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April 19, 2023

Colorado Parks and Wildlife Commission
6060 Broadway
Denver, CO 80216

**Subject: Halligan Water Supply Project (Halligan Project) – C.R.S. § 37-60-122.2
Proposed Fish and Wildlife Mitigation and Enhancement Plan Applicant Proposal**

Dear Commissioners,

The City of Fort Collins Utilities (Fort Collins) is submitting its proposed Fish and Wildlife Mitigation and Enhancement Plan (FWMEP) for the Halligan Project for the Commission's review and approval. The Halligan Project will provide Fort Collins with about 8,200 acre-feet of additional water storage needed to meet projected growth and provide additional reliable water supplies for existing water customers. The purpose of the proposed FWMEP is to comply with C.R.S. § 37-60-122.2, which intends that impacts be mitigated to the extent and in a manner that is ecologically reasonable and maintains a balance between the development of the state's water resources and the protection of the state's fish and wildlife resources.

Pursuant to the Commission's Procedural Rules, Chapter W-16, Article II – Implementation of HB1158, section 1604.A, Fort Collins is providing the following:

- Halligan Project Fish and Wildlife Mitigation and Enhancement Plan Applicant Proposal (attached to accompanying email with hard copies provided as requested by CPW staff; additional hard copies can be provided upon Commission request if by April 25, 2023); and
- Documents pertaining to the Halligan Project National Environmental Policy Act and Clean Water Act Section 404 permitting process, including the draft environmental impact statement and underlying technical reports (attached by weblink only due to number and size of files, copies can be provided in another format, by request);
(<https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Halligan/>); and
- Application for Department of the Army Permit for the Halligan Project; and
- Fort Collins can provide the Commission with additional public documents related to the Halligan Project upon request.

Fort Collins has been aided in the development of the mitigation and enhancement plans by a significant commitment of time and effort by Colorado Parks and Wildlife (CPW) staff over the last several years. Fort Collins has worked hard to develop measures that are responsive to the concerns of CPW staff. This process has resulted in a comprehensive proposal that will mitigate



and improve the health of the Cache la Poudre River (particularly the North Fork) from current conditions.


Based on Fort Collins' review of the Procedural Rules noted above, we understand that the law requires the Commission to make its evaluation of the proposal within 60 calendar days after the applicant gives notice by submitting the plan, unless extended in writing by the applicant. Fort Collins is providing notice of its final draft FWMEP which is ready for evaluation by the Commission. Statute requires that the Commission complete its evaluation within 60 days of this notice, unless this deadline is extended by Fort Collins in writing. To allow the Commission adequate time to consider the FWMEP at upcoming meetings, Fort Collins is willing to extend the statutory 60-day review period, up through June 30, 2023. This extension will allow for the following proposed schedule:

- April 19, 2023 – Fort Collins' release of FWMEP Applicant Proposal to Commission
 - The FWMEP will be available to the public via CPW's and Fort Collins' Halligan Project websites within a few days after release to Commission
- May 1, 2023 (earlier if possible) – Fort Collins' Halligan Project FWMEP virtual open house starts for gathering public input
 - The virtual open house will be open for 2 weeks
- May 3 or 4, 2023 – Fort Collins' presentation of FWMEP Applicant Proposal to Commission
 - Initial open house input will be shared with the Commission
- June 7, 2023 – Fort Collins' release of the revised FWMEP Applicant Proposal to Commission
 - The revised FWMEP will be available to the public via CPW's and Fort Collins' Halligan Project websites within a few days after release to Commission
- June 14, 2023 – Final open house input will be provided to Commission
- June 22 or 23, 2023 – Commission action of the Final FWMEP

As you will notice from this schedule, Fort Collins has developed a process to allow for public participation in the FWMEP. This public participation is in addition to the public processes implemented by the Corps through the National Environmental Policy Act process and Fort Collins' public processes throughout the life of the Halligan Project.

We look forward to working with the Commission to finalize the Halligan Project FWMEP, which would allow Fort Collins to take a significant step forward in securing its water future while enhancing portions of the Cache la Poudre River, and particularly, the North Fork.

Sincerely,



Jason Graham
Director of Water Utilities

Attachments (as noted)

17. DIRECTIONS TO THE SITE

The site is located northwest of Livermore Colorado. Take Highway 287 north from Livermore approximately 7.5 miles. Turn left at a 2-track dirt road with a locked gate. Follow this road for 4.5 miles to the west.

18. Nature of Activity (Description of project, include all features)

See attached marked as BLOCK 18

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The need for the Halligan Project is to secure additional system firm yield for Fort Collins Utilities, necessary to satisfy its projected 2065 municipal and industrial demands. The need for the Project is determined, in large part, by the magnitude and timing of the Fort Collins Utilities water demands in excess of water supplies available, including during drought years. The need for the project is based on Fort Collins' existing firm yield (based on Fort Collins' 2010 water portfolio), estimates of population growth for Fort Collins Utilities service area, water use trends, and future water demands as well as other pertinent factors, such as current and future conservation measures taken in Fort Collins Utilities service area. Construction of the enlarged dam will likely take two years and is anticipated to occur in 2024 through 2026.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Construction to enlarge and rehabilitate a 110-year old dam, including a new spillway, will require construction in the North Fork of the Cache la Poudre River. Construction of a new North Poudre Canal diversion will require construction in the North Fork of the Cache la Poudre River. Construction will require placement of concrete, temporary placement of construction access or water management structures such as ramps and pipes, and temporary placement of erosion control materials.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
to be determined during design		

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres See attached marked as BLOCK 22
or
Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

see attached marked as BLOCK 23

24. Is Any Portion of the Work Already Complete? Yes No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address- See attached marked as BLOCK 25

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
BLM	Right of Way		12/27/2016		

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.


SIGNATURE OF APPLICANT

Nov. 14, 2019
DATE

SIGNATURE OF AGENT

DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than \$10,000 or imprisoned not more than five years or both.

PERMIT APPLICATION SUPPORTING INFORMATION

HALLIGAN WATER SUPPLY PROJECT

BLOCK 18 – NATURE OF ACTIVITY

The City of Fort Collins, through Fort Collins Utilities is pursuing enlargement of existing Halligan Reservoir, located on the North Fork of the Cache la Poudre River (also referred to as the “North Fork”). The reservoir would be enlarged from the existing capacity of 6,425 ac ft, to a total capacity of 14,525 ac ft, to provide reliable water supply for anticipated demands associated with projected growth of the City of Fort Collins Utilities service area. The reservoir would be enlarged by raising and rehabilitating the existing 110-year old concrete dam an additional 25 feet, for a new total dam height of 100 ft. Operation of the enlarged reservoir would include release of 3 cfs of water from storage to the North Fork for subsequent diversion at the Fort Collins intakes between Oct 1 and Apr 30 of each year (Winter Release Plan), as well as releases to maintain a minimum flow of 5 cfs in the approximately 22 miles of the North Fork between Halligan Dam and Seaman Reservoir from May 1 to Sept 30 each year (Summer Low Flow Plan). To ensure these flows and other Fort Collins Utilities reservoir releases can bypass the existing North Poudre Canal diversion on the North Fork, the diversion structure will be reconstructed. A Peak Flow Bypass Program that would forgo all diversions to the enlarged pool at Halligan Reservoir for the three days that coincide with the forecasted peak runoff flow event for the North Fork.

BLOCK 22 – SURFACE AREA IN ACRES OF WETLANDS OR OTHER WATERS FILLED

The area to be filled includes inundation due to reservoir enlargement:

- A total of 16.74 acres of wetlands along the shoreline of Halligan Reservoir will be inundated upon enlargement of the reservoir. Of that 16.74 acres, 10.9 acres of similar wetlands is expected to re-establish along the new ordinary high-water mark.
 - A total of 4.29 acres of other waters, namely a portion of the existing North Fork upstream of Halligan Reservoir and some of tributaries, would be inundated due to reservoir enlargement. This includes about 4.03 acres of perennial tributaries and about 0.26 acre of intermittent or ephemeral tributaries.
 - The project would result in the long-term loss of 8.5 acres of riparian shrublands and 2.6 acres of riparian woodlands.
 - In summary this project would result in a net functional loss of -2.63 Ecological Functional Units.
-

BLOCK 23 – DESCRIPTION OF AVOIDANCE, MINIMIZATION, AND COMPENSATION

In addition to the operational measures described in Block 18, the project would include minimization of large and dramatic flow changes resulting from releases from Halligan Reservoir during seasons when large flow changes do not occur naturally.

Other Infrastructure design and construction avoidance and minimization measures include the following:

- A multilevel outlet tower that allows water to be pulled from different elevations within the enlarged reservoir water profile.
- Management of construction staging and sequencing to minimize impacts to big game during construction.
- Preconstruction habitat surveys, including botanical surveys, bat surveys, migratory birds and raptor surveys.
- Stormwater management plans and standard construction best management practices.
- Reclamation of construction disturbance areas and noxious and invasive weed control.
- Minimization of impacts to nearby residents and traffic on Highway 287.
- Preconstruction Class III cultural resources survey.

Compensatory mitigation measures are summarized below:

- Mitigation of permanent and/or temporal loss of wetlands and Preble’s Meadow Jumping Mouse (if required), would be performed via the reestablishment of shoreline wetlands and projected functional improvements on the North Fork through wetland and habitat enhancement, restoration, and establishment activities downstream of the Halligan dam.
- Mitigation of adverse effects to historic properties, if determined necessary.

BLOCK 25 – ADDRESSES OF ADJOINING PROPERTY OWNERS, LESSEES, ETC., WHOSE PROPERTY ADJOINS THE WATERBODY

Adjoining properties will be affected by enlargement of Halligan Reservoir due to inundation. A summary of those landowners and mailing addresses is provided in the table below.

Property Owner	Land Affected	Mailing Address
Geo A. Henderson CO., Inc.	NE1/4 S34 and SE1/4 S34	P.O. Box 668 Sterling, CO 80751-0668
Free Enterprises, Inc.	SW1/4 S27 SW1/4 S28	1803 N. Garfield Avenue Loveland, CO 80538
Viola K. Moore Revocable Trust	SE1/4 S29	1230 Country Club Road Fort Collins, CO 80524
Bureau of Land Management	NW1/4 S34	
Colorado Parks and Wildlife	NE1/4 S32	

Cubic Carbon LLC	Mining Claims: Halligan #1 (CMC 290794) Halligan #2 (CMC 290795) Halligan #3 (CMC 290796) Halligan #4 (CMC 290797)	4290 W 10 th St. #110 Greeley CO 80634-1400
Landowners Association of Phantom Canyon Ranches	Nearby property owner	C/O Brian Gray 1411 Andrews Park Rd. Livermore, CO 80536

Halligan Water Supply Project

FINAL Draft

Fish and Wildlife Mitigation and Enhancement Plan

Prepared by



with support from

Jacobs

April 19, 2023



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Acronyms and Abbreviations

Term	Definition
2008 Mitigation Rule	2008 U.S. Army Corps of Engineers, Compensatory Mitigation for Losses of Aquatic Resources; Final Rule
bighorn sheep	Rocky Mountain bighorn sheep
BLM	U.S. Department of the Interior Bureau of Land Management
BMP	best management practice
C-BT	Colorado–Big Thompson, in reference to the C-BT Project
CCR	<i>Code of Colorado Regulations</i>
CDNR	Colorado Department of Natural Resources
CDPHE	Colorado Department of Public Health and Environment
CFR	<i>Code of Federal Regulations</i>
cfs	cubic feet per second
CMP	Conceptual Mitigation Plan
Coalition	Coalition for the Poudre River Watershed
Commission	Parks and Wildlife Commission
Corps	U.S. Army Corps of Engineers
CPW	Colorado Parks and Wildlife
CRS	Colorado Revised Statute
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
DAU	data analysis unit
DEIS	Draft Environmental Impact Statement
DM	daily maximum
DO	dissolved oxygen
DWR	Colorado Department of Water Resources
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
Fort Collins	City of Fort Collins, acting through its Fort Collins Utilities
FR	<i>Federal Register</i>
FWMEP	Fish and Wildlife Mitigation and Enhancement Plan
GIS	geographic information system
GMU	Game Management Unit
GPS	global positioning system
Halligan Project, Project	Halligan Water Supply Project
LAPCR	Landowners Association for Phantom Canyon Ranches
Main Stem	Main Stem of the Cache la Poudre River
MLOW	multilevel outlet works

Term	Definition
MMI	macroinvertebrate multimetric index
NEPA	National Environmental Policy Act
NISP	Northern Integrated Supply Project
North Fork	North Fork of the Cache la Poudre River
North Fork confluence	confluence of the North Fork and Main Stem
Northern Water	Northern Colorado Water Conservancy District
NPIC	North Poudre Irrigation Company
NRCS	Natural Resources Conservation Service
Poudre River	Cache la Poudre River
Preble's	Preble's meadow jumping mouse
ROD	Record of Decision
SPWRAP	South Platte Water Related Activities Program
SAM	species activity mapping
SWA	State Wildlife Area
SWAP	State Wildlife Action Plan
TEP	temporary environmental pool
TNC	The Nature Conservancy
TMDL	total maximum daily load
U.S., US	United States
U.S.C.	<i>United States Code</i>
USFWS	United States Fish and Wildlife Service
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division

Key Terminology

Key terminology used throughout this report is defined in this section and is listed in alphabetic order. If a citation is listed, the definition provided is directly from that regulatory reference.

Best Management Practices. Best management practices (BMPs) refer to structural and non-structural methods, measures, or practices implemented to prevent, reduce, or mitigate adverse impacts resulting from construction and operation of a project. BMPs may also be called control measures.

Poudre River-related Terminology:

Exchange Reach. For purposes of this Fish and Wildlife Mitigation and Enhancement Plan (FWMEP), the Exchange Reach is defined as the segment of the Main Stem between its confluence with the North Fork and the Fort Collins Intake(s): the Fort Collins Intake and Munroe Gravity Canal are located approximately 0.6 river mile and 1.5 river miles upstream of the North Fork confluence, respectively. Exchanges are a unique type of water right. They are, in essence, a trade where water is diverted at upstream locations when an equal amount of water is delivered to or released at downstream locations.

Main Stem. In this FWMEP, the Main Stem refers to the portion of the Poudre River from the Munroe Diversion to the confluence with the South Platte River.

Cooperating Agency. In the Draft Environmental Impact Statement (EIS) (Section 1.2), the United States (U.S.) Army Corps of Engineers (Corps) refers to cooperating agencies pursuant to 40 *Code of Federal Regulations* (CFR) Section 1501.8. The regulation states: *“Upon request of the lead agency, any other Federal agency with jurisdiction by law shall be a cooperating agency. In addition, any other Federal agency which has special expertise with respect to any environmental issue may be a cooperating agency. A State, Tribal or local agency of similar qualifications may become a cooperating agency by agreement with the lead agency.”*

Ecological Function. Ecological function is defined as the work performed or role played individually or collectively by the physical, chemical, and biological processes that contribute to the maintenance of the aquatic and terrestrial environments that constitute the natural environment (Law Insider n.d.).

Enhancement-related Terminology:

Enhancement. Colorado Parks and Wildlife’s (CPW’s) rules and regulations for fish and wildlife mitigation and enhancement plans pursuant to Colorado Revised Statute (CRS) 37-60-122.2 define enhancement as “the improvement of the total value of fish and wildlife resources affected by the project beyond that required by mitigation and beyond that which would occur without the project” (2 *Code of Colorado Regulations* [CCR] 406-16). This involves activities conducted within existing aquatic or other resources that heighten, intensify, or improve one or more functions of the resource. Enhancement is often implemented for a specific purpose, such as to improve water quality, flood water retention, or wildlife habitat.

Enhancement Plan. CPW’s rules and regulations for fish and wildlife mitigation and enhancement plans pursuant to CRS 37-60-122.2 define an enhancement plan as a “document describing the measures to be completed by the applicant which will enhance fish and wildlife resources beyond that which would occur without the project. It includes a cost estimate for the implementation of the plan and a schedule for completion” (2 CCR 406-16). Fort Collins’ enhancement plan is set forth in Chapter 5 of this FWMEP.

Environmental Effect/Impacts. An environmental effect or impact is defined as any change to the environment, whether adverse or beneficial, resulting from an action taken.

Direct effects/impacts are those that would result directly from implementing the Halligan Water Supply Project (Halligan Project). Most direct effects would occur from construction and from inundation by the enlarged Halligan Reservoir.

Indirect effects/impacts are those that result from the Halligan Project but occur later in time or are farther removed in distance. The primary indirect effects would be associated with Project-related flow changes in the North Fork and the Main Stem.

