is a bacterium found in the gut of warm-blooded animals that is expelled into the environment within fecal matter. Several kinds of *E. coli* can cause illness if consumed. *E. coli* can enter waterways from discharged sewage, leaking septic systems, and runoff of animal waste including cattle.

A TMDL has been established for *E. coli* in the Little Butte Creek Watershed within the study area (DEQ 2008). This TMDL called for reductions in *E. coli* within Little Butte Creek, North Fork Little Butte Creek, South Fork Little Butte Creek, and Lake Creek. Since the TMDL was established, *E. coli* concentrations have been reduced in North Fork Little Butte Creek and South Fork Little Butte Creek and *E. coli* is currently listed as an attaining parameter in those systems (DEQ 2022b).

4.3.3.12 Methylmercury

The methylmercury criterion on the Section 303 (d) list indicates the methylmercury concentrations within fish tissue in regard to human health criterion for the consumption of fish. The Rogue River within the area of MID operations does not meet Oregon standards for methylmercury (DEQ 2022b; Table 5-2). Mercury can enter waterways from discharge of sewer treatment plants and aerial deposition from toxic air pollutants from coal and oil-fired power plants. Mercury can bioaccumulate within fish in the form of methylmercury and be harmful to humans if consumed.

4.3.3.13 Biological Criteria

The biological criteria parameter on the Section 303(d) list indicates that a waterbody does not meet standards for biological integrity of aquatic communities (primarily macroinvertebrates). The Rogue River within the area of MID operations does not meet Oregon standards for biological criteria (DEQ 2022b; Table 5-2). Oregon's rules for biological criteria (OAR 340-041-0011) require waters of the

state to be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

4.3.3.14 Flow Modification

South Fork Little Butte Creek within the area of MID operations is identified as impaired due to flow modification (DEQ 2022b; Table 5-2) from water diversions for irrigation. Flow alteration refers to modification of flow characteristics relative to reference or natural conditions. Human activities can significantly alter flow and may lead to biological impairment. For example, human activities may change how much water reaches a stream, divert flow through human-made channels, or alter stream shape and location. Changes to streamflow characteristics may benefit some aquatic organisms while harming others, thereby changing the biotic community composition (EPA 2023c).

4.3.3.15 Habitat Modification

South Fork Little Butte Creek and Lake Creek within the study area are identified as impaired due to habitat modification (DEQ 2022b; Table 5-2). Habitat modification activities include channelization and channel modification, dams, and streambank and shoreline erosion. A frequent result of channelization and channel modification activities is a diminished suitability of instream and streamside habitat for fish and wildlife. Such modification activities can also alter instream patterns of water temperature and sediment type, as well as the rates and paths of sediment erosion, transport, and deposition (EPA 2023d).

4.3.4 Groundwater

4.3.4.1 Hydrogeology

The groundwater study area is located in the Western Cascades physiographic subprovince, which is composed of old and softened volcanic materials (BLM and USFS 1997). The groundwater study area is composed of three geomorphic landforms; valley floor, alluvial bottom, and stream terrace. Alluvial bottom includes current floodplains associated with Little Butte Creek in addition to South Fork Little Butte Creek and North Fork Little Butte Creek, whereas stream terrace is relict floodplain. Valley floor composes the remainder of the groundwater study area.

Alluvial bottom and stream terraces have shallow surficial deposits of quaternary alluvium that are underlain by tertiary volcanic rocks such as tuff, basalt, basaltic andesite, and andesite that formed from lava flows and eruptions from nearby volcanic cones and vents (BLM and USFS 1997; Hull 1999; DEQ 2008). Quaternary alluvium varies from 8 to 35 feet deep and consists of gravels, silt, clay, and boulders (OWRD 2024a). Soils within the alluvial bottom are generally well drained, whereas stream terraces have an associated hardpan layer resulting in somewhat poor drainage (BLM and USFS 1997). The valley bottom generally lacks surficial deposits and is entirely composed of tertiary volcanic rocks. During the water and wetland delineation surveys (April and June 2024), shallow soils and shallow bedrock characteristics were observed as commonly occurring along the valley bottom.

An unconfined aquifer is present within the quaternary alluvium. This alluvial aquifer is likely linked to Little Butte Creek and its associated tributaries. Water level fluctuations in the alluvial aquifer likely vary with flow patterns in the river systems. The alluvial aquifer is further supported by irrigation and canal seepage during the irrigation season. This alluvial aquifer is likely small and is not recorded to be used solely by wells within the study area (ORWD 2024a). The one well that accesses this alluvial aquifer receives the majority of its water from deeper aquifers, but it indicates

the depth of the alluvial aquifer at 5 to 12 feet below the ground surface (OWRD 2024a). Water within the alluvial aquifer likely moves northwest along with the configuration of the stream system. Underlying the alluvial aquifer is likely an impermeable layer of andesite, basalt, or tuff that perches this aquifer.

Within the tertiary volcanic rocks, there are numerous confined aquifers that domestic water users rely on. These confined bedrock aquifers likely formed from fractured or fissured lava flows and are supported by rain and snowmelt on the hillslopes; rain and snowmelt are transported to these aquifers via long groundwater pathways (DEQ 2013). These bedrock aquifers used for domestic consumption generally occur 40 to 245 feet below ground surface and are generally narrow with a thickness of 1 to 5 feet. These water resources are likely not influenced by flow patterns within the stream system or canal seepage as aquitards prevent the infiltration of water from these waterbodies into them. Movement of water within these bedrock aquifers is dictated by the shape of fractures or fissures within the rock layer. It is assumed that water within these confined aquifers moves to the northwest.

The MID does not rely on groundwater wells for irrigation. Registered wells in the study area are used for domestic consumption and rely upon confined bedrock aquifers that are not influenced by stream infiltration and canal seepage.

4.3.4.2 Groundwater Level

Groundwater level and fluctuations within the alluvial aquifer are unknown. The one well that accesses this alluvial aquifer indicates that the alluvial aquifer is 5 to 12 feet below the ground surface (OWRD 2024a). The water level within the alluvial aquifer likely fluctuates rapidly with storm events and spring melt. The well-drained soils within the alluvial bottom allow for quick recharge from precipitation and stream infiltration. However, the well-drained character of the material also allows for rapid groundwater movement and stream discharge. Thus, the alluvial aquifer water levels quickly rise and fall with precipitation events. The water levels within the system likely mimic Little Butte Creek's hydrograph with high water levels during late fall through early spring followed by low levels throughout the remainder of the year (see Section 5.3.2). A monitoring well outside of the groundwater study area indicates that water levels in another alluvial aquifer fluctuated seasonally by up to 20 feet, with high water occurring in the winter and early spring and low water occurring during summer and early fall (OWRD 2024b). During the summer, the alluvial aquifer is also supported by irrigation water infiltration and canal seepage.

Water-bearing zones within the groundwater study area in bedrock aquifers vary from 38 to 675 feet below the ground surface. Monitoring wells outside of the groundwater study area indicate that water pressure within other bedrock aquifers varies throughout the season and from year to year without a discernible trend (OWRD 2024b).

Within the Upper Rogue River Basin, aquifer depths are presumed to be declining (Stabach and Siedlecki 2024) which is likely attributable to increased aquifer consumption and more frequent drought conditions.

4.3.4.3 Canal Seepage

Groundwater recharge from leaking irrigation canals acts as an additional artificial input into the groundwater system and likely minorly elevates groundwater levels in the alluvial aquifer. However, the influence of groundwater on flows within Little Butte Creek is unknown. Stream discharge increases as Little Butte Creek flows down gradient, but this could reflect tributary inputs or groundwater recharge. Increases in groundwater storage within the alluvial aquifer as a result of

canal seepage could be resulting in increased groundwater discharge to Little Butte Creek. Canal leakage rates have been found to vary greatly within the Upper Rogue Watershed (FCA 2020) likely depending on the geology of the canal bottom, the degree to which cracks and voids have been filled by sediment, and the wetted perimeter of the canal. Groundwater monitoring data within the groundwater study area are nonexistent, and it is not possible to determine the effect canal seepage has had on groundwater levels. Seepage loss estimates indicate that up to approximately 5,047 AF/year may be lost from the JSC via canal leakage (FCA 2024).

5. Impact Assessment Methodology and Data Sources

5.1 Long-Term Impact Assessment Methods

Potential adverse and beneficial long-term impacts of the alternatives on surface water and groundwater resources were determined by analyzing and reviewing the following:

- Impacts to Water Rights. Potential long-term impacts were assessed based on the potential effects of the No Action and Modernization Alternative on the ability of MID and RRVID to deliver sufficient irrigation water to patrons.
- Impacts to Surface Water Hydrology. Anticipated streamflow trends as a result of the Modernization Alternative were determined by a hydrologic model of the Little Butte Creek Watershed developed by GSI Water Solutions. Model outputs for the 20th percentile (dry conditions), 50th percentile (normal conditions), and 80th percentile (wet conditions), as well as the average of monthly streamflow, diversion, and reservoir storage were used to quantify pre and post Project effect on surface water hydrology in Fish and Fourmile Lake, North Fork Little Butte Creek, South Fork Little Butte Creek, and Little Butte Creek (RM 10.2 – 17.2). Averages are used to describe the general trends in hydrology in these waterbodies in Section 7.1.2. Month by month modeled changes in surface water hydrology in these waterbodies on an average basis and for wet, normal, and dry conditions can be found in Appendix A.
- Impacts to Surface Water Quality. Potential long-term impacts to surface water quality were assessed based on review of existing activities currently affecting surface water quality and the potential for the alternatives to affect levels of pollutants, sediment, and temperatures in the study area.
- Groundwater Impacts. Potential long-term impacts to groundwater were assessed based on, and comparison of, current and anticipated climatological and streamflow trends in the Upper Rogue River system relative to the amount of water conserved or not conserved as a result of the Project.
- Beneficial Impacts. Water conserved through modernization of the JSC would help MID and RRVID in the Upper Rogue River Basin to meet their patrons' agricultural irrigation demands more reliably and increase streamflow by a reduction in diversion rates. Additionally, reduction in water loss through JSC modernization would potentially help to mitigate future water shortages that could result from the competing needs to meet the year-round minimum streamflow requirements for Southern Oregon/Northern California Coast coho salmon while delivering sufficient irrigation water to MID patrons. As a result, beneficial impacts are discussed where applicable.