Flow-Related Operational Measures. These are measures that would re-establish a perennial flow regime of 3 cubic feet per second (cfs) to 5 cfs or more to the North Fork below the enlarged Halligan Reservoir, minimize abrupt changes to flows that would otherwise result from Fort Collins' operations, and allow for a portion of the hydrologic peak flows to bypass the enlarged reservoir when Fort Collins could otherwise be diverting water to storage. These measures include the Winter Release Plan, Summer Low-flow Plan, Ramping Rate Limitations, and Peak Flow Bypass Program.

Fort Collins. The proponent of the Halligan Project is the City of Fort Collins, acting through Fort Collins Utilities.

Fort Collins Intake(s). Two diversions are located on the Main Stem where Fort Collins diverts water for municipal purposes. The two diversions that deliver water to Fort Collins' Water Treatment Facility are:

Fort Collins Intake. Diversion on the Main Stem located approximately 0.6 river mile upstream of the North Fork confluence, which diverts water into the Fort Collins pipeline.

Munroe Canal. Diversion on the Main Stem located approximately 1.5 river miles upstream of the North Fork confluence, which delivers Fort Collins' water into the Pleasant Valley Pipeline.

In the future, releases from Fort Collins' portion of the enlarged Halligan Reservoir will most likely be diverted by exchange at the Fort Collins Intakes. Of the approximately 1,700 acre-feet of annual average releases by Fort Collins under the Halligan Project, about 90 percent are diverted at the Fort Collins Intake and about 10 percent are diverted at Munroe Canal.

Inherent Benefits. These are beneficial effects on natural resources as a result of the Halligan Project and Pleasant Valley Pipeline, including but not limited to ecological benefits resulting from flow-related operational measures and the natural re-establishment of wetland and riparian communities at the enlarged reservoir shoreline and on the North Fork.

Linkage Area. Is being used to describe habitat that successfully moves animals across fracture zone. Fracture zones are highways, railroads, and similar potential barriers to wildlife movement and the adjacent development of private lands. So, even though use may vary by season of year or not it is still used as a movement or linkage area connecting two blocks of viable, suitable, and used habitat (Interagency Grizzly Bear Committee Public Lands Wildlife Linkage Task Force 2004).

Mitigation-related Terminology:

Mitigation. CPW's rules and regulations for fish and wildlife mitigation and enhancement plans under CRS 37-60-122.2 define mitigation as "any action or measures taken to address undesirable project impacts on fish and wildlife resources which may be accomplished in several ways, including reducing, minimizing, rectifying, compensating, or avoiding impacts" (2 CCR 406-16). As used in this FWMEP, mitigation includes:

Avoidance. These are measures undertaken to avoid adverse impacts of a project, such as design refinements to reduce the project footprint (U.S. Environmental Protection Agency [EPA] 1990).

Minimization. This consists of measures undertaken to minimize adverse impacts through project modifications and permit conditions (40 CFR Sections 230.70–77).

Compensatory Mitigation. This means any action or measures taken to address unavoidable project impacts on fish and wildlife resources after all appropriate and practical avoidance and minimization measures have been implemented. This may be accomplished in several ways, including rectifying or compensating impacts.

Early Mitigation. These are mitigation efforts initiated by Fort Collins before construction and operation of the Halligan Project, or in some cases before developing this FWMEP.

Mitigation Plan. CPW’s rules and regulations for fish and wildlife mitigation and enhancement plans developed pursuant to CRS 37-60-122.2 define a mitigation plan as a “document describing the measures to be completed by the applicant which will mitigate losses to fish and wildlife resources resulting from the project. It includes a cost estimate for the implementation of the plan and a time schedule for completion.” (2 CCR 406-16). Fort Collins’ mitigation plan is set forth in Chapter 4 of this FWMEP.

Preservation. This involves permanently protecting ecologically important aquatic or other resources by implementing appropriate legal and physical mechanisms, such as conservation easements and title transfers. Preservation of aquatic resources may include protecting upland areas adjacent to aquatic resources as necessary to ensure protection or enhancement of the aquatic ecosystem (2008 Mitigation Rule [USACE 2008]; 73 *Federal Register* [FR] 19593).

Restoration. This is defined as reestablishing or rehabilitating an aquatic or other resource with the goal of returning natural or historical functions and characteristics to a former or degraded resource. Restoration may result in a gain in resource function, acres, or both (2008 Mitigation Rule; 73 FR 19593).

Monitoring-Related Terminology:

Baseline Assessments. This consists of assessments undertaken before project implementation to document existing conditions in order to understand how resources may be affected by the project or are the subject of mitigation measures before mitigation and/or enhancement actions are taken.

Construction Compliance Monitoring. This consists of monitoring undertaken to evaluate whether construction-related avoidance and minimization measures are being implemented.

Mitigation Compliance Monitoring. This involves monitoring undertaken to evaluate whether compliance with the compensatory mitigation requirements are being met.

Voluntary Enhancement Monitoring. This consists of monitoring that Fort Collins would perform voluntarily and that does not directly relate to monitoring required to evaluate compliance.

Project. The Halligan Water Supply Project is also referred to as the “Halligan Project” in this FWMEP, which primarily entails the enlargement of Halligan Reservoir, construction of the replacement Halligan Dam, and replacement of the North Poudre Canal Diversion. The Project is referred to as Fort Collins’ “Proposed Action” in the National Environmental Policy Act (NEPA) process and associated EIS.

Halligan Project Area. This term is used to describe the general area of Project construction and the area affected by operations of the enlarged Halligan Reservoir. The Halligan Project Area refers generally

to the area of the enlarged Halligan Reservoir; the North Poudre Canal Diversion; the North Fork downstream of Halligan Reservoir to the confluence with the Main Stem; the Exchange Reach; and areas temporarily or permanently affected by construction activities, plus a 0.5-mile buffer for noise, visual, or vibratory disturbance. The Halligan Project Area also includes roads that would be temporarily widened to provide access for construction of the Halligan Project. The Halligan Project Area does not include mitigation sites that are not adjacent to the areas listed in this section (refer to Section 1.3).

Executive Summary

The City of Fort Collins, acting through Fort Collins Utilities (Fort Collins), is pursuing the Halligan Water Supply Project (Halligan Project or Project), a municipal water supply project. Implementation of the Halligan Project requires various regulatory approvals, including federal permitting processes administered by the United States (U.S.) Army Corps of Engineers (Corps) under the Clean Water Act (CWA) and the National Environmental Policy Act (NEPA). A Draft Environmental Impact Statement (DEIS) was issued by the Corps for the Halligan Project on November 22, 2019 and serves as the basis for documenting current conditions and impacts. Fort Collins has prepared this Fish and Wildlife Mitigation and Enhancement Plan (FWMEP) in coordination with Colorado Parks and Wildlife (CPW) staff pursuant to Colorado Revised Statute (CRS) 37-60-122.2 and applicable rules and regulations (2 CCR] 406-16).

The Halligan Project Overview. The Halligan Project primarily involves enlarging the existing Halligan Reservoir on the North Fork of the Cache la Poudre River (North Fork), located approximately 25 miles northwest of Fort Collins. The existing Halligan Reservoir currently supplies water to shareholders of the North Poudre Irrigation Company (NPIC), which would continue to use and operate the historical reservoir pool. Fort Collins would store its water in the enlarged portion of the reservoir. Fort Collins' water would primarily come from water rights historically used to irrigate now-developed lands in the Fort Collins area that have been transferred to municipal use. Existing infrastructure would be used to deliver water from the enlarged reservoir pool to Fort Collins' water treatment facility.

Since the release of the DEIS in November 2019, Fort Collins has modified their Proposed Action from rehabilitation and raising of the existing dam to constructing a new dam, which is also referred to as the replacement dam. Halligan Reservoir would be enlarged by replacing the existing 114-year-old dam, as of 2023, with a new dam constructed approximately 200 feet downstream of the existing dam. The replacement dam would raise the existing reservoir elevation by approximately 25 feet, to increase the total water storage capacity by approximately 8,200 acre-feet, for a total enlarged reservoir volume of approximately 14,600 acre-feet. Enlarging the reservoir would increase the current surface area of Halligan Reservoir from 253 to 391 acres.

Fort Collins would release its water from the enlarged reservoir into the North Fork below the dam. Fort Collins' releases would be conveyed approximately 24 miles in the North Fork to its confluence with the Main Stem of the Cache la Poudre River (Main Stem). Using an exchange, Fort Collins would then divert a like amount of water at either of the two Fort Collins Intakes on the Main Stem, located approximately 0.6 river mile and 1.5 river miles upstream.

The Halligan Project also includes rebuilding the existing North Poudre Canal Diversion located on the North Fork approximately 6 river miles downstream of Halligan Reservoir. The replacement ensures that Fort Collins' releases from the enlarged Halligan Reservoir would bypass the diversion and remain in the North Fork.

In the DEIS Section 1.4.2, the Corps defined Fort Collins' purpose and need for the Halligan Project as "to provide additional system firm yield for Fort Collins in order to satisfy an additional need of approximately 7,900 acre-feet per year to meet its projected approximate 2,065 municipal and industrial demands with water of a quality comparable to the water now delivered to its customers." In addition, the Halligan Project ensures that Fort Collins can satisfy future water supply and demands by providing a storage reserve for emergency water supply, increasing drought security, and improving water system reliability and flexibility.

The Fish and Wildlife Mitigation and Enhancement Plan. This FWMEP was developed in collaboration with CPW staff pursuant to CRS 37-60-122.2 and applicable regulations (2 CCR 406-16). In addition to

describing the Halligan Project and its context, this FWMEP includes both a mitigation plan (Chapter 4) and an enhancement plan (Chapter 5).

Fort Collins understands that CPW staff's interpretation of these regulations are that only a portion of Fort Collins' mitigation and enhancement measures will be considered to be part of the Parks and Wildlife Commission's (Commission's) proposed mitigation recommendation for purposes of CRS Section 37-60-122.2 and 2 CCR 406-16. Fort Collins also understands that CPW staff's interpretation is that the Commission acknowledges the importance and value of all mitigation and enhancement measures as described in Fort Collins' Modified Proposed Action and required by other agencies, but distinguishes a different category of which the Commission is recommending on top of, or in addition to those measures proposed within the Modified Proposed Action and required by other agencies. Fort Collins desires to complete this process for the FWMEP and has thus not taken a position on CPW staff's interpretation.

This FWMEP thus includes a comprehensive description of all of Fort Collins' planned mitigation and enhancement measures for the Halligan Project that are related to fish and wildlife. Some of these commitments and measures are included as part of Fort Collins' Modified Proposed Action for its federal permitting requirements in the Final EIS, and some of these commitments and measures were developed for purposes of this FWMEP. As such, Fort Collins' total estimated mitigation and enhancement costs for all measures, as well as CPW's interpretation of what are attributable to the Commission's recommendations pursuant to CRS Section 37-60-122.2 are presented as part of this FWMEP. All cost commitments presented in the FWMEP are depicted in 2022 dollars and will be increased in the amount of the U.S. Bureau of Labor Statistics Consumer Price Index for Denver-Aurora-Lakewood from January 1, 2023 to the date of final payment under the FWMEP obligation.

Chapters 1 and 2. These sections provide an overview and summary of the Halligan Project and its context. Chapter 1 includes information regarding current operations at Halligan Reservoir and along the North Fork, as well as proposed future operations after the reservoir is enlarged. Chapter 1 also provides current estimated costs and an overview of the regulatory framework. Chapter 2 describes Fort Collins' water portfolio and extensive water conservation efforts. Additional and more detailed technical information and analyses are provided in the Corps' DEIS and its technical reports (Corps 2019).

Chapter 3. This section summarizes fish and wildlife conditions in the Halligan Project Area and effects of the Halligan Project. Since completion of Halligan Reservoir in 1909, operations of Halligan Dam and the North Poudre Canal Diversion have significantly and adversely affected river flows in the North Fork and impaired downstream aquatic habitats.

The Halligan Project effects described in this FWMEP are based on detailed evaluations in the DEIS and supporting technical reports, and further analyses conducted since the DEIS. Most Halligan Project permanent impacts would occur from inundation by the enlarged reservoir along a portion of the North Fork upstream of the reservoir, including a Colorado Water Conservation Board (CWCB) instream flow water right, and at the footprint of the replacement dam. Temporary impacts would occur from construction activities, including access and materials mobilization and stockpiling, at the replacement dam and at the North Poudre Canal Diversion. Minor indirect impacts are anticipated for the North Fork between Halligan Reservoir. As well as minor indirect impacts for the Mainstem in the form of reduced runoff flows while diverting water to storage in the enlarged reservoir and for the Main Stem in the form of reduced flows within the Exchange Reach when Halligan Releases are being diverted by exchange into the Fort Collins Intakes. This FWMEP also addresses additional concerns regarding the Halligan Project that were identified by CPW staff during Project consultations.

Chapter 4. The mitigation plan describes the measures that would be used to avoid and minimize Project impacts on fish and wildlife resources, as well as measures that would be used to compensate for unavoidable impacts on fish and wildlife resources. Key measures include:

- Flow-related operational measures, including the following:
 - Winter Release Plan to provide continuous releases of 3 cubic feet per second (cfs) from the enlarged reservoir to the North Fork from October 1 through April 30 each year
 - Summer Low-Flow Program to maintain a continuous flow of at least 5 cfs in the approximately 22 miles of the North Fork between Halligan Dam and Seaman Reservoir from May 1 to September 30 each year
 - Ramping rate limitations on Fort Collins’ operations to gradually change flow rates associated with diversions and releases from the enlarged reservoir
 - Peak Flow Bypass Program to maintain historical peak flushing flows for at least 3 days
- Operational measures for sediment management, such as construction-related sediment controls and the Peak Flow Bypass Program
- Infrastructure design measures, including the following:
 - Design of new replacement Halligan Dam with redundancy in operation function
 - Enlarged outlet conduit to allow for the peak flow bypass
 - Design of the partial or total demolition of the existing Halligan Dam and features that remain in place, the details of which are not known at this time
- Construction-related measures, including the following:
 - Best management measures, including control of erosion, dust, stormwater, and waste
 - Preconstruction surveys for certain federal- and state-listed species, including noxious weeds
 - Provide raptor nesting/roosting platforms
 - Modified existing infrastructure design for North Poudre Canal Diversion
 - Construction timing restrictions at the North Poudre Canal and Calloway Diversions
- Compensatory mitigation for unavoidable Halligan Project impacts on fisheries, water quality and temperature, terrestrial wildlife, federally and state-listed species, and inundated instream flow water rights.
 - Early mitigation measure consisting of a conservation easement on the 4,557-acre Roberts Ranch
 - Design and construction of features to improve fish passage around the Fort Collins Intake on the Main Stem
 - Bighorn sheep mitigation, including improved food and water access, movement monitoring, avoiding/minimizing construction impacts, and compensation for mortalities
 - Funding for stream restoration as mitigation for stream temperature impacts

Chapter 5. The enhancement plan summarizes the measures that Fort Collins proposes to incorporate into the Halligan Project that are not required to meet regulatory mitigation needs, but rather would be implemented to improve existing conditions for fish and wildlife resources in and around the Halligan Project Area. Key enhancement measures are summarized in this section.

- Aquatic resource enhancements including the following:
 - Create a temporary environmental pool within Halligan Reservoir
 - Provide fish passage around the North Poudre Canal Diversion
 - Improve the North Fork channel at the Calloway Diversion and remove some or all elements of the diversion structure to support flow, sediment transport, and fish movement
 - Implement potential future ramping rate limitations for NPIC’s use of the enlarged reservoir
- Terrestrial resource enhancements include the following:
 - Restrict domestic sheep and goat grazing on Fort Collins-owned land or on any easements on lands around Halligan Reservoir during construction
 - Advocate cessation of domestic sheep and goat grazing on other lands
- Recreation resource enhancements include the following:
 - Reconcile title chain confusion related to certain lands thought to be part of the Cherokee State Wildlife Area – Middle Unit, with Fort Collins acquiring such lands and conveying an easement to CPW across these lands for public use
 - Fund a public access lease with Roberts Ranch
 - Establish parking area outside of the enlarged reservoir inundation area for public access

1 Introduction

The City of Fort Collins (Fort Collins) proposes the Halligan Project to meet its strategic objective of providing a reliable, high-quality water supply. The Halligan Project is a municipal water supply project designed to provide additional system firm yield for Fort Collins to satisfy its projected municipal and industrial water demands with water quality comparable to that of the water now delivered to its customers.

The Halligan Project primarily involves enlargement of the existing Halligan Reservoir and replacement of the existing North Poudre Canal Diversion. Halligan Reservoir would be enlarged by replacing the existing 114-year-old dam, as of 2023, with a new dam constructed approximately 200 feet downstream of the existing dam. The Halligan Project is described in greater detail in the *Draft Environmental Impact Statement (DEIS) Halligan Water Supply Project* (United States [U.S.] Army Corps of Engineers [Corps] 2019) and is referred to as Fort Collins' "Proposed Action," with certain aspects relevant to fish and wildlife discussed in this Fish and Wildlife Mitigation and Enhancement Plan (FWMEP).