5.2 Short-Term Impact Assessment Methods

Short-term impacts of the Modernization Alternative and its alignment options on water resources were assessed based upon the potential for construction activities to affect surface water hydrology and surface water quality in the Little Butte Creek Watershed and groundwater quality beneath the project area. Short-term impacts of the No Action Alternative were assessed based on the presumed absence of construction activities that would otherwise be associated with the Modernization Alternative.

5.3 Indirect Impact Assessment Methods

Indirect impacts include those that are not a direct result of the Project but would potentially occur later in time or farther in distance as a result of the alternatives. Potential indirect impacts were determined by evaluating how the alternatives could change conditions for other water resources, uses, or projects in light of the existing development, climate impacts, and ongoing water resource trends occurring in the Upper Rogue River Basin.

5.4 Cumulative Impact Assessment Methods

Known past, ongoing, and reasonably foreseeable future actions with potential to affect water resources in the study area were identified through desktop research and review of recent and pending irrigation modernization projects in the Upper Rogue River Basin and Little Butte Creek Watershed. Cumulative actions in the study area include previous development and other ongoing, authorized, or proposed modernization projects by MID and other irrigation districts. Based on the analysis of potential long-term impacts of the No Action and Modernization alternatives, it was determined whether the alternatives have the potential to result in additive impacts on water resources that are also impacted by other past, present, and future projects.

6. Environmental Consequences

6.1 Long-Term Impacts

6.1.1 No Action

Under the No Action Alternative, no federal funding would be provided under Pub. L. No. 83–566 for system modernization improvements. The existing JSC would remain open, and MID's delivery system within the project area would remain in its current condition. Modernization of MID's infrastructure along the JSC would not be reasonably certain to occur.

No water would be saved under the No Action Alternative. Losses associated with seepage and evaporation would continue at current levels. Water delivery reliability for MID patrons would not improve, and current concerns regarding water availability and inefficient water delivery for agricultural use in addition to risk of infrastructure failure would not be addressed. As the ongoing shift in precipitation patterns in the Upper Rogue River Basin continues, the No Action Alternative would potentially contribute to continued reductions in streamflow during the summer, decreased water delivery reliability, increased water temperatures and deterioration in surface water quality, and declines in aquatic and riparian habitat conditions.

6.1.1.1 Water Rights

Under the No Action Alternative, MID's water rights would not change. There would be no change to the water rights of other irrigation districts in the Upper Rogue River Basin. Current system operations and maintenance practices would remain the same. Ongoing warming trends and changes in precipitation patterns of warmer, wetter winters and drier summers would be expected to persist (Dalton et al. 2015). Projections of warmer, drier summers with reduced snowpack will likely contribute to increased potential for drought conditions which are already occurring. Drought was declared for the years 2020–2023 in Jackson County (OWRD 2023) which has prevented MID from providing full water delivery in those years. Without the available benefit of additional saved water, MID's and RRVID's future ability to deliver water to patrons would be constrained.

6.1.1.2 Surface Water Hydrology

The No Action Alternative would have no direct effect on existing surface water hydrology in waterbodies associated with MID operations and infrastructure. The MID would continue to divert water in volumes that calculate for water loss due to seepage and evaporation. The JSC would continue to receive flow from streams that are intercepted by the canal, and headgates and canal seepage would continue to augment flows of downslope streams.

6.1.1.3 Surface Water Quality

The No Action Alternative would have no effect on existing surface water quality in waterbodies associated with MID operations and infrastructure (see Table 7-1). Existing diversion rates and storage levels within Fish Lake and Fourmile Lake would continue.

Under the No Action Alternative, the open irrigation canal would continue to collect stormwater and flood irrigation runoff from livestock grazing pastures, subsequently delivering contaminants such as herbicides, pesticides, fecal coliform bacteria (including *E. coli*), and other pollutants to patrons downgradient in the system. The open irrigation canal would also continue to be exposed to sunlight

and warm ambient temperatures during the summer, consequently elevating its temperature. Under the No Action Alternative, contaminated warm water would continue to be released by headgates into downslope streams which flow into Little Butte Creek.

There would be no effect on the waterbodies associated with MID operations and infrastructure that are on the Oregon Section 303(d) list, and these systems would continue to be listed as not meeting water quality standards for metrics including flow modification, temperature, dissolved oxygen, pH, sedimentation, phosphorus, harmful algal blooms, chlorophyll *a*, *E. coli*, methylmercury, and biological criteria.

6.1.1.4 Groundwater

The No Action Alternative would have no effect on existing groundwater conditions in the groundwater study area or the Upper Rogue River Basin. Annually, approximately 5,057 AF of water per year would continue to seep from the JSC into the Little Butte Creek alluvial aquifer downgradient within the groundwater study area. Within the Upper Rogue River Basin, aquifer depths are presumed to be declining (Stabach and Siedlecki 2024) which is likely attributable to increased aquifer consumption and more frequent drought conditions.

6.1.2 Modernization Alternative (Future with Federal Investment)

6.1.2.1 Joint System Canal

Hydrology and Water Quality

Under the Modernization Alternative, piping of the JSC (canal only; does not include the siphons discussed below) would be within the existing canal alignment. Piping of the JSC would result in a water savings of approximately 5,057 AF/year. Of this total, 3,793 AF/year (75 percent) would be used to fulfill existing water rights of MID and RRVID patrons, and 1,264 AF/year (25 percent) would be restored in South Fork Little Butte Creek in August and September. During these months, MID would commit 1,264 AF/year to an instream water right in South Fork Little Butte Creek, which is equivalent to 10.45 cfs. The 10.45 cfs instream water right would consist of existing voluntary bypasses (4.36 cfs on average) plus an additional 6.09 cfs (on average) bypass. These instream flows will be additive to the existing senior instream water right (1.67 cfs) to ensure flows in South Fork Little Butte Creek below RM 1.1 do not go below 12.12 cfs. This would increase flows in South Fork Little Butte Creek below RM 1.1 in addition to portions of Little Butte Creek (RM 10.2 to 17.2). Flow gains are not expected to be realized in the lower portions of Little Butte Creek (RM 0 to 10.2) and Upper Rogue River due to the Project's elimination of canal seepage and incidental headgate release of canal water, which in part support flow in these waterbodies.

The 3,793 AF/year (75 percent) of saved water retained would augment water management within Fish Lake, Fourmile Lake, and North Fork Little Butte Creek from the outlet of Fish Lake (RM 16) to the MID/RRVID North Fork Little Butte Creek diversion (RM 0.9). The saved water would be retained within Fish Lake and Fourmile Lake for use during dry years. This would increase water volumes in these lakes and would generally result in decreased flows during the irrigation season in North Fork Little Butte Creek from RM 0.9 to 16. During dry years, the saved stored water resulting from the Project would be released from the lakes to extend the irrigation season, resulting in increased flows in September in North Fork Little Butte Creek from RM 0.9 to 16.

Piping the JSC and eliminating canal seepage and incidental headgate release would allow MID to divert less water and still meet patron demands. As a result, streamflow would increase in North Fork

Little Butte Creek below the diversion point (RM 0.9) and the upper portions of Little Butte Creek (RM 10.2 to 17.2) in spring when MID relies on natural flow only and no stored water (May and June).

Piping and burying the JSC would prevent the canal from intercepting and capturing flow from 13 streams (Grasshopper, Owens, and Eagle gulches, and Unnamed Drainages 1 to 10). These streams would be reconnected to their downslope stream channels by bioengineered stream channels that would convey streamflow over the piped JSC. Reconnecting these streams would better facilitate runoff during precipitation events and would likely result in higher flows in these streams and Little Butte Creek during the non-irrigation season.

Piping the JSC would eliminate canal seepage. Canal seepage augments groundwater discharge into waterbodies adjacent to the JSC, and the loss of this water source could result in decreases in artificial hydrology to Lake Creek, Osborne Creek, Wyant Gulch, Grasshopper Gulch, Owens Gulch, Eagle Gulch, and Unnamed Drainages 1 to 10. Furthermore, piping the JSC would eliminate incidental headgate release which augments flow in Grasshopper Gulch, Eagle Gulch, and Unnamed Drainages 7 and 10. This loss of artificial hydrology could reduce flows in these systems during the irrigation season and could minorly influence flows in Little Butte Creek. However, eliminating canal seepage and incidental headgate releases would remove these point and nonpoint sources of thermal and contaminant pollution which could result in improved water quality to waterbodies that currently receive these artificial sources of hydrology.