1.1 Purpose of this Fish and Wildlife Mitigation and Enhancement Plan

This FWMEP was developed pursuant to Colorado Revised Statute (CRS) 37-60-122.2 and applicable rules and regulations (2 *Code of Colorado Regulations* [CCR] 406-16). This FWMEP sets forth the actions that Fort Collins would take to mitigate the potential impacts that the Halligan Project may have on fish and wildlife resources, and to enhance existing conditions in the Halligan Project Area (the general area of Project construction and the area affected by operations of the enlarged Halligan Reservoir; refer to the definition in the Key Terminology section and also refer to Figure 1-1). In addition to addressing Halligan Project impacts, which are based on the DEIS and subsequent analyses, this FWMEP also addresses additional concerns regarding the Halligan Project that were identified by Colorado Parks and Wildlife (CPW) staff during Project consultations.

Fort Collins understands that CPW staff's interpretation is that the Fort Collins Water Quality Control Commission (WQCC) acknowledges the importance and value of all mitigation and enhancement measures as described in Fort Collins' Modified Proposed Action and required by other agencies but distinguishes a different category of which the WQCC is recommending on top of, or in addition to, those measures proposed within the Modified Proposed Action and required by other agencies. Therefore, the WQCC's proposed mitigation recommendation for purposes of CRS 37-60-122.2 and 2 CCR 406-16 may be a subset of Fort Collins' mitigation and enhancement measures described in this FWMEP.

It is Fort Collins' understanding that all measures in this FWMEP have been evaluated by CPW staff to determine what would be recommended by the WQCC. Rather than parsing the distinctions throughout the FWMEP, the categories based on CPW staff's interpretation are captured in Appendix B, which shows a distinction between Fort Collins' total estimated mitigation and enhancement costs and those CPW's staff believe are attributable to the WQCC's recommendations via separate cost columns.

Fort Collins intends to complete the mitigation and enhancement measures developed as part of this FWMEP, as well as those identified in Clean Water Act (CWA) Section 401 water quality certification and the Corps CWA Section 404 permit and associated Record of Decision (ROD). It is anticipated that compliance with the mitigation plan portion of this FWMEP will be attached as permit conditions by the Corps on the ROD and CWA Section 404 permit, and the mitigation commitments in this FWMEP will be in addition to any other measures required by other entities.

1.2 Contents of this Fish and Wildlife Mitigation and Enhancement Plan

This FWMEP includes both a mitigation plan and an enhancement plan. The following sections are included in this FWMEP:

- **Chapter 1—Introduction** (this chapter) describes the Halligan Project, purpose of the FWMEP, current operations of Halligan Reservoir, and proposed operations of an enlarged Halligan Reservoir, water rights, estimated Project cost, and the regulatory framework for the Halligan Project.
- **Chapter 2—Fort Collins Water Portfolio** summarizes Fort Collins’ existing and future water supply and demand, as well as demand management through water conservation. Chapter 2 also provides information about current and related regional activities.
- **Chapter 3—Fish and Wildlife Conditions and Impacts** describes current conditions and summarizes the anticipated effects of the Halligan Project on fish and wildlife resources, including inherent benefits of the Halligan Project.
- **Chapter 4—Proposed Fish and Wildlife Mitigation Plan** describes the measures that would be used to avoid and minimize impacts on fish and wildlife resources, as well as those measures that would be used to compensate for unavoidable impacts on fish and wildlife resources.
- **Chapter 5—Proposed Fish and Wildlife Enhancement Plan** summarizes the measures that Fort Collins proposes to voluntarily incorporate into the Halligan Project that exceed the mitigation requirements and are proposed to improve existing conditions in and around the Halligan Project Area.
- **Chapter 6—References** provides detailed references to the works cited in this FWMEP.

Maps of key Project elements and water quality sampling stations are provided in Appendix A and Appendix D. Appendix B provides a tabular summary of the components of this FWMEP. Appendix C is a table that lists the mitigation and enhancement measures described in Sections 4 and 5, including the cost of each item.

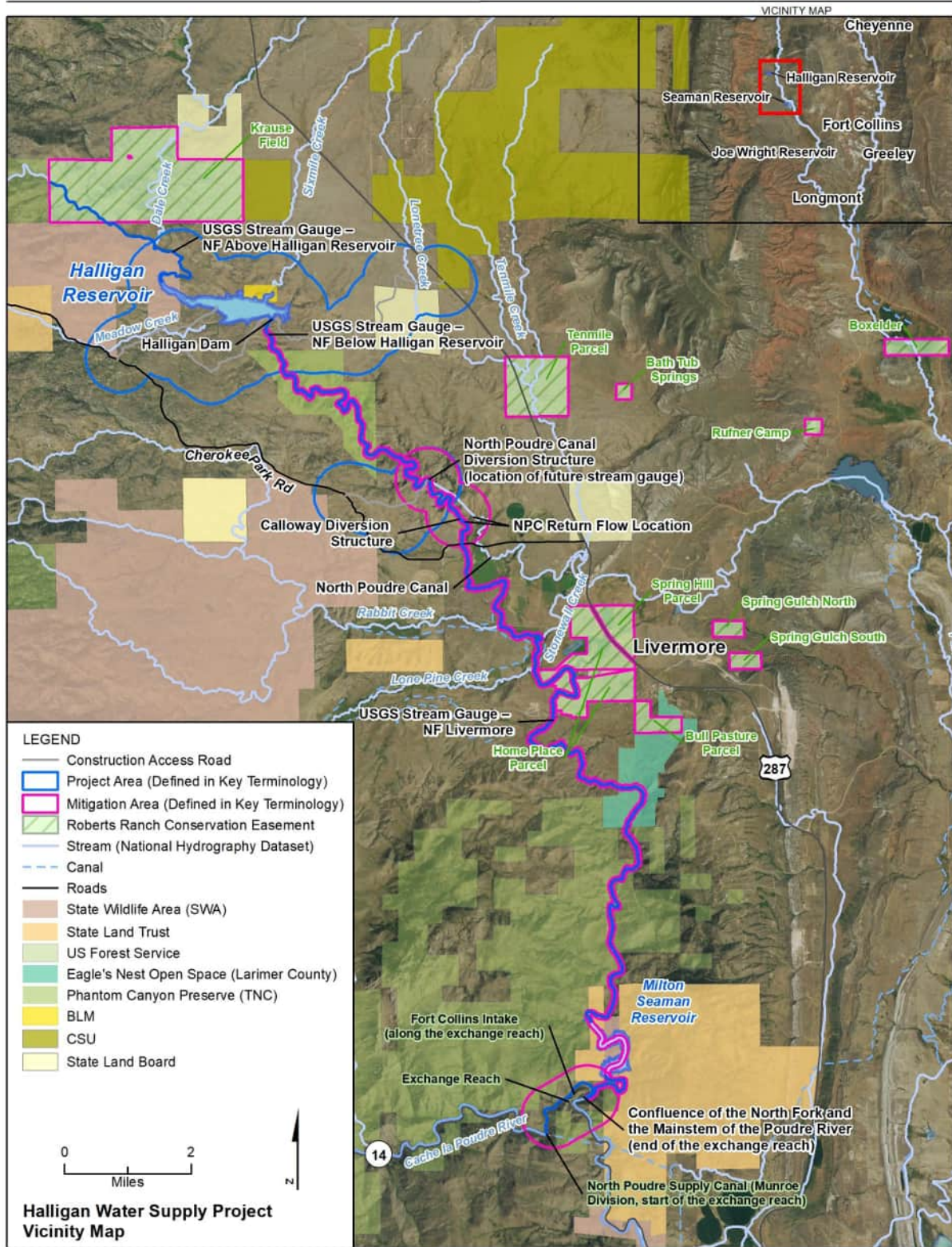
1.3 Halligan Project Overview

The Halligan Project includes enlarging the existing Halligan Reservoir on the North Fork, located approximately 25 miles northwest of Fort Collins in Larimer County. The location of the Halligan Project is shown on Figure 1-1. Appendix A provides overview and detailed maps of key Project elements. Halligan Reservoir would be enlarged by replacing the existing 114-year-old dam, as of 2023, with a new dam constructed approximately 200 feet downstream of the existing dam. The replacement dam would raise the existing reservoir elevation by approximately 25 feet to increase the total water storage capacity by approximately 8,200 acre-feet, for a total enlarged reservoir volume of approximately 14,600 acre-feet. Enlarging the reservoir would increase the current surface area of Halligan Reservoir from 253 to 391 acres. Figure 1-2 shows the reservoir inundation area at the current and proposed enlarged ordinary high water mark, and Figure 1-3 presents anticipated construction features, including the replacement dam infrastructure, access roads, and potential borrow or stockpile areas.

The Halligan Project also includes rebuilding the existing North Poudre Canal Diversion located approximately 6 river miles downstream of Halligan Reservoir to allow Fort Collins’ releases from the enlarged Halligan Reservoir to bypass the diversion and remain in the North Fork.

The Halligan Project ensures that Fort Collins can satisfy future water supply and demands by:

- Meeting future water demands of the Fort Collins Utilities water service area
- Providing a storage reserve for emergency water supply
- Increasing drought security
- Improving water system reliability and flexibility



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Figure 1-1. Overview of Halligan Project Elements and Other Infrastructure

(Refer to Appendix A for detailed maps)

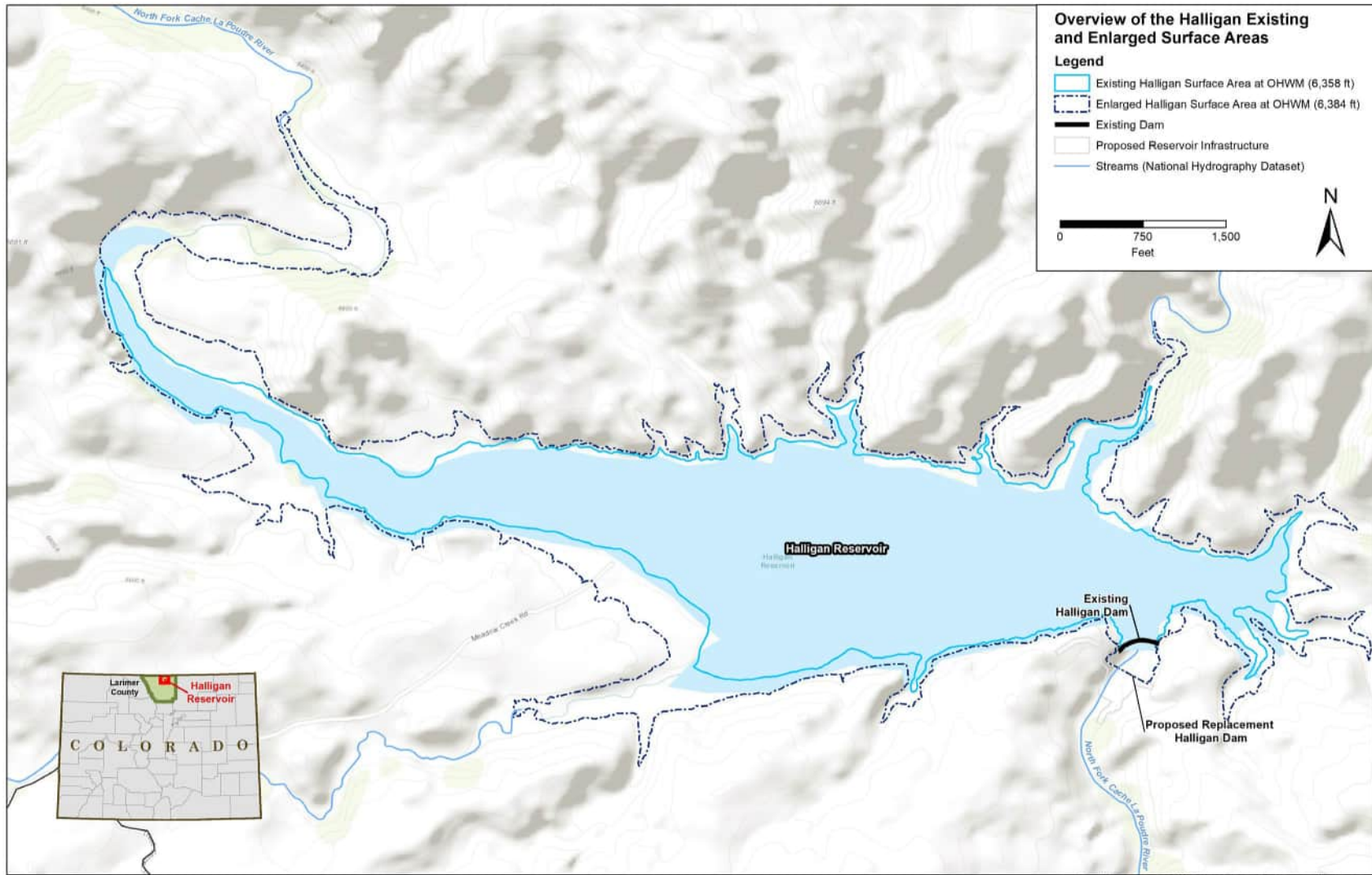


Figure 1-2. Overview of the Halligan Existing and Enlarged Surface Areas

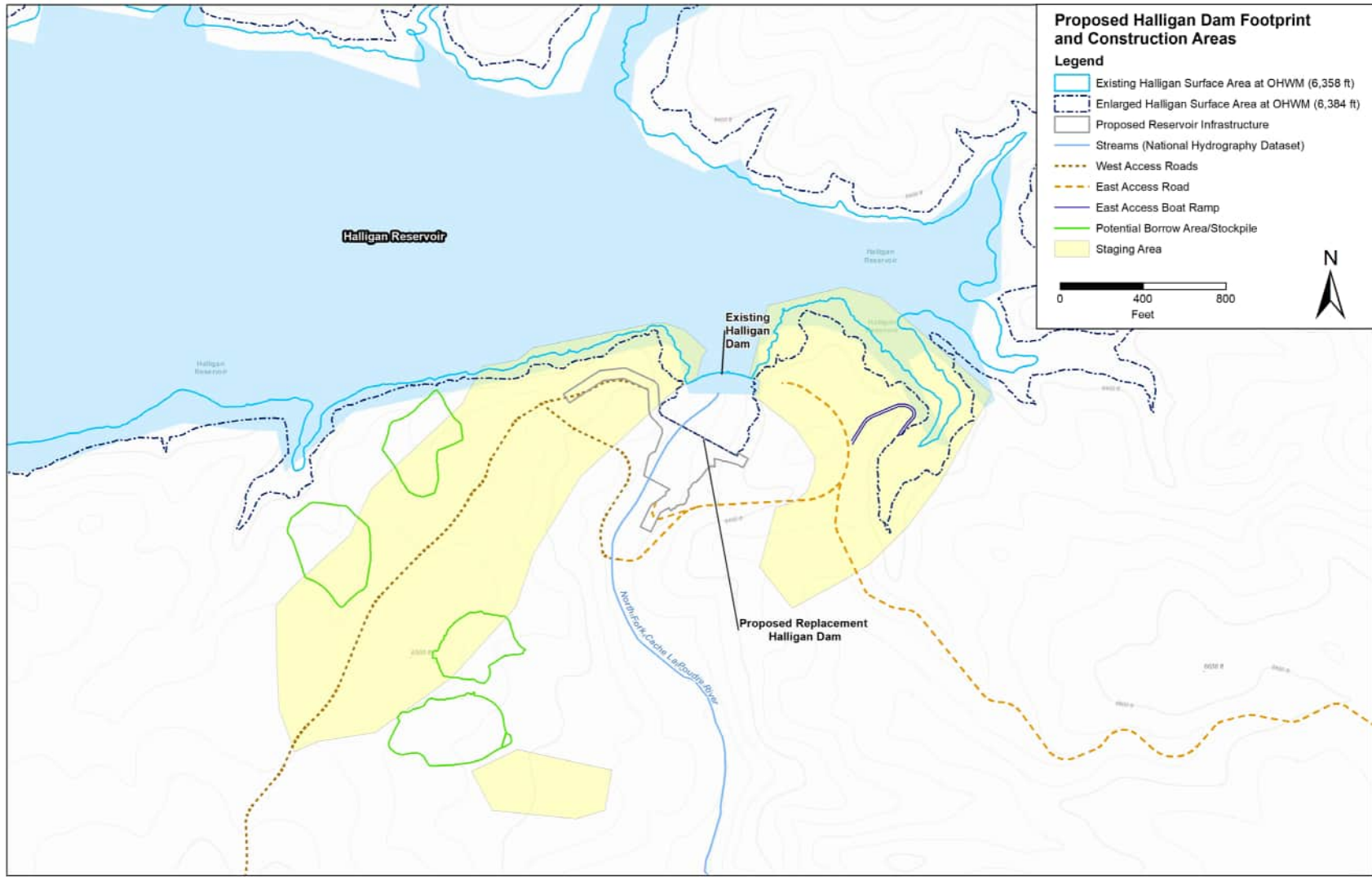


Figure 1-3. Proposed Halligan Dam Footprint and Construction Areas

Fort Collins anticipates developing the following infrastructure and construction areas in association with the Halligan Project:

- Replacement of Halligan Dam, including outlet works, stilling basin, and other appurtenant structures constructed approximately 200 feet downstream of the existing dam
- Reconstruction of the North Poudre Canal Diversion
- Partial or total demolition of the existing dam after the replacement dam is constructed
- Temporary construction areas and features, including temporarily widened roads to allow for construction vehicle access, construction staging areas, concrete batching plant, and possible borrow pits for concrete aggregate
- Construction of a temporary construction access river crossing below the existing dam
- Permanent remnants of construction, including waste rock piles, new access roads in the immediate area of the reconstructed dam, and/or widened roads in limited areas where the roads cannot be reclaimed on portions of Fort Collins' property and/or where private property owners request to retain widened roads

Future operation of the Halligan Project is described in Section 1.3.1.2. Features that would be constructed as part of avoidance, minimization, compensatory mitigation, and enhancement measures are described in Sections 4 and 5.