Table 7-1 provides a summary of hydrologic and water quality impacts of piping the JSC. Sections below provide further detail on these impacts and their relative magnitudes of effect. For the purposes of this analysis, “dry,” “normal,” and “wet” conditions are represented by the 20th, 50th, and 80th percentile flows for any given flow, diversion, or storage volume. However, from 2005-2024, MID diversions were terminated before the end of September in 12 out of 20 years, an indication that overall conditions during this period of record were relatively dry compared to historical district operations. Month by month modeled changes in surface water hydrology in these waterbodies for wet, normal, and dry conditions, as well as average monthly changes, can be found in Appendix A.

Table 7-1. Impacts of the Modernization Alternative on Waterbodies Associated with MID Operations and Infrastructure

Name	*Irrigation Season* Hydrology	*Irrigation Season* Water Quality	*Non-irrigation Season* Hydrology	*Non-irrigation Season* Water Quality
South Fork Little Butte Creek (RM 0– 1.1)	On average, streamflow would increase by approximately 6.09 cfs (106 percent) in August and September. Minimum flows in August and September would be 12.12 cfs.	Increased flows in August and September would reduce stream temperatures and increase dissolved oxygen concentrations.	No change.	No change.
North Fork Little Butte Creek (RM 0– 0.9)	On average, flow would increase by approximately 4.6 cfs (13 percent) during May and June.	Increased flows in May and June would reduce stream temperatures and increase dissolved oxygen concentrations.	Insignificant increase in flows.	No change.

Name	*Irrigation Season* Hydrology	*Irrigation Season* Water Quality	*Non-irrigation Season* Hydrology	*Non-irrigation Season* Water Quality
North Fork Little Butte Creek (RM 0.9–16)	On average, flow would decrease by approximately 1.4 cfs (-2 percent) during the majority of irrigation seasons. During dry years, streamflow would increase by approximately 26.5 cfs (79 percent) during the month of September.	Decreased flows during the irrigation season would minorly increase stream temperature and decrease dissolved oxygen concentrations. Increased flow during September of dry years would significantly decrease stream temperatures and increase dissolved oxygen concentrations.	Insignificant increase in flows.	No change.
Lake Creek	No change.	No change.	No change.	No change.
Osborne Creek and Wyant Gulch	Decrease in flows from reduced groundwater discharge from loss of canal seepage.	Elimination of nonpoint source pollution from piping the JSC would improve water quality.	No change.	No change.
Grasshopper Gulch, Eagle Gulch, Unnamed Drainages 7 and 10	Decrease in flows due to loss of incidental headgate release and reduced groundwater discharge from loss of canal seepage.	Elimination of point and nonpoint source pollution from piping the JSC would improve water quality.	Increase in flows.	Reduced stream temperature and increased dissolved oxygen concentration.
Owens Gulch and Unnamed Drainages 1–6, 8, and 9	Decrease in flows from reduced groundwater discharge from loss of canal seepage.	Elimination of nonpoint source pollution from piping the JSC would improve water quality.	Increase in flows.	Reduced stream temperature and increased dissolved oxygen concentration.
Little Butte Creek	On average, flow in Little Butte Creek from RM 10.2 to 17.2 would increase by approximately 3.5 cfs (4%) during the irrigation season.	Elimination of point and nonpoint source pollution from piping the JSC would improve water quality through the entirety of the creek. In addition, increased flow from RM 10.2 to 17.2 would also improve water quality by decreasing stream temperatures and increasing dissolved oxygen concentrations.	Minor increase in flows.	Minor reduction in stream temperature and minor increase in dissolved oxygen concentration.
Rogue River	No change.	Insignificant improvement in water quality.	Insignificant increase in flows.	Insignificant improvement in water quality.
Fish Lake and Fourmile Lake	Reduced drawdown of the lakes would increase water stored in the lakes by 16 percent on average during the irrigation season.	Increased water volume in the lakes would decrease water temperature and increase dissolved oxygen concentration.	Reduced drawdown of the lakes would increase water stored in the lakes by 20 percent on average during the non-irrigation season.	Increased water volume in the lakes would decrease water temperature and increase dissolved oxygen concentration.

JSC = Joint System Canal; RM = river mile

South Fork Little Butte Creek (RM 0 to 1.1)

Hydrology

The 25% of saved water as a result of piping the JSC (1,264 AF/year) would be protected within South Fork Little Butte Creek from RM 0 to 1.1 during August and September. This stream reach and timing was prioritized for restoring water instream owing to the extremely low flows downstream of the South Fork Little Butte Creek diversion (RM 1.1) which creates a migratory barrier for local fish populations. Currently, MID is required to bypass 1.67 cfs from its South Fork Little Butte Creek diversion point owing to a senior instream water right. However, in practice MID voluntarily bypasses an additional 4.36 cfs, on average, during August and September.

The Project will place MID's existing voluntary bypass (4.36 cfs on average), plus an additional 6.09 cfs (on average) as a 10.45 cfs instream water right from RM 0 to 1.1 in South Fork Little Butte Creek from August 1 to September 30. Additional bypass water was modeled to vary from 2.72 cfs during wet conditions to 9.22 cfs during dry conditions, with an average of 6.09 cfs. The 6.09 cfs in additional bypass water will increase flows by 106% on average. In tandem with the existing 1.67 cfs senior water right, this will guarantee that flows in this waterbody do not go below 12.12 cfs during August and September. Thus, piping the JSC would have a large long-term beneficial impact on hydrology within this waterbody during the months of August and September. The Project would have no impact on this waterbody during the non-irrigation season.

Although not included within this analysis, two new senior instream water rights were issued in 2025 upon completion of a conserved water project, which will increase the combined rate of senior instream water rights for South Fork Little Butte Creek to 12.28 cfs, 0.16 cfs greater than assumed. There will be no impact to MID operations of increasing flows from 12.12 cfs to 12.28 cfs below the diversion.

Water Quality

Higher flows during August and September would have large, long-term beneficial impact on water quality as they could result in a decrease in stream temperatures and an increase in dissolved oxygen concentrations. The Project would have no impact on the water quality of this waterbody during the non-irrigation season.

North Fork Little Butte Creek (RM 0 to 0.9)

Hydrology

Currently, MID diverts water at the diversion points in excess of patron needs to account for canal losses from seepage and incidental headgate release. As a result of piping, canal losses would be eliminated and MID would need to divert less water to meet patron needs. Thus, when MID is only relying on natural flow (May and June), an additional 4.6 cfs on average would be bypassed at the North Fork Little Butte Creek Diversion because that water is not needed at that time. The 4.6 cfs of bypassed water would increase flows in this waterbody by 13%, on average, during the months of May and June. These higher flows would have a minor long-term beneficial effect on hydrology in this waterbody. During the non-irrigation season, increases in water storage may lead to increased water releases from Fish Lake to North Fork Little Butte Creek if the reservoir exceeds its storage capacity. However, during the modeled time period (2005-2024) there was no significant impact to flows in North Fork Little Butte Creek as Fish Lake storage is typically below levels that would require reservoir releases. Thus, the Project will overall have an indiscernible long-term effect on flows in North Fork Little Butte Creek during the non-irrigation season as potential increases in Fish Lake releases in response to increased water storage are anticipated to be rare and isolated.

Water Quality

Higher flows in May and June would have a long-term beneficial effect on water quality resulting from an increase in stream temperature and a decrease in dissolved oxygen concentrations.

North Fork Little Butte Creek (RM 0.9 to 16)

Hydrology

Releases of water from Fish Lake into North Fork Little Butte Creek during the irrigation season are predominantly dictated by MID's North Fork Little Butte Creek Diversion. Thus, the reduced need for diversion after piping would decrease releases from Fish Lake and thereby reduce flow in North Fork Little Butte Creek during the irrigation season. In effect, water saved as a result of piping that is retained by MID (3,793 AF/year) would be stored in Fish Lake and Fourmile Lake for use during dry years to extend the irrigation season. Currently during dry years, MID and RRVID are not able to meet patron water demands in September due to insufficient water storage. As a result of piping the JSC, retained water savings stored in Fish Lake and Fourmile Lake would be used to meet MID and RRVID patron water demands in September of dry years, thereby extending the irrigation season.

The altered water management of Fish Lake and Fourmile Lake would increase or decrease flow in North Fork Little Creek from RM 0.9 to 16 depending on the water year and time of year. During the majority of irrigation seasons, flow would decrease in this reach of the creek by 1.4 cfs on average due to reduced diversions after piping, which is a 2 percent decline in streamflow. Conversely, during September of dry years, flow in this reach of the creek would increase by 26.5 cfs, which is a 79 percent increase in streamflow. Overall, this would have a minor long-term decrease in hydrology during the majority of irrigation seasons and a significant long-term increase in hydrology during dry years in September. As described above, flows in North Fork Little Butte Creek could increase during the non-irrigation season during years that Fish Lake reaches its storage capacity as a result of the Project. However, these events are anticipated to be rare and isolated and would not have a significant impact on flows in these reach during the non-irrigation season.

The Project would have no impact on the hydrology of this waterbody during the non-irrigation season.

Water Quality

Lower flows during the majority of irrigation seasons would have minor long-term effects on water quality as they could result in an increase in stream temperature and decrease in dissolved oxygen concentration.

Higher flows during Septembers of dry years would have a large long-term beneficial effect on water quality resulting from a decrease in stream temperature and an increase in dissolved oxygen concentration during that timeframe.

Lake Creek

Hydrology

Lake Creek could be affected by piping of the JSC through the loss of canal seepage that may augment groundwater discharge into the waterbody. However, the magnitude of the impact of the loss of canal seepage on groundwater inflow to Lake Creek downslope of the JSC would depend on the size of the waterbody and the contributing catchment that receives canal seepage. Lake Creek is a relatively large waterbody that has a small contributing catchment that receives canal seepage. Thus, although loss of canal seepage would result in reduced groundwater inflow into Lake Creek,

this loss is not anticipated to have a detectable change as canal-seepage-augmented groundwater inflow represents a small percentage of inflow compared among other sources. Thus, hydrology in Lake Creek is not anticipated to be affected by piping the JSC.

Water Quality

Hydrology within Lake Creek is not anticipated to be impacted by piping the JSC, and canal seepage is likely not a significant contributor of nonpoint source pollution to the waterbody. Thus, piping the JSC would have no long-term effect on water quality within Lake Creek.

Osborne Creek and Wyant Gulch

Hydrology

During the irrigation season, Osborne Creek and Wyant Gulch could be affected by piping the JSC through the loss of canal seepage that may augment groundwater discharge into the waterbodies. In contrast to Lake Creek, these waterbodies are smaller and have larger contributing catchments that receive canal seepage. Thus, the loss of canal seepage would be expected to have a minor long-term decrease in streamflow in these systems downslope of the JSC during the irrigation season. There is no information on hydrology within these waterbodies nor on the degree of canal seepage that enters in these waterbodies, so the exact degree of impact is unknown. The Project would have no effect on the hydrology of these waterbodies during the non-irrigation season.

Water Quality

As discussed in Section 5.3.3, Surface Water Quality, canal seepage from the JSC likely acts as a nonpoint pollution source to these waterbodies. Elimination of this nonpoint pollution source could decrease water temperature, turbidity levels, and concentrations of *E. coli* within these waterbodies. Thus, piping the JSC would have a minor long-term beneficial impact on water quality within these waterbodies during the irrigation season. The Project would have no impact on the water quality of these waterbodies during the non-irrigation season.

Grasshopper Gulch, Eagle Gulch, and Unnamed Drainages 7 and 10

These waterbodies would be affected by piping the JSC through reconnection of these systems over the JSC and the loss of incidental headgate water releases and canal seepage.

Hydrology

As a result of piping the JSC, these streams would be reconnected to the downslope stream channel by a bioengineered stream channel that would convey streamflow over the piped JSC. Thus, these streams would no longer contribute water to the JSC and their downslope portions would no longer receive canal seepage and incidental headgate release of irrigation water. Reconnecting these streams would better facilitate runoff during precipitation events and would likely result in higher flows during the non-irrigation season. Thus, during the non-irrigation season, piping the JSC would have a minor long-term benefit to hydrology within these waterbodies.

During the irrigation season, piping the JSC would eliminate artificial sources of water through the loss of incidental headgate releases of irrigation water and loss of canal seepage. This is anticipated to result in a moderate long-term decline in hydrology within these streams. Overall, piping the JSC would restore the natural hydrology of these streams by better facilitating runoff and streamflow during the non-irrigation season and eliminating artificial water sources during the irrigation season.

Water Quality

Higher flow during the non-irrigation season would have a minor long-term beneficial impact on water quality, as it could decrease stream temperature and increase dissolved oxygen concentration.

During the irrigation season, as discussed in Section 5.3.3, Surface Water Quality, incidental headgate releases of irrigation water and canal seepage likely act as point and nonpoint pollution sources, respectively. Eliminating these sources of pollution would have moderate long-term beneficial impacts on water quality as it could decrease water temperature, turbidity levels, and *E. coli* concentrations within these waterbodies.

Owens Gulch and Unnamed Drainages 1 to 6, 8, and 9

Hydrology

As a result of piping the JSC, these streams would be reconnected with their downslope counterparts by a bioengineered stream channel that would convey streamflow over the piped JSC. Reconnecting these streams would better facilitate runoff during precipitation events and would likely result in higher flows during the non-irrigation season. Thus, during the non-irrigation season, piping the JSC would have a minor long-term benefit to hydrology.

During the irrigation season, piping the JSC would eliminate artificial sources of water through the loss of canal seepage. This is anticipated to have a minor long-term decline in hydrology within these streams. Overall, piping the JSC would restore the natural hydrology of these streams by better facilitating runoff and streamflow during the non-irrigation season and eliminating artificial sources of hydrology during the irrigation season.

Water Quality

Higher flow during the non-irrigation season would have a minor long-term beneficial impact on water quality as it could decrease stream temperature and increase dissolved oxygen concentration.

During the irrigation season, as discussed in Section 5.3.3, Surface Water Quality incidental headgate releases of irrigation water and canal seepage likely act as point and nonpoint pollution sources, respectively. Eliminating these sources of pollution would have moderate long-term beneficial impacts on water quality as it could decrease water temperature, turbidity levels, and *E. coli* concentrations within these waterbodies.

Little Butte Creek

Hydrology

Impacts on Little Butte Creek hydrology as a result of piping the JSC would be influenced by (1) reduced diversion rates from North Fork Little Butte Creek during May and June, (2) saved water restored instream in South Fork Little Butte Creek during August and September, (3) alterations to flow patterns in 15 small tributaries as discussed above for Wyant, Grasshopper, Owens, and Eagle Gulches; Osborne Creek; and Unnamed Drainages 1 to 10 and; (4) elimination of JSC seepage.

During the irrigation season, flows in Little Butte Creek would likely increase in its most upstream portion (RM 10.2 to 17.2) by 3.5 cfs on average, or 4 percent. The increased flows in this portion of Little Butte Creek would result from decreased diversions on North Fork Little Butte Creek during May and June and allocation of saved water instream in South Fork Little Butte Creek during August and September. Increased flow in Little Butte Creek is not anticipated to occur below RM 10.2 due to decreased tributary input from the 15 smaller tributaries and decreased groundwater discharge due

to the elimination of incidental headgate release and canal seepage. The contribution of incidental headgate release and canal seepage to Little Butte Creek flows is unknown. There is little data available on Little Butte Creek's aquifer and the groundwater- surface water dynamics in this heavily altered watershed. Little Butte Creek is a gaining reach whose streamflow is increased by tributary input, flood irrigation tailwater discharge, and groundwater discharge. Groundwater discharge into Little Butte Creek is governed by aquifer storage, inputs (precipitation, irrigation, and canal seepage), and flow path lengths. Given the complexity of the system, the relative contribution of JSC water losses to Little Butte Creek flows cannot be determined with the data that is available. It is likely the majority of water lost by the JSC via incidental headgate release and canal seepage does not enter Little Butte Creek and is lost to evapotranspiration, reclaimed by private irrigators in stock ponds and irrigation canals, or enters into aquifer storage. It is conservatively estimated that decreased tributary input from the 15 smaller tributaries and decreased groundwater discharge into Little Butte Creek is likely to be commensurate with increased tributary input from North Fork Little Butte Creek and South Fork Little Butte Creek. Thus, in the most upstream portion of Little Butte Creek (RM 10.2 to 17.2), piping the JSC would have a minor long-term benefit to hydrology within the creek and the hydrology below RM 10.2 is not anticipated to be impacted by piping the JSC.

During the non-irrigation season, increased flows in 13 small tributaries that are currently intercepted by the JSC would increase flows in Little Butte Creek. Thus, during the non-irrigation season, piping the JSC would have a minor long-term benefit to hydrology.

Water Quality

Higher flows during the non-irrigation season would have a minor long-term beneficial impact on water quality as they could result in a decrease in stream temperature and increase dissolved oxygen concentration.

During the irrigation season, as discussed in Section 5.3.3, Surface Water Quality, incidental headgate release of irrigation water and canal seepage likely act as point and nonpoint pollution sources, respectively, to Little Butte Creek tributaries. Elimination of these sources of pollution would decrease water temperature, turbidity levels, and *E. coli* concentration within these tributaries; the same water quality parameters within Little Butte Creek could also be influenced. Furthermore, higher flows in the upper reaches of this waterbody could result in a decrease in stream temperature and increased dissolved oxygen concentration. Thus, during the irrigation season, piping the JSC would have a minor long-term benefit to water quality within Little Butte Creek.

Rogue River

Hydrology

Little Butte Creek contributes, on average, approximately 7 percent to flows within the Rogue River from RM 126 to 132. As such, Little Butte Creek's influence on the Rogue River is minor compared to the influence of other sources of hydrology. Thus, flow alterations to Little Butte Creek as a result of the Project as discussed in the section above are anticipated to have no significant change on hydrology in the Rogue River. The Project would have no detectable effect on hydrology within the Rogue River.

Water Quality

Minor improvements to water quality parameters in Little Butte Creek such as *E. coli*, temperature, turbidity, nutrients, and dissolved oxygen may also benefit these parameters in the Rogue River and improve source drinking water from the Duff Water Treatment Plant for MWC. However, Little Butte Creek is a relatively small contributor to the Rogue River and therefore these minor improvements to

Little Butte Creek water quality are unlikely to have a detectable effect on water quality in the Rogue River. Thus, the Project is not anticipated to have a detectable beneficial effect on water quality within the Rogue River.

Fish Lake and Fourmile Lake

Hydrology

As discussed for North Fork Little Butte Creek (RM 0.9 to 16) above, 3,793 AF/year of water conserved as a result of piping the JSC would be stored in Fish Lake and Fourmile Lake to extend the irrigation season during dry years and thereby meet patron demands for water in September. The release of water from Fish Lake into North Fork Little Butte Creek would decrease during the irrigation season due to reduced diversion following piping. Fish Lake and Fourmile Lake act as a unit to store water for release into North Fork Little Butte Creek for downstream water users. Thus, as a result of piping the JSC, water storage drawdown within these lakes would be slower over the course of the irrigation season and would result in an overall increase in water storage. Water storage is estimated to increase on average by 16 percent during the irrigation season and 20 percent during the non-irrigation season. Thus, piping the JSC would have a significant long-term beneficial impact on hydrology within Fish Lake and Fourmile Lake.