1.3.1 Operations, Storage, and Water Rights

1.3.1.1 Current Operations of Halligan Reservoir

Halligan Reservoir is an existing on-stream reservoir that North Poudre Irrigation Company (NPIC) constructed in 1909 to supply water to its shareholders. Fort Collins acquired Halligan Reservoir and certain surrounding lands from NPIC in 2004 pursuant to a 1993 option agreement. Although Fort Collins owns Halligan Reservoir, the reservoir is currently operated by NPIC and supplies water to NPIC shareholders only. Water is currently released from Halligan Reservoir and diverted at the North Poudre Canal Diversion, where it is conveyed in the North Poudre Canal into NPIC's ditch and reservoir system for delivery to NPIC shareholders. The 1993 option agreement between Fort Collins and NPIC allows Fort Collins to enlarge Halligan Reservoir but requires Fort Collins to reconvey the reservoir and associated lands back to NPIC if Fort Collins abandons the Halligan Project or is otherwise unable to enlarge the reservoir.

Under current operations, NPIC fills Halligan Reservoir starting in the fall. Filling continues until water levels reach the dam spillway crest and water spills over the dam into the North Fork. Spilling typically occurs annually in the spring but can occur as early as December or January. NPIC begins releasing water to the North Fork from the dam outlet in the spring. NPIC then diverts the releases at the North Poudre Canal Diversion, which is located approximately 6 river miles downstream of Halligan Dam.

During the irrigation season (summer through early fall), NPIC typically "sweeps" the river by diverting all flows into North Poudre Canal, the initial portion of which is a tunnel through the canyon wall. Where the tunnel daylights approximately 1.9 miles downstream, water that NPIC is not entitled to use or that is in excess of the North Poudre Canal's capacity is returned to the river through a return structure. These operations typically result in low-flow conditions, dry-up points, and disconnected pools in the 1.9-mile stretch of the North Fork between the North Poudre Canal Diversion and where some water is returned (Figure 1-1).

NPIC frequently releases water from Halligan Reservoir at a rate that they can divert into the North Poudre Canal at the North Poudre Canal Diversion. During the irrigation season, NPIC typically diverts all water released from Halligan Reservoir, unless spilling at the dam results in a larger amount of water than can be diverted at the North Poudre Canal.

At the end of the irrigation season, NPIC typically commences diverting water into Halligan Reservoir for storage and releases from Halligan Reservoir cease. Winter reservoir operations typically result in low-flow conditions, dry-up points between November and March, and disconnected pools in the North Fork for approximately 10 miles between Halligan Reservoir and the first downstream tributary, Rabbit Creek (Figure 1-1).

Dam inspection reports summarize current conditions of the dam, as indicated by the State of Colorado's Dam Safety Office. Inspection reports indicate that the existing Halligan Reservoir dam is currently sound. However, the dam is over 114-years old, as of 2023, and seepage through the dam and freeze-thaw cycles will continue to degrade the dam and present an increasing safety risk unless it is rehabilitated. As described in the DEIS, significant construction would be required in the future to rehabilitate the existing dam if the Halligan Project is not implemented. Design of the replacement Halligan Dam is underway and involves close coordination with the State of Colorado's Dam Safety Office.

1.3.1.2 Proposed Future Operations of the Enlarged Halligan Reservoir

The enlarged Halligan Reservoir would be operated by Fort Collins. Although Fort Collins intends to meet any operational commitments included in this FWMEP, actual operations of the Halligan Project may change pursuant to applicable permits and approvals, water rights administration, or other things beyond Fort Collins' control. No changes to these commitments are anticipated at this time. If operations of the Halligan Project change significantly from those described in this FWMEP, Fort Collins and CPW will re-evaluate whether additional mitigation measures are necessary as a result.

The enlarged reservoir would continue to be filled with direct flows from the North Fork. Fort Collins would generally keep its portion of the enlarged Halligan Reservoir relatively full until the water is needed to meet demands during droughts or other water supply shortages.

Fort Collins' future operations of the enlarged Halligan Reservoir have been designed to not only avoid and minimize potential impacts from the Halligan Project, but also improve the existing conditions of the North Fork below Halligan Reservoir. Fort Collins' operations of the enlarged Halligan Reservoir include year-round releases from the enlarged reservoir to provide flows in the North Fork below Halligan Reservoir and eliminate dry-up points that are currently found along the North Fork at various times of the year. These flow-related operational measures are described in detail in Section 4.2.1.

Fort Collins' releases from the enlarged Halligan Reservoir would be delivered down the North Fork to its confluence with the Main Stem and typically "exchanged up" to the Fort Collins Intake(s) on the Main Stem. NPIC would continue to operate its portion of the enlarged Halligan Reservoir, including diversions, storage, and releases, as it does currently.

Fort Collins would generally use water from Halligan Reservoir to meet demands after other sources of water are unavailable. The enlarged Halligan Reservoir has no predetermined demand or release pattern, but in general, releases from the enlarged Halligan Reservoir would occur as follows:

- To meet Fort Collins' reusable water demand when other reusable water sources are lacking
- During dry periods or other water supply disruptions as needed to meet Fort Collins single-use and reusable water demands when other Fort Collins' water sources are unavailable or insufficient

1.3.1.3 Water Rights for Storage in an Enlarged Halligan Reservoir

Fort Collins would use several water rights to fill the enlarged Halligan Reservoir, including the following:

- Changed water rights attributable to shares in the so-called “Southside Ditches” companies (Arthur Irrigation Company, Larimer County Canal No. 2 Irrigating Company, and New Mercer Ditch Company)
- The Halligan Reservoir Enlargement conditional water right
- A portion of the one-eighth interest of the Grey Mountain conditional water right
- Changed water rights attributable to shares in the Water Supply and Storage Company

The majority of Fort Collins’ water stored in the enlarged Halligan Reservoir would come from the changed water rights in the “Southside Ditches” companies that were historically used to irrigate farms in portions of the Fort Collins area that have since been developed. Fort Collins changed the use of these water rights and, pursuant to the Water Court decrees approving the changes, Fort Collins must maintain the return flow patterns associated with the historical irrigation use of these water rights. Thus, the Halligan Project is, for the most part, not a new demand on the Poudre River system as a whole¹, but instead, a conversion of water use from direct flow irrigation to municipal storage.

1.3.2 Estimated Halligan Project Cost

Fort Collins’ Modified Proposed Action would cost an estimated \$157.8 million² (2022 dollars). The estimated cost includes pre-construction costs (for example, field exploration and design), construction costs (labor, equipment, materials, and supplies), and land and other acquisition costs. The project cost estimate does not include costs of mitigation or enhancements (as described in Appendix B), or any costs related to risk or uncertainty given the limited conceptual design that exists. Table 1-1 provides a breakdown of the estimated project cost.

Table 1-1. Estimated Halligan Project Costs Shown in 2022 Dollars

Task	Estimated cost
Pre-construction ^[a]	\$13,865,000
Construction ^[a]	\$130,719,000
Permitting & Legal	\$2,892,000
Land Acquisition	\$10,315,000
Total	\$157,791,000

^[a] The sum of these two values are presented in Appendix B.

1.4 Regulatory Framework

The Halligan Project has undergone and continues to undergo significant regulatory scrutiny at the federal, state, and local levels. For final Halligan Project authorization, Fort Collins is required to obtain numerous federal and state permits, licenses, and approvals as identified in DEIS Section 1.6

¹The project will result in flow changes on the North Fork of the Poudre River, but not the overall Poudre system.

² These values are estimated by the Corps as part of the Halligan Project and done in a similar manner for all Halligan Project alternatives. They do not reflect all the actual costs to Fort Collins of the Modified Proposed Action. For example, the Corps calculates Permitting & Legal expenses as 2% of Pre-construction and Construction costs combined when actual expenses have been significantly more to date for Fort Collins.

(Corps 2019). The following subsections summarize the primary regulatory processes related to the Halligan Project effects on fish and wildlife, although other approvals and processes may be required that are not included in this summary.

1.4.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the potential environmental impacts of proposed actions before authorizing a “major federal action.” The Halligan Project is considered a “major federal action” because it may significantly affect the human environment as defined by NEPA. The Halligan Project would discharge fill material into jurisdictional waters of the U.S. and, thus, also require authorization by the Corps under CWA Section 404, as described in Section 1.4.2. The Corps Omaha District, Denver Regulatory Office, is the lead federal agency for the NEPA process and is preparing an Environmental Impact Statement (EIS) to evaluate potential environmental impacts resulting from the Halligan Project. The Corps will use the EIS in determining a final permit decision that will be documented in the ROD.

The Corps published a DEIS on November 22, 2019 (Corps 2019) that described analyses of the potential environmental impacts associated with the Halligan Project. The analyses and DEIS were developed in compliance with the Council on Environmental Quality’s NEPA regulations (*40 Code of Federal Regulations* [CFR] Parts 1500–1508) and the Corps NEPA implementation procedures for its regulatory program (33 CFR Part 325). The DEIS provides a comparison of the Halligan Project (described there as the Proposed Action) and several alternatives to the Halligan Project. The DEIS also addresses factors relevant to the CWA Section 404(b)(1) guidelines (40 CFR Part 230) and applicable public interest review criteria identified in 33 CFR Part 320.4. The Corps is currently developing a Final EIS (FEIS) that will address comments on the DEIS received from the public, resource agencies, and other stakeholders.

The DEIS presents a draft Conceptual Mitigation Plan (CMP) prepared by Fort Collins (City of Fort Collins 2019c) that includes both mitigation and enhancement measures. Based on public comments received on the DEIS, comments from Project stakeholders, and discussions with CPW staff, this FWMEP builds upon and/or replaces many of the aquatic life and terrestrial wildlife components of the draft CMP. An updated final CMP will be prepared by Fort Collins for the Final EIS.

The U.S. Department of the Interior Bureau of Land Management (BLM) is a cooperating federal agency, and will determine NEPA adequacy for Project activities or impacts that may occur on BLM lands.

1.4.2 Clean Water Act Section 404

CWA Section 404 regulates the discharge of dredged or fill material into waters of the U.S., including jurisdictional wetlands. The CWA Section 404 permit program is administered by the Corps with oversight by the U.S. Environmental Protection Agency (EPA) (EPA 1972). The Halligan Project would result in a regulated discharge; therefore, Fort Collins is seeking authorization of the discharge under a CWA Section 404 individual permit.

Projects subject to the CWA Section 404 individual permit process must comply with CWA Section 404(b)(1) guidelines, which provide direction for evaluating activities regulated under CWA Section 404. Under the guidelines, “no discharge of dredged or fill material may be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” To comply with the guidelines, a permit applicant must take all appropriate and practicable steps to avoid and minimize adverse impacts on waters of the U.S. Compensatory mitigation

may be required to offset any unavoidable impacts and ensure compliance with the CWA Section 404(b)(1) guidelines.

- **CWA Section 401 Water Quality Certification**— A CWA Section 401 water quality certification is a state approval process for water quality impacts that is administered by the Water Quality Control Division of the Colorado Department of Public Health and Environment (CDPHE) to implement CWA Section 401 (refer to CRS 25-8-302(1)(f)). The CWA Section 401 water quality certification process is conducted according to Regulation 82 (5 CCR Section 1002-82). Any additional mitigation conditions or requirements that are required for CWA Section 401 water quality certification will be incorporated into the CWA Section 404 permit. Fort Collins is collecting data and conducting additional water quality and temperature analysis for the Halligan Project in preparation for the CWA Section 401 water quality certification application.

1.4.2.1 2008 Compensatory Mitigation for Losses of Aquatic Resources

The Corps *Colorado Mitigation Procedures* (Corps 2020) describes compensatory mitigation procedures for wetland and stream impacts in Colorado, and outlines the steps that the Corps districts may follow to meet regulatory obligations. Although *Colorado Mitigation Procedures* was formally approved by the Corps for mitigation procedures in April 2020, it has not been used on the Halligan Project because mitigation planning was already well underway when these procedures were approved. The compensatory mitigation plan will be consistent with Corps regulations and mitigation policy.

The Corps and EPA established the type and extent of compensatory mitigation necessary to demonstrate compliance with the CWA Section 404(b)(1) guidelines (40 CFR Part 230) in the 2008 Mitigation Rule (73 *Federal Register* [FR] 19593; EPA and Corps 2008).

The Corps determines the appropriate form and amount of compensatory mitigation required for a Section 404 permit based on the nature and extent of anticipated unavoidable impacts on aquatic resources. Fort Collins will prepare a wetlands mitigation plan independent of this FWMEP for future authorization by the Corps as part of the CWA Section 404 permitting process.

1.4.3 Federal Wildlife Regulations

The following federal wildlife regulations apply to the Halligan Project:

- **Endangered Species Act (ESA)**—The ESA protects species that are federally listed as threatened or endangered under the federal ESA of 1973 as amended (16 *United States Code* [U.S.C.] Section 1531 et seq.) (USFWS 1973). In accordance with ESA Section 7, projects with a federal nexus that could affect federally listed species and/or their habitats require consultation with the U.S. Fish and Wildlife Service (USFWS). Impacts on candidate species are not required to undergo a Section 7 consultation unless the species becomes listed during project planning and construction. In accordance with ESA Section 7, the EIS describes evaluations conducted to determine potential impacts on federally listed species from activities related to implementing the Halligan Project and each alternative to the Halligan Project. A Biological Assessment is then conducted for the Project to identify measures that compensate for the Project's impacts on federally listed species and/or their designated critical habitat. The USFWS then renders a Biological Opinion after they have reviewed the Biological Assessment and consulted with the lead federal agency. The Corps has begun the Section 7 consultation process for the Halligan Project.
- **Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act**—The Migratory Bird Treaty Act (16 U.S.C. Sections 703–712) established a federal prohibition, “unless permitted by regulations, to pursue; hunt; take; capture; kill; attempt to take, capture, or kill; possess; offer for sale; sell; offer

to purchase; purchase; deliver for shipment; ship; cause to be shipped; deliver for transportation; transport; cause to be transported; carry or cause to be carried by any means whatever; receive for shipment; transportation, or carriage; or export at any time, or in any manner, any migratory bird, part, nest, or egg of any such bird” (USFWS 2004). Similarly, the Bald and Golden Eagle Protection Act (16 U.S.C. Sections 668–668c) prohibits the “taking” of bald or golden eagles, including their parts, nests, and eggs. In accordance with the Acts and as part of the NEPA process, potential impacts on protected bird species have been evaluated, and appropriate avoidance, minimization, or mitigation measures have been incorporated into this FWMEP.

- **Fish and Wildlife Coordination Act**—The federal Fish and Wildlife Coordination Act (16 U.S.C. Sections 661–666c) (USFWS 1934) places requirements on water development projects, including consultation with the USFWS and state fish and wildlife agencies (in this case, CPW) when the “waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted or otherwise controlled or modified” by any agency under a federal permit or license. The consultation goal is conserving wildlife resources by preventing loss and/or damage to them, as well as potentially improving the resources as part of the proposed project. State-listed species are also considered during such a consultation. In Colorado, this requirement is largely fulfilled through consultation with USFWS and CPW, and by developing and implementing this FWMEP. The Corps must prepare a Fish and Wildlife Coordination Act report for the USFWS that “provides 1) clear documentation of the proposed project’s impacts on fish and wildlife resources and 2) specific recommendations as to the measures that should be taken to conserve those resources.”