Water Quality

Increased water volumes within Fish Lake and Fourmile Lake would have a minor long-term beneficial effect on water quality; water temperature would decrease and dissolved oxygen concentration would increase.

Water Rights

In August and September in all water years, the District would reduce diversions at its South Fork Little Butte Creek Diversion. The District would work with OWRD and others to determine the best mechanism for leaving water savings instream below the South Fork Little Butte Creek Diversion.

Groundwater

Currently, the 5,057 AF/year of water lost from the JSC, in part, support the alluvial aquifer within the Little Butte Creek valley bottom. The 1,264 AF/year of water saved as a result of the piping the JSC would remain in South Fork Little Butte Creek where it could enter the alluvial aquifer via infiltration. The remaining 3,793 AF/year of saved water would be retained by MID and RRVID for meeting patron demands, which are predominately outside of the Little Butte Creek Watershed. Thus, piping the JSC would result in the alluvial aquifer within the Groundwater Study Area losing approximately 3,793 AF/year of water input. The loss of this water input into the alluvial aquifer would have a minor long-term effect groundwater.

Major contributors to alluvial aquifer recharge include surface water from rivers, reservoirs, lakes, irrigation, and canal seepage (DEQ 2013). Given other sources of alluvial aquifer recharge the 3,793 AF/year of water input from the JSC into the alluvial aquifer is a relatively minor contribution to the groundwater system and is not anticipated to have a significant effect on groundwater levels. The majority of domestic water users within the groundwater study area source water from confined aquifers that are not supported by the alluvial aquifer or from JSC water losses and thus would not be affected by the Project.

6.1.2.2 Upgrade Existing Siphons and Canal Loop Improvements

Osborne Creek Siphon

Option 1 (Existing Alignment) and Option 2 (Adjacent Alignment)

Under Option 1, the existing 1,094-foot-long siphon would be upgraded in its current alignment, and all permanent impacts would be within the existing canal alignment. The siphon would be constructed beneath Osborne Creek, and there be no long-term impact to water resources. Under Option 2, if the siphon was built adjacent to the existing alignment the effects to water resources would be the same.

Lake Creek Siphon

Option 1 (Existing Alignment) and Option 2 (Adjacent Alignment)

The existing 563-foot-long siphon would be upgraded in its current alignment, and all permanent impacts would be within the existing canal alignment. The siphon would be constructed beneath Lake Creek, and there would be no long-term impact to water resources.

Wyant Gulch Siphon

Option 1 (Existing Alignment)

Under this route option, the existing 145-foot-long siphon would be upgraded in its current alignment and all permanent impacts would be within the existing canal alignment. The siphon would be constructed beneath Wyant Gulch, and there be no long-term impact to water resources.

Option 2 (New Alignment

Under this route option, a new siphon would be constructed downslope of the existing canal under Wyant Gulch. The new siphon would be approximately 512 feet in length and would avoid approximately 1,689 feet of in-canal piping and the need to upgrade the existing siphon. The existing 145-foot siphon would be filled in place with controlled low-strength material. The new siphon would be constructed beneath Wyant Gulch, and there would be no long-term impact to water resources.

Grasshopper Segment

Option 1 (Existing Alignment))

Under this route option, no siphon would be constructed at Grasshopper Gulch. The new pipeline would be installed in the existing canal alignment, and all permanent impacts would be within the existing canal alignment. A channel would be constructed on top of the buried pipeline to convey Grasshopper Gulch over the infrastructure and reconnect the stream. Impacts to Grasshopper Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with piping the JSC at Grasshopper Gulch.

Option 2 (Siphon)

Under this route option, a new siphon would be constructed downslope of the existing canal under Grasshopper Gulch. The new siphon would be approximately 438 feet in length and would avoid 1,521 feet of in-canal piping. The siphon would be constructed underneath Grasshopper Gulch and the retired canal where Grasshopper Gulch intersects the JSC would be recontoured and irrigation infrastructure removed to reconnect upslope and downslope portions of the stream. Impacts to

Grasshopper Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with the Grasshopper Siphon.

Owens Segment

Option 1 (Existing Alignment)

Under this route option, no siphon would be constructed at Owens Gulch. The new pipeline would be installed in the existing canal alignment, and all permanent impacts would be within the existing canal alignment. A channel would be constructed on top of the buried pipeline to convey Owens Gulch over the infrastructure and reconnect the stream. Impacts to Owens Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with piping the JSC at Owens Gulch.

Option 2 (Siphon)

Under this route option, the new Owens Siphon would be constructed downslope of the existing canal under Owens Gulch. The siphon would be approximately 537 feet in length, and it would avoid 2,268 feet of in-canal piping. The siphon would be constructed underneath Owens Gulch. The retired canal where Owens Gulch intersects the JSC would be recontoured, and irrigation infrastructure would be removed to reconnect upslope and downslope portions of the stream. Impacts to Owens Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with the Owens Siphon.

Eagle Gulch Siphon

Option 1 (Existing Alignment)

Under this route option, no siphon would be constructed at Eagle Gulch. The new pipeline would be installed in the existing canal alignment, and all permanent impacts would be within the existing canal alignment. A channel would be constructed on top of the buried pipeline to convey Eagle Gulch over the infrastructure and reconnect the stream. Impacts to Eagle Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with piping the JSC at Eagle Gulch.

Option 2 (Siphon)

Under this route option, a new siphon would be constructed downslope of the existing canal under Eagle Gulch. The new siphon would be approximately 1,001 feet in length and would avoid 4,802 feet of in-canal piping. The siphon would be constructed underneath Eagle Gulch, the retired canal where Eagle Gulch intersects the JSC would be recontoured, and irrigation infrastructure would be removed to reconnect upslope and downslope portions of the stream. Impacts to Eagle Gulch are discussed in Section 7.1.2.1, and there would be no further long-term impact to water resources associated with the Eagle Gulch Siphon.

6.2 Construction Impacts

6.2.1 Impacts from Construction

6.2.1.1 Joint System Canal

Potential short-term impacts of piping the JSC (canal only, does not include the siphons discussed in Section 7.2.1.2) would be attributed to construction activities and would be expected to abate following completion of construction.

Potential short-term construction impacts would depend on the following:

- Area of total disturbance adjacent to waterbodies.
- Impacts from fine sediment and contaminants (e.g., hydraulic oil, fuel).
- Erosion or soil characteristics.
- Depth to groundwater.
- Streambank or slope steepness.

No short-term impacts to water rights are anticipated because construction of piping within the four project groups would occur over four non-irrigation seasons. Construction would take place outside of the period when irrigation water is being delivered to MID and RRVID patrons and would not be expected to disrupt patrons' use of water under MID water rights.

Short-term impacts to surface water hydrology and water quality are anticipated because 13 streams (Grasshopper, Owens, and Eagle gulches, and Unnamed Drainages 1 to 10) intermittently flow into the JSC, especially during the non-irrigation season when construction would occur. At the locations of these drainages and the JSC, the work area would be isolated with sandbag cofferdams and temporary water management would maintain flows downstream and out of the work area. During construction, there could be minor short-term impacts to water quality and hydrology as a result of the placement and removal of the cofferdams and temporary water management system.

Construction activities can potentially affect surface water quality by facilitating increased erosion and mobilization of sediment in stormwater. The accidental discharge of fuels, fluids, and construction materials can impact both surface water quality via stormwater runoff and groundwater quality via infiltration. These short-term impacts would be minimized or avoided through implementation of BMPs during construction to control erosion and pollution. Work is proposed adjacent to South Fork Little Butte Creek and at Grasshopper Gulch, Owens Gulch, Eagle Gulch, and Unnamed Drainages 1 to 10; therefore, there could be minor short-term impacts to water quality in these waterbodies. The anticipated excavation depth to install the pipeline would be insufficient to result in direct contact with groundwater or to introduce contaminants into groundwater.

Construction-phase erosion and sediment control measures would be installed during project construction to prevent stormwater runoff from mobilizing sediment and pollutants into surface water. The MID or its construction contractor would be required to provide an erosion and sediment control plan as part of its 1200-CA construction stormwater permit application; the plan would detail the measures to be implemented and approaches for maintaining them. Pollution control and spill prevention BMPs would be implemented to avoid and minimize impacts from accidental spills of fuels, fluids, solvents, oils, and other hazardous materials typically associated with construction vehicles and equipment. A construction-phase spill prevention control and countermeasures plan

would include protocols for storing and handling hazardous substances, as well as cleanup response protocols to be used in the event of inadvertent releases.

Proposed BMPs to reduce or control environmental health hazards would likely include but may not be limited to the following:

- Routinely inspect equipment, tools, and vehicles for leaks or damage.
- Promptly repair or replace leaking connections, pipes, hoses, and valves.
- Use drip pans under equipment when maintaining, repairing, or servicing in the field.
- Remove oil and grease buildup on equipment.
- Use nontoxic solvents whenever possible.
- Keep spill kit, including cleanup materials such as dry absorbent materials, on-site for prompt cleanup of small spills related to equipment failure.
- Prohibit discharge of wastewater to stormwater drains or surface stormwater facilities such as ditches and swales.
- Perform equipment and vehicle maintenance in areas that prevent discharges to storm drain systems or surface stormwater facilities.
- Collect and properly manage (recycle or dispose of) used materials: grease, oil, oil filters, antifreeze, cleaning solutions, lead-acid batteries, tires, and hydraulic and transmission fluids.
- Clean surfaces following any discharge or spill incident.

Construction-phase erosion, sediment, and pollution control and spill prevention BMPs would minimize the potential for stormwater runoff to mobilize sediment and pollutants into surface waters and prevent the introduction of contaminants into surface water and groundwater. Following construction, new pipelines would be buried. All disturbed areas would be recontoured and planted with a seed mix of native grasses and forbs in consultation with NRCS, thus mitigating the potential for soil erosion and the mobilization of sediments in stormwater. The potential for soil erosion along the banks of the JSC would be eliminated where the open canal is replaced with a buried pipe. Herbaceous riparian vegetation would be established along the banks of reconnected channels that convey drainages across the piped JSC. Based on the foregoing, short-term impacts to surface water would be minor and short-term impacts to groundwater resources would be negligible.

6.2.1.2 Upgrade Existing Siphons and Canal Loop Improvements

Upgrade Existing Siphons

Under this route option for the Lake Creek, Osborne Creek, and Wyant siphons, the existing siphons would be upgraded by either sliplining the current siphon, removing the current siphon and replacing it, or decommissioning the current siphon and constructing a siphon adjacent to it. The appropriate siphon construction method would be determined for each siphon prior to construction and may include a condition assessment of existing siphons. Sliplining the existing siphon would result in minimal ground disturbance, would not involve in-water work, and would have no effect on water resources. If required, decommissioning the existing siphon would involve backfilling the siphon with controlled low-strength material. Decommissioning would not involve in-water work, and it would not involve ground disturbance adjacent to waterbodies; thus, it would have no effect on water resources.

Replacing the existing siphon or constructing an adjacent siphon would involve vegetation clearing, trenching, equipment mobilization and staging, and backfilling of trenches after pipe installation for the project area outside of waterbodies. Construction-phase erosion, sediment, and pollution control and spill prevention BMPs as discussed in Section 7.2.1.1 would be employed to minimize stormwater runoff to waterbodies. Construction of the siphon across the waterbody could occur using a variety of methods including a cut and cover trench or jack and bore similar to a road or railroad crossing by a utility. Below is a discussion of the potential construction methods and their effects to water resources.

Trenching

Trenching approximately 10 to 14 feet below the bottom of the active streambed would be used to place the new siphon. The abandoned siphon would be backfilled with controlled low-strength material, and the work area would be restored to initial conditions including restoring riparian vegetation and reestablishing preexisting contours of the site. Proposed BMPs to reduce or control environmental hazards during boring would likely include but may not be limited to the following:

- Trenching would occur within the ODFW-preferred work period for Rogue River tributaries above Marial, Oregon (June 15 to September 15).
- The work area within a waterbody would be isolated by cofferdams.
- Temporary water management would maintain flows downstream and out of the work area.

During construction, there would be minor short-term impacts to water quality and hydrology as a result of the placement and removal of cofferdams and temporary water management. In addition, temporary removal and reestablishment of riparian vegetation would result in minor short-term impacts to water quality due to reduced shading and increased water temperature.

Boring

Jack and bore would involve establishing two pits, one on either side of the waterbody. The two pits would be used to install the siphon approximately 4 to 8 feet below the bottom of the active streambed, and the stream would not be disturbed. Proposed BMPs to reduce or control environmental health hazards during boring would likely include but may not be limited to the following:

- All equipment fuels and fluids, waste, and loose soil must be contained.
- Erosion and sediment controls are placed around pits.
- An adequate supply of materials must be kept on hand for erosion control and containment of drilling fluids.
- Drilling operators must report drilling fluid spills and have a contingency plan for the inadvertent return of drilling fluid.

Construction within 50 feet of waterbodies could result in a short-term increase in the potential for sediment loading into waterways; this could have a minor short-term effect on water quality.

Canal Loop Improvement: Siphon Route

Under this route option for Wyant, Grasshopper, Owens, and Eagle Gulch canal loop segments, a new siphon would be constructed. Construction of the new siphon would likely involve vegetation clearing, trenching, equipment mobilization and staging, and backfilling of trenches after pipe installation for the project area outside of waterbodies. Construction of the new siphon across the waterbody may also occur using a variety of methods including a cut and cover trench or jack-and-bore method. The

effects of these construction methods on water resources are discussed above in the section, Upgrade Existing Siphon.

Canal Loop Improvement Existing Alignment (No Siphon)

Under this route option for Grasshopper, Owens, and Eagle gulches, siphons would not be constructed. Impacts to water resources under this route option are similar to those described in Section 7.2.1.1.

6.2.2 Potential Off-Site Staging Areas

The construction contractor could potentially select one or more off-site staging areas outside the project area. These sites would be used to store or assemble materials that would then be transported by truck to the construction site.

Areas that have been previously disturbed and are accessible via existing access routes would be prioritized. In some locations, specifically at new siphons, construction access would need to be created before delivering pipe or equipment into construction areas. This could include vegetation clearing within the construction area and temporary disruption of existing land uses. Appropriately sized construction equipment would be used to minimize disturbance in the construction area.

Potential staging areas have been identified at the following locations:

- Three areas within Jackson County Tax Lot 362E5500:
  - → Adjacent to the JSC, west of the junction of the North Fork Canal and the South Fork Canal (Bench Flume 1 staging area).
  - → Adjacent to S Fork Little Butte Creek Road, west of an unnamed creek crossing this road, south of the Main Canal/JSC (Diversion Road staging area).
  - → Adjacent to the JSC east of the existing Lake Creek Siphon (Turnaround staging area).
- One area within Jackson County Tax Lot 362E7701 adjacent to the JSC at the west end of the existing Lake Creek Siphon (Lake Creek Siphon staging area).
- One area within Jackson County Tax Lot 362E19100 adjacent to the JSC at the south end of the proposed Grasshopper Siphon (Grasshopper Siphon staging area).
- One area overlapping Jackson County Tax Lots 361E10300 and 361E10302 adjacent to the Main Canal/JSC, south of the northward turn of Little Butte Creek, south of Lake Creek Loop Road (Bench Flume 2 staging area).
- Two areas wholly within Jackson County Tax Lot 361E10302:
  - → Adjacent to the JSC at the south end of the Osborne Siphon (Osborne staging area 1).
  - → Adjacent to the Main Canal/JSC at the north end of the Osborne Siphon (Osborne staging area 2).
- One area within Jackson County Tax Lot 361E14100, north of the JSC between two unnamed creek drainages, south of Little Butte Creek (Panther Crushing staging area).
- One area within Jackson County Tax Lot 361E08700, west of the Bradshaw Drop and north of the Hopkins Canal.

The contractor would be responsible for relevant local land use or local, state, or federal environmental permitting required for use of a chosen site. Therefore, it is assumed that because of

regulatory and time constraints on the contractor, any site chosen would need to be already developed with road access. Potential staging areas listed above would not involve ground disturbance within waterbodies, and they are not located within 50 feet of a waterbody. Erosion and sediment control measures would be employed to minimize the potential for runoff from staging areas. Thus, staging materials in these areas would have no impact on water resources.

6.3 Cumulative Effects

The combined, incremental effects of past, present, and reasonably foreseeable actions are referred to as cumulative effects. While they may be insignificant by themselves, cumulative effects accumulate over time from one or more sources and can result in the degradation of important resources. The MID Infrastructure Modernization Project could potentially contribute to cumulative effects on water resources when considered in combination with other water resource development and conservation projects in the Little Butte Creek Watershed.

6.3.1 No-Build Alternative

Under the No Action Alternative, no federal funding would be forthcoming to support the Project and modernization of MID infrastructure would not take place. No new direct effects on water resources would result from the Project, and existing conditions would remain unchanged. The Project would, therefore, not contribute to cumulative impacts to water resources over current conditions.

6.3.2 Modernization Alternative

Past actions over the last 130 years that have affected water resources in the Little Butte Creek Watershed include urban and agricultural development, construction and maintenance of the roadway network, water impoundment projects, and other irrigation projects. Since the early 2000s, various water conservation projects conducted by the NRCS Oregon Regional Conservation Partnership Program, Jackson Soil and Water Conservation District, and nongovernmental organizations such as the Rogue River Watershed Council and Trout Unlimited have resulted in improved water quality and streamflow within waterbodies in the Little Butte Creek Watershed. These projects include removal of push-up dams, conversion from flood to sprinkler irrigation, decommissioning of roads, and instream water rights transfers. In 2012, NMFS issued a biological opinion for the Reclamation Rogue River Basin Project which included operations of MID, RRVID, and TID. The biological opinion increased flow in South Fork Little Butte Creek and Little Butte Creek by mandating minimum flows in these waterbodies and reducing diversion rates.

Guidance documents will further promote activities that will improve water resources within the Little Butte Creek Watershed. The Inland Rogue Agricultural Water Quality Management Area Plan (ODA 2022) addresses water pollution coming from private agricultural land. The plan identifies educational programs, suggested land treatments, management activities, and monitoring to reduce water pollution from agricultural lands. Actions are voluntary, but noncompliance with Agricultural Water Quality Management Area Rules is subject to enforcement by the Oregon Department of Agriculture. Prohibited conditions outlined in the document will prevent the further degradation of waterbodies by minimizing sediment inputs and riparian vegetation destruction and preventing exceedance of water quality standards from irrigation return flows. The Water Quality Improvement Plan for Little Butte Creek Watershed (RRWC 2018) outlines numerous realistic projects and initiatives to achieve compliance with water quality standards for Section 303(d)-listed streams. These projects focus on attaining more instream water rights, decreasing temperature by increasing

shading by riparian vegetation, and reducing bacteria loading into waterbodies within the Little Butte Creek Watershed.