1.4.4 State of Colorado

The following state statutes apply to various resources covered in this FWMEP and are most relevant to the FWMEP:

- **Fish and Wildlife Mitigation Plan**—This FWMEP was prepared to satisfy the requirements of CRS 37-60-122.2. The statute states that “fish and wildlife resources found in and around state waters which are affected by the construction, operation, or maintenance of water diversion, delivery, or storage facilities” are a “matter of statewide concern and that impacts on such resources should be mitigated by the project applicants in a reasonable manner.” The statute further explains that the extent and nature of the mitigation should be “economically reasonable and maintain[s] a balance between the development of the state’s water resources and the protection of the state’s fish and wildlife resources.”

Such fish and wildlife mitigation plans are to be developed by the project applicant, generally working in cooperation with CPW staff members, and submitted to the Commission. If the Commission and applicant agree on the plan, the Commission then forwards it to the Colorado Water Conservation Board (CWCB) for adoption as the official state position on the mitigation actions required of the applicant.

CRS 37-60-122.2 distinguishes mitigation of Halligan Project impacts from enhancement of fish and wildlife resources over existing conditions. The *Procedural Rules for the Commission* (Chapter 16) provide definitions for both a mitigation plan and an enhancement plan (refer to the Key Terminology section of this report). This FWMEP includes both a mitigation plan that contains measures developed to mitigate Halligan Project impacts, and an enhancement plan that enhances fish and wildlife resources over and above existing levels without the Halligan Project. Fort Collins is required by CRS 37-60-122.2 to submit a proposed mitigation plan, but submittal of an enhancement plan is voluntary.

- **CWCB Rule 7 Process**—The enlarged Halligan Reservoir would inundate approximately 0.75 mile of the North Fork upstream of the current reservoir where the CWCB holds a decreed instream flow water right. Fort Collins would, therefore, need to undergo a process to seek approval to inundate an instream flow under the CWCB’s instream flow program rules (Rule 7, 2 CCR 408-2) (CWCB n.d.). During this process, the CWCB may seek recommendations from, among others, CPW and the Colorado Division of Water Resources (DWR). CWCB would consider factors such as the extent of inundation proposed, impacts on the natural environment, any unique or rare characteristics of the instream flow water right to be inundated, any regulatory requirements or conditions imposed upon the applicant by federal, state and/or local governments, land ownership, economic benefits, and the mitigation or compensation offered by Fort Collins to offset adverse impacts on the instream flow right. Ultimately, the CWCB Board would either approve, conditionally approve, defer, or deny the request to inundate.

1.4.5 Larimer County

Colorado House Bill 74-1041 authorized certain local governments, including counties, to identify, designate, and regulate areas and activities of state interest through a local permitting process to provide them with control over certain development projects. The Halligan Project is located entirely within Larimer County, and Larimer County is a cooperating agency on the Halligan Project. Larimer County’s 1041 regulations are specified in the County’s land use code. Unless specifically exempted, Section 10.3.1(J) requires a 1041 Permit for “Site selection and construction of a new water storage reservoir or expansion of an existing water storage reservoir resulting in a surface area at high water line in excess of 50 acres, natural or manmade, used for the storage, regulation and/or control of water for application to a beneficial use, including augmentation, commercial, domestic, industrial, municipal, and replacement uses, provided this designation excludes water storage reservoirs used exclusively for irrigation or stormwater detention facilities. A new water storage reservoir shall also include all appurtenant uses, structures and facilities (i.e., those necessary and integral to the proper functioning of the project), including internal roads, parks, parking, trails, recreational uses, and other uses.” The Halligan Project thus requires a 1041 Permit from Larimer County pursuant to the procedures in Larimer County’s land use code.

1.4.6 Consultation, Coordination, and Public Input

Fort Collins consulted with CPW during preparation of this plan. In addition, CPW and cooperating agencies reviewed and commented on the DEIS and some associated reports. CRS 37-60-122.2 requires CPW and the CWCB to review and provide input on the mitigation proposed to address Halligan Project impacts on fish and wildlife resources. Although CRS 37-60-122.2 does not require public review and input, Fort Collins and CPW have developed a process to also allow for public participation as part of the development of this FWMEP.

The Corps (through the NEPA process), Fort Collins, and CPW have provided, and will continue to provide, the following public meetings and opportunities to solicit input on the potential impacts and mitigation for the Halligan Project:

- Fort Collins has provided many updates about the Halligan Project in public forums to Fort Collins City Council and the Fort Collins WQCC (previously known as the Water Board) throughout the life of the Halligan Project. Fort Collins has also published newspaper articles about the Halligan Project and maintains a website where the public can receive Halligan Project-related updates and submit comments on the Halligan Project at any point. Fort Collins regularly seeks out opportunities to educate and solicit feedback about the Halligan Project, including targeted stakeholder

presentations or discussions, distribution of information at community events, videos, and social media posts.

- On January 26, 2006, the Corps submitted written requests to the EPA, USFWS, U.S. Forest Service, CPW, Weld County, and Larimer County to participate as cooperating agencies in the preparation of the then-planned joint EIS for the Halligan and Seaman Water Supply projects pursuant to 40 CFR Section 1501.6. The Corps subsequently recognized that the CDPHE, Colorado Department of Natural Resources (CDNR), Colorado State Historic Preservation Officer, and the BLM had expertise or regulatory authority over aspects of the Halligan and Seaman Water Supply projects. Those agencies were also invited and agreed to serve as cooperating agencies; the CPW, CDPHE, CDNR, BLM, EPA, USFWS, and Larimer County accepted the invitation to serve as cooperating agencies, but Weld County declined to serve as a cooperating agency. As of the writing of this FWMEP, the proposal for the Seaman Water Supply Project has been withdrawn and is inactive.
- On February 1, 2006, the Corps published the Notice of Intent in the FR to prepare an EIS to analyze the potential impacts of two water supply projects known as the Halligan-Seaman Water Management projects in Northern Colorado (71 FR 5250).
- On February 23, 27, and 28, 2006, three public scoping meetings were held at the Livermore Community Church in Livermore, the Lincoln Center in Fort Collins, and the Bunk House at Island Grove in Greeley, respectively.
- As part of the NEPA process, the Corps initially contacted 59 Native American tribes in writing to solicit input regarding the Halligan Project. Only two tribes, the Standing Rock Sioux Tribe and the Cheyenne River Sioux Tribe, responded to the request. On May 23, 2019, the Corps provided a consultation letter to seven Native American tribes, including the Apache Tribe of Oklahoma, Gros Ventre and Assiniboine Nations, Northern Cheyenne Tribe, Comanche Nation, Cheyenne-Arapaho Tribes of Oklahoma, Arapaho Tribe of the Wind River Reservation, and the Northern Apache Tribe. In meetings with Fort Collins, the Corps indicated that they will continue to reach out to tribal contacts as the NEPA process continues.
- On November 22, 2019, the Corps published the DEIS for the Halligan Project. A public hearing was held in Fort Collins on January 13, 2019, which was attended by approximately 85 people. Comments on the DEIS were accepted through January 21, 2020. Approximately 60 written comment letters or oral comments were received on the Halligan Project.
- On April 27, 2023, Fort Collins anticipates releasing the FWMEP Application on the Halligan Project website. *Note to reviewers: location, date, and summary to be added after this event occurs.*
- On May 1, 2023, Fort Collins anticipates the launch of a virtual open house and comment period for the public to review the FWMEP and provide feedback on the FWMEP. *Note to reviewers: location, date, and summary to be added after this event occurs.*
- CPW Commission Meeting (Glenwood Springs) – *Note to reviewers: location, date, and summary to be added after this event occurs.*
- CPW Commission Meeting (location) – *Note to reviewers: location, date and summary to be added after this event occurs.*
- CWCB meeting – *Note to reviewers: location, date and summary to be added after this event occurs.*

Input gathered from these processes and other outreach activities were used to prepare the draft and final FWMEP. Release of the final FWMEP is expected by mid-2023.

2 Fort Collins Water Portfolio

2.1 Existing Water Supply and Demand

Fort Collins, through Fort Collins Utilities, is one of several water providers in Fort Collins' municipal boundaries and growth management area. Fort Collins generally provides water service to the central portion of the Fort Collins community. Various water districts provide water service to the other portions of the Fort Collins community. The water service areas for Fort Collins and the neighboring water districts are shown on Figure 2-1.

Fort Collins' water supplies are surface supplies and come from two physical systems: the Poudre River watershed and Horsetooth Reservoir.³ Fort Collins diverts water from the Poudre River watershed into its system on the Main Stem at the Fort Collins Intake(s). These supplies are primarily native Poudre River water, but also include some water from the Colorado, Michigan, and Laramie rivers. Fort Collins also diverts water at other locations to irrigate parks, golf courses, two cemeteries, greenbelt areas, and some schoolgrounds, as well as to meet contractual raw water delivery obligations and to meet return flow and other obligations. Fort Collins also takes delivery of water from Horsetooth Reservoir at the Soldier Canyon Outlet. These supplies are primarily Colorado River water from the Colorado–Big Thompson (C-BT) Project and Windy Gap Project. Fort Collins' water system is described in greater detail in the DEIS. Certain aspects of Fort Collins' system are shown on Figure 2-1.

Fort Collins treats water from the Poudre River watershed and Horsetooth Reservoir at the Fort Collins Water Treatment Facility. The treated water is then delivered to Fort Collins' customers through approximately 540 miles of pipeline to over 34,000 taps. Fort Collins' customers include residences (single and multifamily) and commercial entities of various types. In 2014, Fort Collins delivered 7.4 billion gallons of water to approximately 136,500 people. In 2020, demand increased to 7.7 billion gallons of water delivered to approximately 142,800 people.

³ Horsetooth Reservoir borders the City of Fort Collins and is an East Slope terminal reservoir in the C-BT System. More information on the C-BT Project, which is operated and maintained by Northern Water and the U.S. Bureau of Reclamation, is provided at <https://www.northernwater.org/what-we-do/deliver-water/colorado-big-thompson-project>.

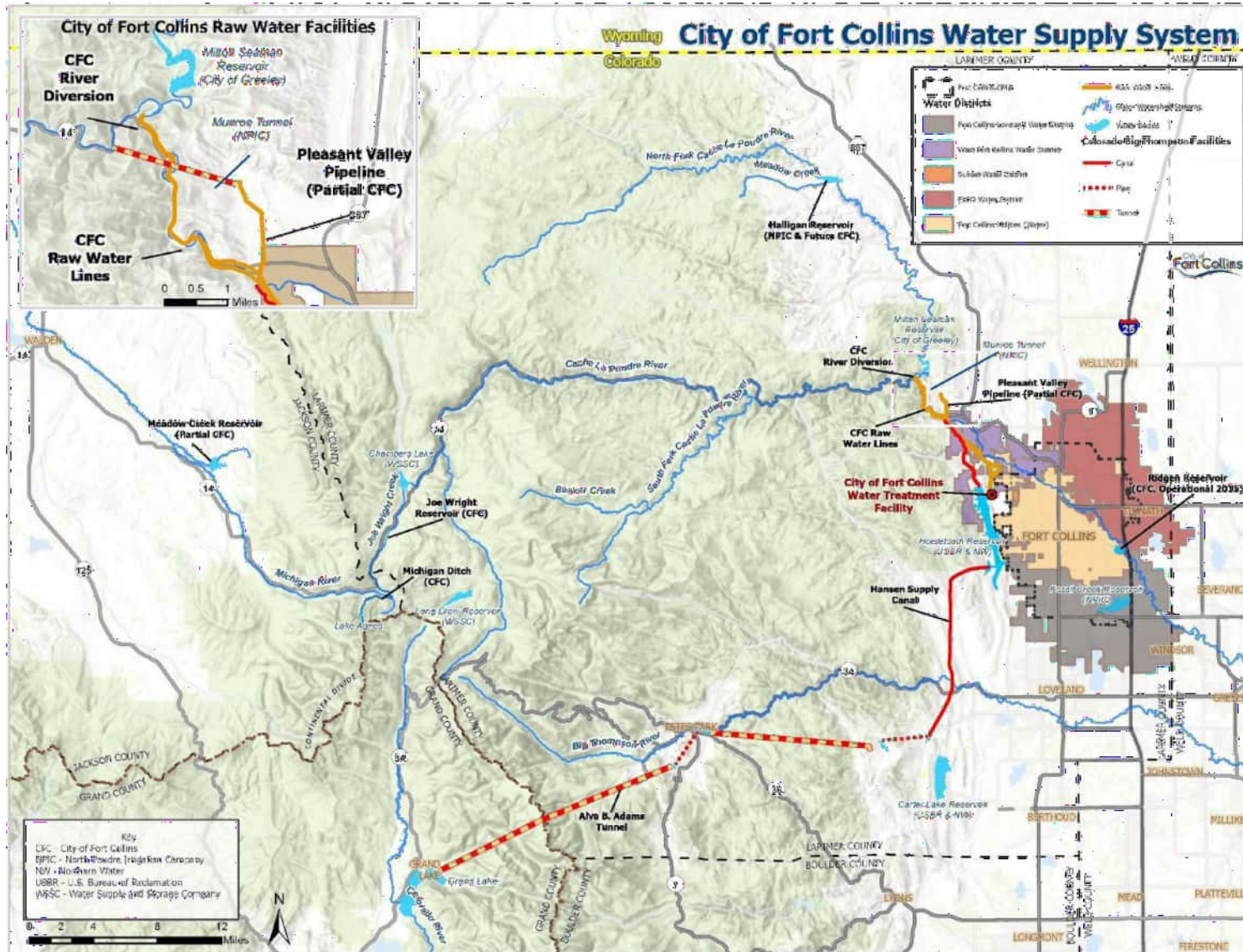


Figure 2-1. Fort Collins Utilities Water Supply System

Source: City of Fort Collins 2021a

2.2 Water Conservation and Water Restrictions

Fort Collins has a strong commitment to ensuring the efficient and responsible use of water. Fort Collins' water conservation program started in 1977 and continues to evolve to support the community in using water efficiently. Some of Fort Collins' water conservation efforts are detailed in the DEIS, as well as Fort Collins' *2015 Water Efficiency Plan* (City of Fort Collins 2015a). Fort Collins' conservation efforts include metering of all customers and a customer data portal; customer leak notifications; free irrigation system audits and home water assessments; irrigation and fixture equipment rebates; landscaper trainings; water-efficient landscape conversion trainings and financial incentives; conservation-oriented water rate structures; extensive customer outreach, including monthly water use reports and targeted industry outreach; a restrictive covenants ordinance; conservation kit giveaways; and building audit. Currently, planned efforts focus on leveraging advanced water use meter data, promoting and supporting greater outdoor water efficiency, greater integration of water efficiency into land use planning and building codes, expanding commercial and industrial strategies, and efforts to increase community water literacy. Fort Collins is also updating water supply requirement costs for new developments to improve equity while incentivizing efficient design.

Fort Collins also uses the *Water Shortage Action Plan* (City of Fort Collins 2020b), previously known as the Water Supply Shortage Response Plan, to manage water shortages. As defined in the plan, water shortage conditions occur when projected water supply is less than the anticipated water demand, which considers required water reserves in storage and other criteria. The following events, or combination of events, are examples of scenarios that could cause a water shortage: drought; water quality issues, such as contamination or fire impacts; and infrastructure issues, such as broken pipeline or water treatment facility issues.

The population and demand within Fort Collins' water service area are expected to grow. Water conservation efforts and water shortage management practices have helped reduce water use and manage supply challenges. However, as discussed in the DEIS, future demand exceeds the amount of water that could be conserved through conservation measures; therefore, the timing of when increasing future water demand exceeds Fort Collins' existing water supplies can be delayed through water conservation efforts, but not avoided.

2.3 Future Water Demand

Future water demand is calculated based on a projected population growth in the Fort Collins' water service area, combined with projections of future potable water demand using the reliable gallons per capita per day forecasting technique detailed in the DEIS (Corps 2019). The Corps estimated in the DEIS that Fort Collins' 2065 potable water demand will be approximately 38,400 acre-feet, an increase of about 11,700 acre-feet from the 2015 potable water demand. This estimate incorporated minimized demand based on reduced water used as a result of the water conservation and water supply management techniques described previously.

In 2019, Fort Collins completed the *Fort Collins Utilities Water Supply Vulnerability Study* (City of Fort Collins 2019a), in which the enlargement of Halligan Reservoir was assumed. That study found that climate change is the most significant vulnerability affecting Fort Collins' water supply. Future climate conditions may be more impactful to Fort Collins' ability to meet its water supply planning policy criteria than the occurrence of any particular infrastructure outage or environmental condition simulated by the study's risk scenarios. However, climate change is the most difficult risk to quantify or track. Long-term trends are difficult to measure and are obscured by the natural variability in wet and dry years.