The impact on the Little Butte Creek Watershed of the Klamath Basin Adjudicator granting a large senior priority claim for water (including water stored in Fourmile Lake) by the federal government on behalf of Reclamation, USFWS, and the Klamath Tribes is yet to be determined. When Klamath Tribes asserted its Claim 622 that led to a call on Fourmile Lake by OWRD in 2023, releases from Fourmile Lake were delayed by a month and did not result in a significant disruption to MID and RRVID operations. Recent funding provided by the state of Oregon to RVVID for construction of a reservoir outfall into the Klamath Basin would provide a conveyance pathway for water stored in Fourmile Lake to senior water rights holders in the Klamath Basin. Future calls on Fourmile Lake may decrease the amount of stored water MID releases from Fourmile Lake, which would result in lower storage levels in Fish Lake and lower flows in North Fork Little Butte Creek.

Future irrigation canal piping projects may increase streamflow and reduce groundwater infiltration from canal seepage in the alluvial aquifers. MID and RRVID secured an EPA Community Grant for Phase 1 of the Joint System Canal Pipeline Project for Fiscal Year 2022. This project includes piping the North Fork Canal and South Fork Canal to eliminate water losses from the current open unlined canal. RRVID also proposes to modernize irrigation infrastructure in RRVID by piping or lining opens canals and laterals. The RRVID project would reduce conveyance and operational losses over the irrigation season and improve MID's ability to efficiently provide water to its patrons. The project is sponsored by RRVID, with planning funding from NRCS. The Phase 1 piping project and RRVID irrigation modernization project may result in changes to streamflow in North Fork Little Butte Creek and/or South Fork Little Butte Creek.

Under the Modernization Alternative and its route options, implementation of the Project could contribute to increased streamflow, improve surface water quality, and reduce groundwater infiltration. Other past, present, and reasonably foreseeable future actions are anticipated to result in overall beneficial effects on water resources, although they would also contribute cumulatively to reductions in groundwater levels. Overall, the Modernization Alternative would be expected to have a minor beneficial contribution to overall beneficial cumulative effects on water.

6.4 Compliance with Laws, Regulations, and Standards

6.4.1 Federal

6.4.1.1 Clean Water Act, 1977 as Amended, 33 U.S.C. 1251–1376

Section 303(d) Impaired Waters and Total Maximum Daily Loads

The Project would have beneficial impacts to water quality parameters that are impaired within MID-affected waterbodies. Section 303(d) water quality impairments of temperature, flow modification, dissolved oxygen, *E. coli*, sedimentation, and phosphorus within waterbodies associated with MID operations and infrastructure would be beneficially improved by the Project. The Project would not contribute to Section 303(d) water quality impairments, and it is in compliance with Section 303(d) of CWA.

Section 401 Water Quality Certification

The Project must comply with state water quality requirements and standards. The construction -phase BMPs outlined in Sections 7.2.1 and 0 would align with the water pollution

control requirements to ensure water quality requirements are met. If the pipeline goes through wetlands, anti-seep collars or equivalent technology must be installed to prevent draining of the wetlands. The joint permit application submitted to USACE would be forwarded to DEQ to ensure the Project does not endanger waters of the United States. Water quality certification would be issued by DEQ in coordination with USACE.

Section 402 National Pollutant Discharge Elimination System Permits

Ground disturbance during construction, which has the potential to mobilize sediments or contaminants in stormwater runoff, would be subject to the requirements of CWA Section 402. These would be addressed via the requirement to obtain a 1200-CA construction stormwater permit through DEQ. BMPs developed under this permit would avoid or minimize the potential for erosion and for sediments or contaminants to enter waterbodies and, thus, would limit the potential for short -term detrimental impacts on the environment during construction.

Section 404 for Permitting Discharge of Dredge or Fill Material

The majority of the JSC would not be considered a water of the United States and is not jurisdictional to USACE under Section 4 of the CWA. However, USACE takes jurisdiction over canals that were constructed in a tributary or relocated to a tributary. Thus, the former areas of 13 drainages that currently flow into the JSC would be considered jurisdictional. Furthermore, waterbodies that may be affected by siphon construction would also be considered jurisdictional as they are tributaries to a traditional navigable waterway.

On July 24, 2020, USACE and EPA signed a memorandum providing a clear, consistent approach regarding the application of exemptions from regulation under Section 404(f)(1)(C) of the CWA for the construction or maintenance of irrigation ditches and the maintenance of drainage ditches. Project actions would qualify as construction, which is only an exempt activity if it subject to the recapture provision based on the two-part test: (1) Project actions would not convert an area of water to a use it was not previously subject to, and (2) it would not impair flow or circulation of waters or reduce the reach of waters of the United States. Thus, Project actions would likely not pass the two-part test of the recapture provision and activities would be considered exempt.

If Project activities are not considered exempt from Section 404 regulation, the Project could likely be permitted under Nationwide Permit 58 Utility Line Activities for Water and Other Substances and/or Nationwide Permit 27 Aquatic Habitat Restoration, Establishment, and Enhancement Activities. Permitting under a Nationwide Permit would require submission of a joint permit application to USACE. The Project would result in no net loss of waters of the United States, and no mitigation would be required.

6.4.1.2 Endangered Species Act of 1973 and Amendments, 16 U.S.C. § 1531 et seq.

The USACE Section 404 CWA permit that would be required for the Project includes the Section 7 Consultation required for potential impacts to ESA-listed species. Early coordination is ongoing with USFWS and NMFS to determine appropriate affect determinations for ESA-listed species and their critical habitat.

- If a no effect determination is made, a no effect memorandum would be prepared.
- If a may affect, but not likely to adversely affect determination is made, a biological assessment will be prepared and submitted to USFWS and/or NMFS and a letter of concurrence would be requested.

- If a may affect and likely to adversely affect determination is made, a biological assessment would be prepared and submitted to USFWS and/or NMFS and a biological opinion would be requested.

6.4.1.3 Fish and Wildlife Coordination Act of 1934 and Amendments, 16 U.S.C. § 661 et seq.

The Project would ultimately increase flow in streams and other bodies of water and would improve conditions for fish and wildlife resources. Guidance provided by USFWS on the Project to minimize impacts on fish and wildlife resources in accordance with the Fish and Wildlife Coordination Act would be incorporated into Project implementation,

6.4.1.4 Safe Drinking Water Act. 1974, as amended, 42 U.S.C. 300f

The Project would ultimately improve water quality in Little Butte Creek for water consumption by reducing *E. coli* concentrations and turbidity levels. Little Butte Creek discharges into the Rogue River, which is used as a water source by the Medford Water Commission that provides drinking water to numerous municipalities. Thus, the Project would comply with the Safe Drinking Water Act, and the Project would not require coordination with EPA.

6.4.2 State

6.4.2.1 OAR Division 412, Fish Passage

The Project may trigger fish passage requirements due to abandonment and major replacement of artificial obstructions along Wyant, Grasshopper, Owens, and Eagle gulches in addition to Unnamed Drainages 1 to 10 (OAR 635-412-0005[49]). Fish passage for reconnected channels would not be required if it is determined that no native migratory fish are present, or were historically present, in the waterbody (OAR 635-412-0020 [1]). ODFW conducted a Native Migratory Fish Determination for 14 streams (unnamed drainages 1-10, Wyant Gulch, Grasshopper Gulch, Owens Gulch, and Eagle Gulch) during the winter of 2025. ODFW determined that these streams lacked suitable native migratory fish habitat within the vicinity of the JSC and that fish passage would not be required for drainage reconnection and restoration.

6.4.2.2 ORS 468B, Water Quality

The Project would have overall beneficial impacts on water resources by removing sources of pollution, and as such would align with policies articulated in ORS 468B.

6.4.2.3 ORS 196.795-990, Oregon Removal-Fill Law

Before Project implementation begins, MID would be required to consult with DSL. A wetland and waters determination report is in progress for the project area; the report will be submitted to DSL for concurrence of aquatic resource boundaries and for a determination of the jurisdictional status of these resources within the project area.

Per Oregon removal-fill statute, OAR 141-085-0515(9), an irrigation ditch is not jurisdictional under Oregon removal-fill permitting if it meets both of the following criteria:

- The ditch is operated and maintained for the primary purpose of irrigation.

- The ditch is dewatered outside of the irrigation season except for isolated puddles in low areas.

Therefore, the majority of the JSC would not be considered jurisdictional. However, DSL takes jurisdiction over canals that were created in waters of the state (OAR 141-085-0515(8)). Thus, the former areas of 13 drainages that currently flow into the JSC and any portions of the JSC that may have been created within naturally occurring wetlands or waters would be considered jurisdictional. Furthermore, waterbodies that may be affected by siphon construction would also be considered jurisdictional, as they are intermittent and perennial streams OAR 141-085-0515(3).

The Project would result in temporary and permanent impacts to jurisdictional waters and result in an overall uplift through reconnection of 13 drainages and a reduction of diversion rates. Temporary impacts to jurisdictional waters would require an individual permit and submission of a joint permit application for removal-fill authorization. The Project would result in no net loss of waters of the state, and no mitigation would be required.