Fort Collins will participate in, or stay informed of, state and federal climate change studies to help Fort Collins understand the trajectory of climate change in the region.

Fort Collins' projected increases in population and water demand, coupled with the risks of climate change causing temperature and precipitation variations, have both been identified as key vulnerabilities to Fort Collins' water supply. Without the additional firm yield from the Halligan Project, the performance of Fort Collins' water supply system would be significantly impacted, and current water supply planning policy criteria could not be met under most future climate and demand conditions.

2.4 Related Regional Activities

This section describes regional activities that may help inform the best application or use of Halligan Project-related mitigation in this FWMEP, including other major water supply projects in the Poudre River watershed in various stages of planning and execution, as well as research-based initiatives and collaborative work groups.

2.4.1 Shared Vision Planning

One element of Halligan Project planning included a Shared Vision Planning process (Lorie et al. 2010), a 7-year collaborative planning process focused on modifying planned expansions of Halligan and Seaman Reservoirs on the North Fork to develop design strategies that would improve flows on the North Fork. The core assumption of the Shared Vision Planning process was enlargement of both Halligan and Seaman Reservoirs. During the process, Fort Collins worked collaboratively with the City of Greeley, regulatory agencies, nongovernmental organizations, and other interested parties on development of mutually beneficial and desirable solutions for both projects. However, the City of Greeley is no longer pursuing expansion of Seaman Reservoir, and, therefore, the joint reservoir operational measures explored in the Shared Vision Planning process are no longer available to improve flow conditions on the North Fork. Fort Collins has nonetheless incorporated many of the other measures developed in the process into the Halligan Project. Over 19 years of Halligan Project planning, design and operation development, mitigation planning, and stakeholder collaboration has been completed since the Project was initiated in 2003.

2.4.2 Fort Collins' River Efforts

Fort Collins owns a majority of the Poudre River's floodplain as it flows through Fort Collins and is, therefore, engaged in a long-term effort to support a self-sustaining healthy resilient Poudre River (Main Stem). In recent decades, Fort Collins has proactively implemented projects aimed at restoring the river's connection with its riparian floodplain, connecting aquatic habitats longitudinally, protecting established instream flows, and maintaining stormwater capacity to reduce risk to Fort Collins' assets and public safety. While numerous projects have already been completed, it is expected that these integrated reach-scale river restoration projects will continue into the next several decades.

In 2011, Fort Collins completed the *Cache La Poudre River Natural Areas Management Plan Update* (City of Fort Collins 2011) that detailed management goals, strategies, and objectives for Fort Collins' 21 properties along the river. An update to that management plan is being developed to establish conservation priorities and management tactics for these natural riverine habitats given contemporary ecological stressors, management issues, and dramatic increase in recreational uses.

Fort Collins developed the *Poudre River Downtown Master Plan* (City of Fort Collins 2014) for the Poudre River Main Stem in the downtown corridor (Shields Street to Mulberry Street) to improve in-river and bankside recreation, aquatic habitat connectivity, bank protection, flood mitigation and floodplain management, public safety and access, and transportation. The master plan provides a long-

term vision for this downtown reach and identifies multiple projects to be implemented over an extended period of time. The construction of a whitewater park in 2019 downstream of College Avenue was the first project implemented from this plan.

In 2014, Fort Collins completed an Ecological Response Model in collaboration with a team of scientists to better understand past, present, and potential future river conditions through Fort Collins (Bestgen et al. 2019). This effort, along with numerous other monitoring and biological assessment initiatives, support a community driven quest for taking a data-informed management approach to promoting a healthy Poudre River.

In 2017, Fort Collins released the *State of the Poudre River Report: A River Health Assessment* (City of Fort Collins 2017), which examined the conditions of the Main Stem from the lower portion of Poudre Canyon through Fort Collins to Interstate (I-)25. The effort used an assessment method developed by Fort Collins, known as the *River Health Assessment Framework* (City of Fort Collins 2015b, 2019b), which was adapted from the *Functional Assessment of Colorado Streams* protocol (Beardsley et al. 2015). Fort Collins has used the information related to river health and river function gained from this effort to generally inform the measures described in this FWMEP. In 2022 to 2023, Fort Collins is teaming with the Coalition for the Poudre River Watershed (Coalition) to create an updated River Health Assessment Framework. The updated framework will identify the overarching framework for reporting on the river’s health from the headwaters to its confluence, and aims to identify methods specific to topic and location.

2.4.3 Northern Integrated Supply Project

The Northern Colorado Water Conservancy District (Northern Water) delivers raw water and operates infrastructure that serves numerous communities in northern Colorado. Northern Water, acting through an enterprise on behalf of 15 water providers north of Denver, is seeking a CWA Section 404 permit from the Corps to undertake the Northern Integrated Supply Project (NISP). NISP would use conditional water rights to divert water from the Poudre and South Platte Rivers to provide 40,000 acre-feet of new reliable water supply annually to meet part of the participants’ future water supply needs. NISP involves constructing two new reservoirs—Glade and Upper Galeton—with capacities of 170,000 and 45,624 acre-feet, respectively. The Corps is the lead federal agency and has been analyzing the environmental impacts of NISP since 2004. The Corps is expected to issue a ROD in 2022 or soon thereafter.

2.4.4 Poudre Runs Through It

The Poudre Runs Through It work group is a diverse group of regional leaders and experts with varying interests in the Poudre River, including members from Fort Collins Utilities and Natural Areas. The group convenes agricultural, municipal, environmental, recreation, business, and other stakeholders with the goal of identifying opportunities for cooperative action to help meet their healthy river and working river goals. The Poudre Runs Through It defines a “healthy working river” as “one that supplies the goods and services demanded by our complex society, within the existing and evolving water rights system and honoring existing property rights, while maintaining and improving ecological integrity and resilience” (CSU 2020). Fort Collins shares in this goal of a healthy working river and values input from the work group.

2.4.5 Poudre Flows Plan

The Poudre Flows Plan is a project to increase flows in the Cache la Poudre River, from the Poudre River canyon mouth to its confluence with the South Platte River. A key aspect of the plan is to not injure or adversely affect other water rights and existing water operations. The plan began in 2013 as an

outgrowth of the Flows Subcommittee of the Poudre Runs Through It work group. This plan is being pursued by a coalition consisting of the Cache la Poudre Water Users Association, Fort Collins, the cities of Greeley and Thornton, CPW, CWCB, the Colorado Water Trust, and Northern Water.

Under the Poudre Flows Plan, water that was historically diverted for irrigation and other consumptive uses will be added to the river as “augmentation water” and protected from diversion in defined stream reaches. The Poudre Flows Plan is being pursued as a plan to augment stream flows pursuant to CRS 37-92-102(4.5). An application for approval of the plan was filed with the Water Court on April 29, 2021. The current sources of augmentation water for the plan are certain water rights owned by Fort Collins and the cities of Greeley and Thornton. Additional augmentation water sources are intended to be added to the plan after it is approved. The plan will begin operations following the Water Court’s entry of a final decree, currently anticipated to occur in 2024.

2.4.6 Wildfire Recovery and Monitoring Efforts

The 2020 Cameron Peak and East Troublesome Wildfires are the two largest wildfires in Colorado history. These fires combined to burn more than 400,000 acres of forested landscape. Post-fire pollution continues to pose significant challenges to maintaining the availability and quality of Fort Collins’ drinking water supplies. Fort Collins Utilities has developed post-wildfire water quality monitoring and recovery plans (City of Fort Collins 2021b), which outline a range of different collaborative water quality programs to assist with addressing these pollution concerns. These programs include, for example, targeted post-storm runoff event sampling, real-time water quality monitoring to inform water treatment and other staff, and monitoring long-term trends to better understand watershed recovery.

Fort Collins is a partner in the Larimer Recovery Collaborative Watershed Subcommittee, which is a diverse collaborative stakeholder group focused on watershed recovery following the Cameron Peak Fire. The primary watershed recovery concern following the fire is hillslope erosion, and the most effective treatment is the application of wood mulch. The subcommittee has prioritized sub-watersheds within the burn scar for treatment based on burn severity, slope, erosion risk, and other factors, which ultimately targets finite resources to have the greatest treatment results. In 2021, Fort Collins Utilities helped share the cost of treatment of more than 5,000 high priority acres at a total cost of \$11,353,805. Additional priority acres will be treated in 2022. Fort Collins also continues to work to minimize the risk of future large-scale wildfires in the Cache la Poudre Basin by investing in targeted regional cost share collaborative wildfire mitigation projects. Priority areas identified for future treatment include areas that drain to the North Fork upstream of Halligan Reservoir.

2.4.7 Coalition for the Poudre River Watershed

The Coalition is a nonprofit organization established with the mission of improving and maintaining the ecological health of the Poudre River watershed through community collaboration. With the goal of increasing watershed resiliency and health, the Coalition released the *Upper Poudre Watershed Resilience Plan Final* (JW Associates, Inc. 2017). The plan describes conditions in the Upper Poudre Watershed and identifies target areas, priorities, and actions with the overall goal of increasing watershed resiliency. The plan assesses the baseline health of the riparian and river corridor of the Poudre River watershed upstream of the mouth of the Poudre River Canyon using a close adaptation of the *Cache la Poudre River: River Health Assessment Framework* (City of Fort Collins 2015b). Fort Collins has coordinated with the Coalition and CPW to help inform the development of the mitigation and enhancement measures described in this FWMEP.

2.4.8 Preble’s Meadow Jumping Mouse Site Conservation Team

The Poudre Site Conservation Team for Preble’s meadow jumping mouse (*Zapus hudsonius preblei*) (Preble’s) was established in 2019, and comprises stakeholders organized by the USFWS representing local communities and natural resource management partners, including private landowners and local, state, and federal governments and agencies. The team’s goal is to facilitate the recovery of Preble’s, a threatened species protected under the ESA, in the North Fork watershed in accordance with the *Recovery Plan Preble’s Meadow Jumping Mouse* (USFWS 2018). This recovery plan focuses on abating threats to Preble’s and promoting riparian habitat persistence, with the ultimate goal of recovering the subspecies so that it no longer warrants listing under the ESA. Specifically, the recovery goal for the North Fork watershed is a minimum of 57 miles of healthy, connected Preble’s habitat. Fort Collins is an active participant in the team, supporting such efforts as outreach, recovery population habitat selection, and site identification for riparian habitat improvements in the North Fork riparian corridor.

2.4.9 Platte River Species

Fort Collins participates in the South Platte Water Related Activities Program (SPWRAP), which outlines a programmatic approach for USFWS Section 7 consultation that is described in the Platte River Recovery Implementation Program. Currently, mitigation is not expected to be needed for South Platte River depletions. If mitigation needs associated with the Halligan Project are identified during this programmatic approach or based on USFWS consultation, they will be incorporated into the mitigation strategy for the Halligan Project.

3 Fish and Wildlife Conditions and Impacts

This chapter describes the fish and wildlife resources that are anticipated to be affected by the Halligan Project, as identified in the DEIS and supporting technical reports (Corps 2019), the current conditions influencing those resources, and a summary of the anticipated effects of the Halligan Project on each resource. Background information is presented regarding the status of each resource, followed by a summary of the potential impacts of the Halligan Project on fish and wildlife, including both beneficial and adverse effects. Mitigation measures that Fort Collins is proposing for the Halligan Project are described in Section 4, and enhancement measures are described in Section 5. Appendix B presents a tabular summary of Halligan Project impacts, mitigations, and costs.

Since completion of Halligan Reservoir in 1909, operations of Halligan Dam and the North Poudre Canal Diversion have significantly and adversely affected river flows in the North Fork and impaired downstream aquatic habitats. Enlargement of the reservoir through the Halligan Project provides an opportunity for Fort Collins to provide year-round flows in the North Fork through the flow-related operational measures described in Section 4.2.1, leading to environmental benefits for fish and wildlife in and along the North Fork downstream of the dam.

Halligan Project impacts would occur from inundation by the enlarged reservoir along a portion of the North Fork upstream of the reservoir and at the footprint of the replacement dam. Also, impacts would occur from construction activities, including access and materials mobilization and stockpiling, at the replacement dam and at the North Poudre Canal Diversion. These effects would result directly from implementing the Halligan Project. Indirect effects are those that are Project-induced but occur later in time or are farther removed in distance. Indirect effects associated with the Halligan Project include increased flows in most months that benefit conditions along the North Fork downstream of the dam, as well as some impacts resulting from reduced flows on the North Fork when water is being diverted to storage in the enlarged Halligan Reservoir. As well as reduced flows for the Main Stem in the Exchange Reach upstream of the North Fork confluence when Halligan Releases are being diverted by exchange into Fort Collins Intakes. Another potential indirect effect of the Halligan Project is the risk of a stress-related die-off of Rocky Mountain bighorn sheep (bighorn sheep) (*Ovis canadensis*), discussed further in Section 3.7.4.

3.1 Basis of Halligan Project Effects

The Halligan Project effects described in this FWMEP are based on detailed evaluations in the DEIS and supporting technical reports, and further analyses conducted since the DEIS. Because of advancements in project design, the Halligan Project effects presented in the DEIS are being revised in the FEIS. These revisions are expected to be minor and are a refinement of the Proposed Action in the DEIS. In the DEIS, effects estimates were based on enlargement of the existing dam to raise the reservoir level by approximately 25 feet. Impacts in the FEIS will be determined based on the design plan summarized in Section 1.3 of this FWMEP, which involves replacing the more than 114-year-old dam, as of 2023, with a replacement dam constructed approximately 200 feet downstream of the existing dam. Consistent with the dam enlargement described in the DEIS, the dam replacement presented in the FEIS and this FWMEP would raise the existing reservoir elevation by approximately 25 feet to increase the total water storage capacity by approximately 8,200 acre-feet, for a total enlarged reservoir volume of approximately 14,600 acre-feet. Enlarging the reservoir would increase the current surface area of Halligan Reservoir from 253 to 391 acres. At this time, details of the extent, methods, and impacts related to dam demolition are not known. Fort Collins will consult with CPW as needed on the dam

demolition. Differences in Halligan Project effects between the DEIS and FEIS are expected to be minimal.

3.2 Resources Evaluated

The following resources associated with fish or wildlife are addressed in this FWMEP:

- Surface water hydrology (Section 3.3)
- Surface water quality (Section 3.4)
- Aquatic resources (Section 3.5)
- Terrestrial wildlife, including big game (Section 3.6)
- Rocky Mountain Bighorn Sheep (Section 3.7)
- Special-status species (Section 3.8)
- Recreation (Section 3.9)

DEIS Table 4-2 lists all the resources that are addressed in the DEIS but do not necessarily relate to fish and wildlife. More information about these resources can be found in the DEIS (Corps 2019).

3.3 Surface Water Hydrology

This section describes the current conditions and potential Project effects on surface water resources (Halligan Reservoir, the North Fork, and Main Stem) potentially affected by changes in surface water hydrology resulting from implementation of the Halligan Project.

3.3.1 Current Conditions for Surface Water Hydrology

Snowmelt provides the largest water supply to the North Fork, with runoff primarily occurring from May to July. The DEIS Section 3.6.2.3.1 documents a typical unregulated snowmelt flow regime for the North Fork upstream of Halligan Reservoir; this portion of the North Fork channel is supply limited for sands and finer gravels (Corps 2019).

Historically, NPIC captures water from the North Fork to fill the reservoir beginning in the fall and continuing until water spills over the existing dam to the North Fork in the spring, although spilling can occur as early as December or January. NPIC typically releases water from the existing dam outlet structure from spring through fall, nearly draining the reservoir in most years.

As described in the DEIS Section 3.3.5 and Chapter 4 and in Section 3.3.2 of this FWMEP, Halligan Reservoir and the North Poudre Canal Diversion affect flows. Under current operations, the North Fork can experience many zero-flow days in both winter and summer, particularly during dry or average hydrologic years, creating low-flow conditions and disconnected pools. The DEIS describes zero-flow days in the North Fork below Halligan Dam in winter months when the reservoir is filling, and below the North Poudre Canal Diversion (6 miles downstream of the reservoir) to the North Poudre Canal Diversion turn back or confluence with the downstream tributaries in summer when water is diverted for NPIC shareholders. Flow simulations produced for the DEIS and supporting *Surface Water Resources Technical Report* (CDM Smith 2017) estimated that the North Fork downstream of the North Poudre Canal Diversion has zero-flow days approximately 40 percent of the time during both winter and summer months. Consequently, under current conditions, the aquatic habitat in the North Fork is disconnected between the North Poudre Canal Diversion and the first downstream tributary inflow. Rabbit Creek, Stonewall Creek, and Lone Pine Creek provide small inflows to the North Fork, and zero-flow days are less common downstream of these tributaries.

For the Main Stem, the DEIS Section 3.3.6 notes that trans-basin water deliveries supply significant flows in the Upper Poudre, while irrigation, municipal, and industrial diversions influence flows downstream of

the flow gage located near the mouth of the Poudre Canyon. Multiple dry-up locations currently exist on the Main Stem.

Dramatic flow changes occur naturally on the North Fork in the spring and summer months during spring runoff and summer storms, and also currently occur below Halligan Reservoir during the fall and winter months as a result of NPIC's ongoing and historical operations of the existing Halligan Reservoir. CPW has raised concerns in meetings with Fort Collins that these drastic changes in conditions associated with NPIC's operations, particularly sudden decreases from high to low flow, can adversely affect fish populations.

3.3.2 Halligan Project Effects on Surface Water Hydrology

The Halligan Project would result in both beneficial effects and adverse impacts on the surface water hydrology of the North Fork and on the associated aquatic resources and river morphology. (GEI Consultants, Inc. [GEI] 2016; Western EcoSystems Technologies, Inc. [WEST] 2017b; City of Fort Collins 2017). Each of these effects is described in more detail in the following sections.

3.3.2.1 Inundation Effects

Enlarging Halligan Reservoir would increase the current surface area from 253 to 391 acres at full storage capacity. The water surface area of the enlarged Halligan Reservoir is anticipated to fluctuate from 200 acres to 391 acres. In the enlarged reservoir, NPIC would continue to fill and drain nearly all of their reservoir storage capacity each year, while Fort Collins would fill and drain only a portion of the enlarged reservoir capacity. The water surface elevation of the enlarged Halligan Reservoir would fluctuate at slower rates than the current typical rates for the reservoir.

The Halligan Project would inundate two sections on the North Fork: (1) permanent inundation of a short (approximately 200 feet) section of the North Fork between the existing dam and the replacement dam (Downstream Permanently Inundated 200 feet); and (2) the intermittent inundation of an approximately 0.75 mile stretch of the North Fork upstream of the existing Halligan Reservoir (Upstream Intermittently Inundated 0.75 mile).

- **Downstream Permanently Inundated 200 Feet.** During construction the aquatic community in a short section (approximately 200-foot) of the North Fork would be temporarily disrupted during the construction of the replacement dam in between the existing and replacement dam. In addition, another portion of the reach, approximately 200 feet downstream of the replacement dam down to the temporary construction river crossing, will be impacted. Once construction is complete the approximately 200-feet between the replacement dam and the existing dam would be permanently inundated, converting the controlled river habitat to reservoir.
- **Upstream Intermittently Inundated 0.75 Mile.** DEIS Sections 4.8.3.1 and 4.8.3.4.1.1 discuss the intermittent inundation of the North Fork which would transition the aquatic environment of the 0.75-mile free-flowing (lotic) aquatic habitat to an intermittently ponded (lentic) inlet channel. Meaning in late summer, fall, and early winter the stream would contain significantly higher levels of fine sediment which will eliminate pool habitat and reduces cobble and gravel habitat used for fish spawning.

The permanent inundation of the controlled stream below the existing dam and the intermittent inundation and permanent sedimentation of 0.75 mile of natural free-flowing stream, as well as associated lotic system functions, would be a permanent direct impact from the Halligan Project that would eliminate existing lotic aquatic habitat upstream.

3.3.2.2 Inundation Effects on an Instream Flow Water Right

The CWCB has an instream flow water right (Water Court Case 1985CW430) on the North Fork from its confluence with Dale Creek to the current inlet of Halligan Reservoir. The reach of the instream flow water includes the approximately 0.75 mile of the North Fork stream that would be intermittently inundated and permanently impacted by enlarging Halligan Reservoir, as discussed in the previous subsection.

This inundation will cause injury to the CWCB instream flow water right. In Water Court Case 2013CW3185, Fort Collins and the CWCB reached an agreement regarding how to proceed with respect to the instream flow water right. Key portions of that agreement are summarized in this subsection.

Fort Collins agreed to seek CWCB approval to inundate and to provide mitigation either pursuant to: (a) Rule 7 of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, 2 CCR 408-2; or (b) an agreement pursuant to the CWCB rules and regulations enacted under CRS Sections 37-60-108 and 37-92-102(3).

Fort Collins has submitted to the CWCB a request to defer the CWCB's consideration of a request to inundate pursuant to Rule 7j of those rules and regulations. The CWCB has agreed to defer such consideration until permitting by other state, federal, or local governmental agencies concerning the Halligan Reservoir enlargement is completed.

If Fort Collins is required by other governmental entities to provide mitigation to offset impacts of the Halligan Reservoir enlargement, the CWCB has agreed to consider the cumulative effects of such mitigation on the mitigation or compensation it will require as a condition of granting its approval to inundate any portion of the CWCB instream flow water right.

3.3.2.3 Flow Effects on the North Fork Downstream of Halligan Reservoir

Indirect impacts on the North Fork downstream of Halligan Reservoir would include a minor reduction (DEIS Section 4.3.2) in flows during peak stream flow months when water is diverted to storage in the enlargement under Fort Collins' various water rights decreed for storage in Halligan Reservoir, and temporary flow effects related to dam construction. Below the replacement dam, the North Fork would benefit from Fort Collins' operational commitments associated with the Project, specifically the Winter Release Plan, which provides continuous release of 3 cfs from the enlarged reservoir from October through April to maintain flows in the North Fork below Halligan Reservoir.⁴ Although the Winter Release Plan is an operational commitment and not a mitigation measure, it is described in more detail with other flow-related operational measures in Section 4.2.1 to facilitate understanding of how all flow-related operations will be conducted.

Based on modeling results presented in the DEIS Section 4.3.3.3, with the Winter Release Plan daily mean flows in the North Fork from the replacement dam to the North Poudre Canal Diversion are expected to increase from November through January, and from October through March for the reach below the North Poudre Canal Diversion to at least Seaman Reservoir. The Halligan Projects' Winter Release Plan eliminates the zero-flow days downstream of Halligan Reservoir to the North Poudre Canal and significantly reduces the number of months with zero-flow days both below the North Poudre Canal and at the Livermore Gage. The Halligan Project may improve river connectivity during low-flow periods and could increase downstream areas of riffle and pool complexes. These flow-related operational measures would have varying beneficial effects on approximately 22 miles of the North Fork, from the replacement Halligan Dam to Seaman Reservoir. The beneficial effects from the Winter Release Plan

⁴ 3 cfs would be released from Halligan Reservoir. The amount attributed to this release would be reduced by transit losses assessed by the water commissioner.

would be most impactful where the North Fork currently experiences very low or no flow (for example, below Halligan Reservoir in winter), but those benefits may diminish farther downstream where water enters the North Fork from its tributaries (for example, Rabbit and Lone Pine Creeks).

The Winter Release Plan dedicates continuous 3 cfs releases from the enlarged Halligan Reservoir to the North Fork from October 1 to April 30 of the following year. This operation would satisfy Fort Collins' wintertime return flow obligations, decrease winter consumption of other water sources (that is, Horsetooth Reservoir), and result in the concurrent environmental benefit of improving North Fork stream flows during periods when river flows are typically low (Section 4.2.1.2).

3.3.2.4 Flow Effects on the Poudre River Main Stem

On the Main Stem both above and below its confluence with the North Fork, the DEIS Section 4.3.3.3.4 indicates that the Halligan Project's modeled effects on-stream flows were considered within normal variability and are not meaningful. On the Main Stem above the confluence, a minor increase in stream flows above the Munroe Canal Diversion is expected. Below the Munroe Canal and Fort Collins pipeline diversions to the North Fork confluence, the Halligan Project is expected to cause minor reductions in annual stream flows as a result of diversions of Halligan Reservoir releases made by exchange. Minor reductions have occurred year-round, but were typically highest in June and July, mostly as a result of increased use of Fort Collins' changed rights in the Southside Ditches. As described in the DEIS, the Halligan Project would generally increase the fraction of water originating from the North Fork in the Main Stem downstream of the confluence by about 4 percent on an average annual basis.

3.4 Surface Water Quality

Current conditions for surface water quality and potential surface water quality impacts of the Halligan Project were evaluated and summarized for this plan. Areas addressed include Halligan Reservoir, the North Fork, Seaman Reservoir, and the Main Stem.

3.4.1 Current Conditions for Surface Water Quality

Current conditions for surface water quality relevant to the Halligan Project are summarized in Appendix C, which includes overviews of surface water quality current conditions for Halligan Reservoir, Seaman Reservoir, the North Fork, and the Main Stem. The summary of current conditions in Appendix C is based on information presented in the DEIS as well as detailed recent studies (Hydros 2020, 2021a, 2021b, 2021c, 2021d, and 2022b). These recent studies rigorously document the conceptualization of existing major drivers of spatial and temporal variability in temperature and water quality based on evaluation of observed water-quality data, flow data, diversion patterns, reservoir operations, geology, point sources, land use, and spatially varying meteorological conditions. Appendix C is also supported by two memoranda (Hydros 2022a and 2022c). These two memoranda were developed to document key water-quality discussion topics from meetings held with CPW during the FWMEP development process.

3.4.2 Halligan Project Effects on Surface Water Quality

Halligan Project effects on surface water quality were anticipated based on the detailed conceptual understandings of Halligan and Seaman Reservoirs, the North Fork, and the Main Stem as well as consideration of Halligan Project effects on flows, as summarized in Appendix C and supported by Hydros Consulting, Inc. (Hydros; 2020, 2021a, 2021b, 2021c, 2021d, and 2022b). Fort Collins asserts that no water-quality impacts due to the Halligan Project are currently anticipated in Halligan Reservoir itself, or in Seaman Reservoir. Additionally, numerous meetings⁵ and rounds of comments and responses were

⁵ Fort Collins met with CPW to discuss surface water quality on the following dates: July 9, 2020; February 3, 2022; February 17, 2022; February 24, 2022; April 14, 2022; May 3, 2022; May 17, 2022; May 20, 2022; July 18, 2022; and September 9, 2022.

completed with CPW and the Water Quality Control Division (WQCD) to communicate and coordinate on anticipated surface water-quality effects.⁶ Key discussion topics from those meetings are documented in Hydros publications (2022a and 2022c).

The approach to identifying potential Halligan Project surface water-quality impacts was largely based on consideration of existing conditions and anticipated changes relative to applicable aquatic life standards. A potential impact was anticipated if a concentration or temperature increase (or decrease in the case of dissolved oxygen [DO]) was anticipated because of the Halligan Project, and the system is currently either approaching or exceeding the corresponding aquatic life standard. Additionally, if a large (considering the magnitude of the aquatic life standard) concentration or temperature increase (or decrease in the case of DO) was anticipated to occur because of the Halligan Project, that was also identified as a potential impact on aquatic life. Both acute and chronic aquatic life standards were considered for temperature and water quality. Additionally, following discussions with CPW, literature-based iron concentrations below the currently applicable chronic total iron standard for aquatic life were also considered as thresholds of potential concern for chronic dissolved iron below Halligan Reservoir (refer to Section 3.4.2.5). In this process, iron stands as a unique case of consideration of potential impacts relative to values more stringent than current standards.

The rationale for this largely standards-based approach is that, for temperature and water quality, aquatic life regulations provide an existing, enforceable, quantifiable, state-specific regulatory basis for the identification of impacts. Fort Collins recognizes that state standards do not necessarily provide guidelines for the identification of impacts for the FWMEP for other resources areas (for example, surface water hydrology, aquatic resources, terrestrial wildlife, special-status species, and recreation) and that CPW may have additional concerns about potential Project effects on aquatic resources and wildlife that are not fully addressed by a standards-based approach but that may be addressed through this FWMEP. To understand and evaluate these additional potential concerns, Fort Collins and their technical consultants engaged in numerous meetings⁵ with CPW and the WQCD to discuss water quality and temperature current conditions, the approach to identifying potential water quality impacts, and the potential impacts identified. One outcome of these discussions, as noted previously, is the consideration of a threshold more stringent than existing standards as a special-case exception for iron below Halligan Reservoir, in response to CPW's expressed concerns regarding the protectiveness of the existing aquatic life standard for this constituent.

Additional temperature and water quality modeling is planned for the CWA Section 401 water quality certification process. This includes temperature modeling of the North Fork and Poudre River Mainstem, as well as temperature and water quality modeling of Halligan and Seaman Reservoirs. Note that modeling for Halligan Reservoir will simulate the effects of the relocation of the dam and the selected demolition plan. Modeling results will allow for more definitive determination of any long-term water-quality impacts associated with the new dam configuration that are not anticipated at this time. Modeling for the CWA Section 401 water quality certification process will also support the antidegradation analysis. Antidegradation analyses will allow for the identification of smaller-scale impacts, if present, relative to the baseline available increment, which cannot be reliably identified before numerical modeling. Any antidegradation impacts (including those relative to aquatic life standards) will be evaluated as part of the CWA Section 401 water quality certification application. Further, per the 2017 Memorandum of Understanding (CDPHE and CDNR 2017), intended to streamline the state's role regarding FWMEP and CWA Section 401 water quality certification permitting for water supply projects, CPW may coordinate with CDPHE on the CWA Section 401 water quality certification,

⁶ Note that the analyses to be completed to identify impacts for the 401 Certification Application will differ from those completed for the FWMEP.

including development of conditions. Therefore, in the event that additional aquatic life surface water-quality impacts are identified through modeling and associated antidegradation analysis to be conducted for the CWA Section 401 water quality certification process, CPW will have an opportunity to participate in development of appropriate CWA Section 401 water quality certification conditions for the Halligan Project. If the additional temperature and water quality modeling demonstrates that there are impacts on aquatic life that will not be addressed in the CWA Section 401 water quality certification, Fort Collins will work with CPW to develop additional mitigation measures as needed.

The following subsections describe each of the currently anticipated potential surface water-quality impacts of the Halligan Project. Additionally, the rationale for not anticipating DO impacts downstream of Halligan Reservoir is provided. A range of other key constituents/locations were considered, but ultimately no impacts are anticipated, as documented in recent memoranda to CPW (Hydros 2022a and 2022c). These memoranda reflect information presented in various communications and meetings with CPW.

3.4.2.1 Water Temperature on the North Fork from Halligan Reservoir Dam to Seaman Reservoir

Decreased summer flow rates at times because of the Halligan Project could cause or contribute to existing summer temperature exceedances (acute and chronic) in the North Fork between Halligan Reservoir and Seaman Reservoir. These impacts would be expected to occur at times in the months of July through September, varying by year, depending on hydrology.

3.4.2.2 Water Temperature on the North Fork Below Seaman Reservoir

Decreased summer flow rates at times because of the Halligan Project could cause or contribute to existing summer temperature exceedances (primarily chronic, but also potentially acute) in the CWA Section 303(d)-listed reach of the North Fork below Seaman Reservoir. These impacts would be expected to occur at times in the months of July through September, varying by year, depending on hydrology.

3.4.2.3 Dissolved Oxygen Below Halligan Reservoir

Recognizing the anticipated increase in residence time for Halligan Reservoir with the Halligan Project (that is, roughly doubling average monthly residence time through the summer based on modeled flows from 1980 to 2005; Figure 3-1; Hydros 2022a), the potential for low DO (that is, at levels of concerns to aquatic life) in releases from Halligan Reservoir was considered but ruled out as an anticipated impact. This section explains the considerations behind that decision.