6.4.2.4 Section 401 Water Quality Certification

The Project would result in a net benefit to water quality and would comply with water quality standards set forth in OAR 440-041 and OAR 340-048. The construction-phase BMPs outlined in Section 7.2.1 and 0 would align with the water pollution control requirements to ensure water quality requirements are met during construction when water quality may have temporary impairment. The DEQ water quality certification process requires a land use compatibility statement signed by the local government land use authority to ensure that permits affecting land use are compatible with local government comprehensive plans. The joint permit application submitted to USACE would also be submitted to DEQ for water quality certification to ensure the Project does not endanger waters of the state.

6.4.2.5 1200-CA Construction Stormwater Permit

The Project would require a 1200-CA permit submitted to DEQ that includes a temporary erosion and sediment control plan, a list of selected BMPs, and a schedule for implementing the BMPs. Implementation of these measures during construction is intended to avoid or minimize detrimental impacts to the environment by controlling erosion and the release of sediment or contaminants into waterbodies.

6.4.2.6 Oregon's Statewide Planning Goals and Guidelines, OAR 660-015-0000

Overall, the Project would have beneficial impacts on water resources, and as such it would align with the provisions of Oregon Statewide Planning Goal 6 through compliance with the CWA and DEQ standards and regulations.

6.4.3 Jackson County

6.4.3.1 Comprehensive Plan

The Project is consistent with the Jackson County Comprehensive Plan's Environmental Quality Policies (Jackson County 2005) whose fundamental goal is "To ensure and improve the quality of the County's natural environment and resources in a responsible manner which will maintain and enhance the life sustaining environment." Another policy pertinent in the comprehensive plan that the Project is consistent with is to "Conserve the water resources of Jackson and protect, manage

and improve the quality of surface and groundwaters, for the propagation of wildlife and for domestic, agricultural, industrial, recreational and other beneficial uses." The Project's benefits to waterbodies would improve the quality of Jackson County's natural and water resources. The Project would comply with DEQ standards and regulations for waterbodies within Jackson County.

6.5 Conclusion

The Modernization Alternative would result in minor temporary impacts to water resources along the JSC alignment during construction of the Project. Construction impacts would be minimized by sediment and erosion BMPs and restoration of disturbed areas to initial conditions. Thus, temporary impacts would result in minor short-term impairment of water quality.

Following completion of construction, the Project would have minor long-term benefits to water resources by improvements to hydrology and water quality within waterbodies associated with MID operations and infrastructure. Saved water, reduction in diversion rates, restoration of hydrology, and elimination of pollution sources would improve hydrologic conditions and water quality within 20 different waterbodies.

7. Mitigation Measures

Overall, the Project is expected to have beneficial long-term effects on water resources in the Little Butte Creek Watershed. As a result, no long-term mitigation measures are proposed.

Avoidance and minimization measures, including BMPs and post-construction restoration, would be implemented during construction to ensure that adverse effects on surface water and groundwater are prevented to the greatest extent practicable. Post-construction mitigation and restoration actions would be implemented following construction to ensure that post-construction site conditions do not contribute to ongoing effects on water resources. These are discussed in greater detail in Section 7.2.

8. Contacts and Coordination

Coordination with OWRD, DSL, USACE, and other agencies with authority over water resources for the Project is ongoing. Guidance received by federal and state agencies will be incorporated in Project planning.

9. Preparers

Name	Professional Affiliation	Education	Years of Experience
Colton Kyro	Parametrix	MS, Systems Ecology BS, Ecosystem Science	5
Taya MacLean	Parametrix	MS, Biology BS, Forestry Professional Wetland Scientist	25

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11. Appendix A

Modeled Changes in Surface Water Hydrology

Table A-1. Average Modeled Pre- and Post- Modernization Alternative Surface Water Hydrology Conditions

-	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Fish Lake and Fourmile Lake Water Storage (AF)	Fish Lake and Fourmile Lake Water Storage (AF)
Month	Pre	Post	Pre	Post	Pre	Post	Pre	Post
January	106.77	106.77	54.73	54.73	198.12	198.12	9,483.56	11,228.67
February	106.28	106.28	54.10	54.10	184.12	184.12	10,367.18	12,110.51
March	147.45	147.45	62.54	62.54	236.08	236.08	11,212.56	12,957.67
April	186.85	186.85	70.87	70.87	274.43	274.91	12,504.45	14,249.55
May	109.87	109.87	69.84	69.77	164.66	169.94	14,416.80	16,083.67
June	28.22	28.22	73.92	69.61	50.16	54.13	15,575.95	17,025.40
July	6.60	6.60	93.00	81.98	27.32	27.32	12,518.91	14,417.18
August	5.33	12.13	90.02	90.14	26.05	32.86	8,637.95	10,958.96
September	6.75	12.67	64.74	71.98	27.97	32.38	6,391.60	8,510.00
October	16.77	17.51	37.20	37.15	48.04	48.78	6,264.52	8,055.92
November	31.10	31.10	35.79	35.79	69.41	69.41	7,197.85	8,989.72
December	89.67	89.67	46.25	46.25	150.22	150.22	8,325.64	10,117.51

RM = River mile, cfs = cubic feet per second, AF = acre feet

Green numbers show increases in flow and red numbers show decreases in flow, as compared to flows pre project.

Table A-2. Modeled Pre- and Post- Modernization Alternative Surface Water Hydrology During Dry Conditions (20th percentile)

-	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Fish Lake and Fourmile Lake Water Storage (AF)	Fish Lake and Fourmile Lake Water Storage (AF)
Month	Pre	Post	Pre	Post	Pre	Post	Pre	Post
January	34	34	35	35	78	78	5,897.03	7,264.55
February	30	30	39.18	39.18	61.7	61.7	6,782.6	7,575.93
March	48.6	48.6	43	43	77	77	7,346.36	8,585.96
April	65	65	50.42	50.42	99	99.92	8,217.48	10,292.61
May	18	18	53.1	53.1	34.76	39.6	10,731	12,649.14
June	4.7	4.7	59	57	23.38	26.49	10,604.2	12,434.68
July	3.8	3.8	84	72.6	22.04	22.04	6,818	9,026.04
August	2.9	12.12	81.42	79.71	20.44	26.6	3,366.65	5,923.29
September	3.2	12.12	33.6	60.09	22.4	25	2,451.18	3,872.51
October	8.94	12.12	25	25	34.92	36	2,827.24	3,667.23
November	16.3	16.3	22.82	22.82	40.98	40.98	3,574.6	4,555.98
December	19.1	19.1	25.92	25.92	54.72	54.72	4625	6,058.07

RM = River mile, cfs = cubic feet per second, AF = acre feet

Green numbers show increases in flow and red numbers show decreases in flow, as compared to flows pre project.

Table A-3. Modeled Pre- and Post-Modernization Alternative Surface Water Hydrology during Normal Conditions (50th percentile)

-	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Fish Lake and Fourmile Lake Water Storage (AF)	Fish Lake and Fourmile Lake Water Storage (AF)
Month	Pre	Post	Pre	Post	Pre	Post	Pre	Post
January	67	67	47	47	131.5	131.5	7,655.76	9,861.48
February	71	71	53	53	138	138	9,051.84	11,161.14
March	126	126	58	58	198	198	9,849.34	11,815.14
April	131	131	70.35	70.35	210	210	11,882.04	13,382.18
May	51.65	51.65	65	64.1	79	83.09	13,957.5	15,363.27
June	9.23	9.23	74	67.96	30.1	33.79	14,316.5	15,723.1
July	6.19	6.19	92.25	80.96	28	28	10,767.1	12,534.16
August	5.28	12.12	92.45	91.06	26.95	34.42	6,396.69	9,232.23
September	5.72	12.12	72.7	72.14	28	32.67	4,167.57	7,112.4
October	15.6	15.6	32.75	32.75	46	46	4,429.25	7,040.65
November	23	23	35.65	35.65	58.15	58.15	5,237.85	8,005.14
December	32.7	32.7	43	43	81.1	81.1	6,388.18	8,792.1

RM = River mile, cfs = cubic feet per second, AF = acre feet

Green numbers show increases in flow and red numbers show decreases in flow, as compared to flows pre project.

Table A-4. Modeled Pre- and Post- Modernization Alternative Surface Water Hydrology during Wet Conditions (80th percentile)

-	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	South Fork Little Butte Creek (RM 0.6) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	North Fork Little Butte Creek (RM 5) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Little Butte Creek (RM 16.8) Mean Daily Flow (cfs)	Fish Lake and Fourmile Lake Water Storage (AF)	Fish Lake and Fourmile Lake Water Storage (AF)
Month	Pre	Post	Pre	Post	Pre	Post	Pre	Post
January	159.8	159.8	70	70	285	285	13,455.634	15,802.76
February	156.8	156.8	66	66	259	259	14,729.984	16,570.6
March	218	218	79.8	79.8	351	351	14,872.314	16,997.34
April	273	273	84	84	417	417	16,022.772	18,234.98
May	203.6	203.6	85.2	85.2	296.8	300	17,304.546	20,174.32
June	18	18	89	80.74	44	50.8	22,254.012	23,311.33
July	8.7	8.7	103	91.25	31	31	19,442.104	20,904.22
August	7.6	12.12	105	99.23	31	38.22	14,753.674	16,786.98
September	9.4	12.12	85	83.11	32	38.12	11,655.772	13,550.32
October	22	22	49	49	61	61	10,674.644	13,115.84
November	37	37	48	48	80	80	11,690.48	14,074.68
December	122.6	122.6	56	56	195.6	195.6	12,541.976	14,710.94

RM = River mile, cfs = cubic feet per second, AF = acre feet

Green numbers show increases in flow and red numbers show decreases in flow, as compared to flows pre project.