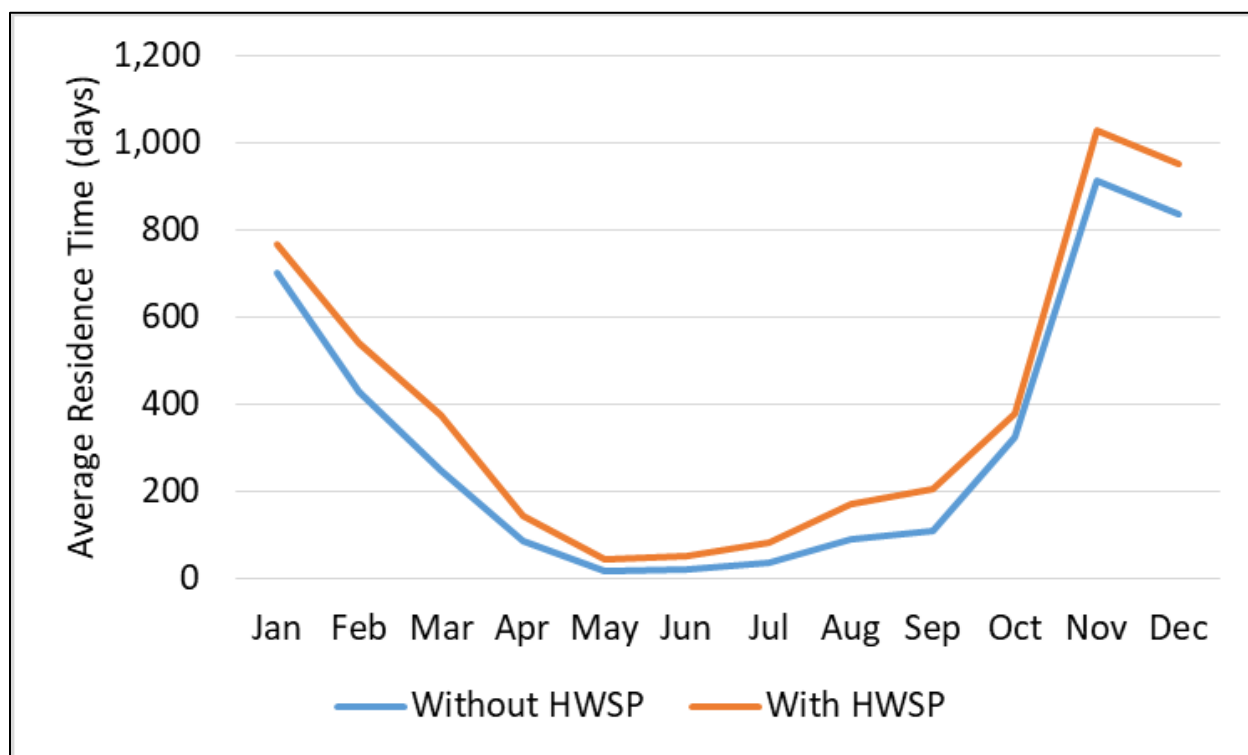


Figure 3-1. Average Monthly Residence Times With and Without the Halligan Project Based on Common Technical Platform Flows, 1980–2005

There is the potential that DO concentrations in the hypolimnion of Halligan Reservoir could decrease in some years in the summer because of the Halligan Project. The magnitude of this potential effect is uncertain but expected to be relatively small, given the competing factors associated with the reservoir expansion. These competing factors include an increase in summer residence time (more time for oxygen consumption in the hypolimnion through decay of organic matter/sediment oxygen demand), a potentially larger hypolimnion (providing a greater volume for dilution of any oxygen effects), and possible cooler bottom temperatures (slowing the rate of organic matter decay).

It is acknowledged that the net result of these competing factors could result in a small decrease in DO at the bottom of Halligan Reservoir. However, any such decrease is not expected to cause DO concentrations to reach levels of concern for aquatic life below Halligan Reservoir for two reasons. First, in spite of existing cases of observed low DO in the Halligan Reservoir hypolimnion during stratification, there are no observed cases of DO concentrations approaching levels of concern (aquatic life standards) in the North Fork at the sampling location below the dam (NBH). Therefore, any small changes to DO at the bottom of Halligan Reservoir are unlikely to result in major changes at NBH that would cause concern. Second, there are plans to include passive aeration into the design of the new Halligan Reservoir dam outlet, as described in Section 4.2.2. This passive aeration should increase the rate of reaeration of releases, addressing any small decrease in DO that may occur because of the Project. Based on this, DO below Halligan Reservoir is discussed here, but it is not identified as an anticipated adverse impact of the Halligan Project. This anticipated response will be further evaluated (quantitatively) as part of the modeling planned for the CWA Section 401 water quality certification process.

3.4.2.4 Sediment Below Halligan Reservoir

Careful management of existing sediment in Halligan Reservoir is needed during construction of the new dam and for long-term operations of the reservoir with the Halligan Project. Without such construction and operational planning, it is possible that a detrimental sediment release event could occur.

3.4.2.5 Iron Below Halligan Reservoir

As described in Appendix C, CPW has raised concerns that the current iron standard for aquatic life is not adequately protective⁷ and that existing concentrations below Halligan are currently above levels of concern identified in recent literature (Cadmus et al. 2018). There is the potential that iron concentrations below Halligan Reservoir could increase in late summer with the Halligan Project because of increased duration of stratification and corresponding increased internal loading from sediments (though there is no concern that iron concentrations would approach the current aquatic life iron standard). CPW has expressed specific concerns about deposition of iron below Halligan Reservoir having the potential to inhibit periphyton growth and directly interfere with benthic macroinvertebrates and early life stages of fish. While there are no observations of iron deposition/precipitation onto benthic material below the current Halligan Dam, CPW is concerned this may occur in the future with the Halligan Project.

3.4.2.6 Water Temperature on the Main Stem from Munroe Canal Diversion to the North Fork

Halligan Project diversions at the Fort Collins Intakes could cause and/or exacerbate chronic summer temperature standard exceedances in most years by causing slight warming in a reach that already exhibits exceedances of temperature standards. These impacts would be expected to occur in the months of July through September, varying by year, depending on hydrology. Note that the majority of Halligan Project diversions from the Main Stem would occur at the Fort Collins pipeline diversion (as opposed to the Munroe Canal Diversion upstream). Therefore, the primary focus reach for this anticipated potential impact is the approximately 0.5 river mile reach from the Fort Collins pipeline diversion to the North Fork confluence. There will also be decreased flows (and corresponding increases in summer temperatures) in the 0.9 river mile reach between the Munroe Canal Diversion and the Fort Collins pipeline diversion, but the greater effects on flow rates and temperatures are expected to occur between the Fort Collins pipeline diversion and the North Fork confluence.

3.4.2.7 Water Temperature on the Main Stem from North Fork to Hansen Supply Canal

Halligan Project diversions at the Fort Collins Intakes could cause and/or exacerbate chronic summer temperature standard exceedances in most years by causing slight warming in the reach from the North Fork to Hansen Supply Canal that already exhibits exceedances of temperature standards. These impacts would be expected to occur in the months of July through September, varying by year, depending on hydrology.

Note that no adverse effects to water temperature on the Main Stem downstream of Hansen Supply Canal are anticipated from the Halligan Project. The small warming effects anticipated upstream of Hansen Supply Canal are not expected to cause issues downstream of Hansen Supply Canal because of the cooling influence of Hansen Supply Canal inflows in the summer months. As noted in Section 3.4.2, Hansen Supply Canal releases comprise a large fraction of summer flow where it enters the Main Stem

⁷ Note that, while CPW has expressed concerns with the existing aquatic life standard for total iron, WQCD has made it clear that the existing standards will be the basis for analysis in the HWSP 401 Certification Application, and a 251 ug/L will not be considered in that analysis as an aquatic life standard for total iron.

(averaging 42 percent for July to September), making the river less sensitive to small changes in flow rates through Poudre River Segment 10b.

In spite of the combined effects of increased amount of diversions at Munroe Canal and Fort Collins pipeline diversions with increased summer flows from the North Fork, adverse water quality effects from the Halligan Project, in terms of aquatic life, are not anticipated on the Main Stem below the North Fork. While the Halligan Project will change the fraction of flow in the Poudre River coming from the North Fork, the changes are expected to be small (Figure 3-2). As noted in Section 3.4.2, the largest differences in water quality between the North Fork and the Main Stem upstream of the North Fork occur in summer months, but minimal percent changes in North Fork contributions to Main Stem flows are expected in summer (Figure 3-2). Additionally, these small percent flow changes in summer are at the time of year when the North Fork contributes the smallest percentage to the Main Stem, further minimizing effects on Main Stem water quality. Beyond monthly average effects, review of individual years of modeled flows with and without the Halligan Project show minimal changes to the resulting distribution of flow contributions from the North Fork to the Main Stem, particularly in summer months (Hydros 2022). In short, the small anticipated changes in the fraction of flow from the North Fork would not be expected to cause a notable shift in water quality on the Main Stem, particularly given the fact that no aquatic life water-quality standards (other than temperature) are currently being approached or exceeded on either the North Fork or the Main Stem downstream of the North Fork.

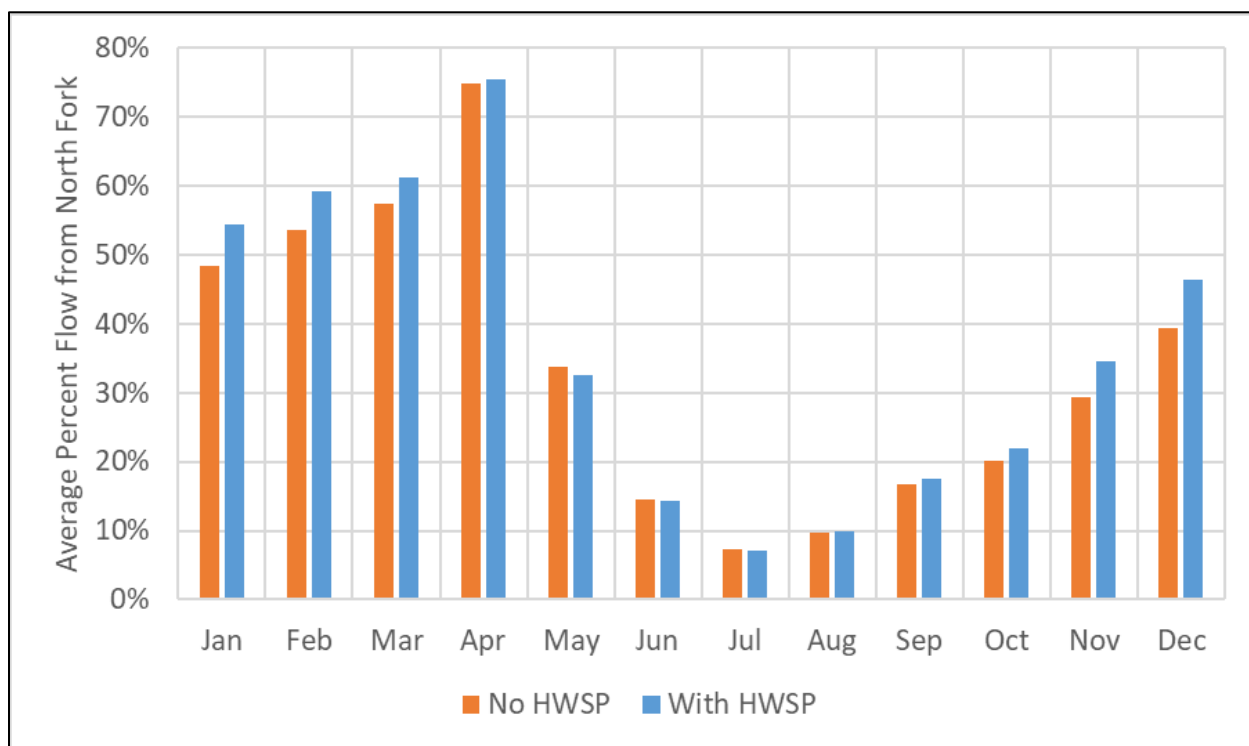


Figure 3-2. Average Monthly Percentage of Flow from the North Fork on the Main Stem below the North Fork Confluence^[a]

^[a] Based on modeled flows of future conditions with and without the Halligan Project, 1980 to 2005. Modeled flows reflect the combined Halligan Project effects of increased diversions upstream of the North Fork and changes to flow patterns from the North Fork to the Main Stem. Note that these flows include the Summer Low-flow Plan and Winter Release Plan (these are incorporated into all modeled flows with the Halligan Project), but these flows do not include an agreement with the City of Greeley for immediate pass-through of those mitigation flows through Seaman Reservoir.

3.5 Aquatic Resources

Aquatic biological resources include fish, benthic macroinvertebrates, periphyton, and aquatic plant communities and their habitat. The suitability of a stream to support aquatic resources is influenced by multiple factors, including hydrology (Section 3.3) and water quality (Section 3.4), geomorphology, and riparian vegetation. The North Fork below Halligan Reservoir provides mountain-to-plains transitional habitat suitable for small-bodied native fish, as well as trout and other species. Throughout consultation with CPW (for example, meetings between CPW and Fort Collins in fall 2020) for the Halligan Project, CPW indicated that their primary focus for the North Fork below Halligan Reservoir is to protect small-bodied native fish species and rainbow trout. This section describes the geomorphology and currently present fish species assemblages in the North Fork to provide a baseline understanding of current conditions for aquatic resources, with a particular focus on small-bodied native fish and rainbow trout.

3.5.1 Current Conditions for Aquatic Resources

The DEIS Section 3.8.5 describes modified flow regimes and habitat conditions in the North Fork compared to historical conditions because of the operation of Halligan Reservoir, built in 1909, and the Seaman Reservoir, built in 1941. DEIS Section 3.8.5 states that currently, stream habitat upstream of Halligan Reservoir includes a mix of approximately half riffles and half pools, and runs-glides. The banks are stable, and the substrate is a mix of gravel, cobble, and boulders. There was not excessive sedimentation of the substrate (Corps 2019). Halligan Reservoir, the North Fork flows through Phantom Canyon, which laterally confines the river channel with little to no overbank/floodplain areas. A notable transition in river condition occurs within Phantom Canyon at the North Poudre Canal Diversion; immediately downstream of the North Poudre Canal Diversion, the thalweg becomes indistinct, and the North Fork is often dry, filled with bed material, and heavily encroached by vegetation. As described in the DEIS and summarized in Section 3.3.1, the total flow of the North Fork is sometimes captured by the North Poudre Canal Diversion, and releases from both the Halligan and Seaman Reservoirs are sometimes reduced to zero, leading to zero-flow days and dry-up points throughout the year. In the dry sections, habitat for aquatic organisms is temporarily eliminated, although some of the functions of stream habitat persist in a limited way through the dry periods (for example, some organisms can find limited habitat refuge in isolated pools or by burrowing into moist substrate, and isolated sections of deep pools and upwelling groundwater are present downstream of the North Poudre Canal Diversion that provide refuge).

The DEIS Section 3.8.3.4 summarizes fish survey data from 1959 through 2017 based on the presence of species and relative abundance. The North Fork supported mostly warmwater fish in terms of number of species, but brown trout (*Salmo trutta*) was often the most abundant during recent sampling events (CPW 2018).

Species assemblage data (unpublished), collected between 1960 and 2019 (CPW 2020a) was analyzed to identify specific small-bodied native fish of interest in the North Fork that may be potentially affected by shifting operational strategies. The fish survey of the North Fork used for analysis was conducted during November 2017 (CPW 2018). Information obtained from the 2017 Fishery Sampling Survey Summary provides the information about the fish communities in the North Fork below Halligan Reservoir. Despite the altered flow regime in the North Fork, the 2017 Fishery Sampling Survey Summary notes that the fishery within Phantom Canyon has maintained a viable trout population and native fish component. These fish sampling efforts indicated high densities of introduced salmonids and small-bodied native fish. Five species native to the drainage were collected in 2017 in the North Fork below Halligan Reservoir and above the North Poudre Canal Diversion. Of those five native species, only two

were observed downstream of the North Poudre Canal Diversion. Non-native species were found both above and below the North Poudre Canal Diversion.

Unpublished data provided by CPW (CPW 2020a) collected over the past 59 years on the North Fork between Halligan and Seaman Reservoirs, including the 2017 study described in the previous paragraph, identified the following species in the North Fork:

- **Native species:** black bullhead (*Ameiurus melas*), creek chub (*Semotilus atromaculatus*), green sunfish (*Lepomis cyanellus*), Iowa darter (*Etheostoma exile*), johnny darter (*Rhinichthys cataractae*), fathead minnow (*Pimephales promelas*), longnose dace (*Rhinichthys cataractae*), longnose sucker (*Catostomus larkia*), and white sucker (*Catostomus commersonii*).
- **Introduced species:** brook stickleback (*Culaea inconstans*), brown trout (*Salmo trutta*), cutbow (*Oncorhynchus larkia* × *mykiss*), rainbow trout (*Oncorhynchus mykiss*), and yellow perch (*Perca flavescens*).

Spawning of small-bodied native fish in the North Fork is temporally limited by seasonal water temperatures. Species observed in the North Fork below Halligan Reservoir require temperatures that range from 12 degrees Celsius (°C) to 29°C (Woodling 1985). Based on temperature data analyzed from 2016 to 2020 (Hydros 2021d), the North Fork below Halligan Reservoir currently maintains suitable spawning temperatures for small-bodied native fish from approximately June to October.

3.5.1.1 Current Conditions for Macroinvertebrates

DEIS Section 3.8.3.6 discusses current conditions for macroinvertebrates in the North Fork. The section references existing macroinvertebrate data available from the CDPHE (2012), Miller Ecological Consultants (Miller) (2009), and the Nature Conservancy (2012), along with additional data collected in 2015 by GEI in support of the DEIS (GEI 2019).

DEIS Section 3.8.3.6 summarizes the current conditions for macroinvertebrates on page 3-146:

Benthic macroinvertebrate data were available from at least one site in each segment, primarily from the current conditions time period. In Segment 1 (below Halligan Dam), an abundant community of invertebrates exists, including some sensitive mayfly, stonefly, and caddisfly species, suggesting water quality is sufficient to support sensitive species. However, the number of taxa, number of mayfly, stonefly, and caddisfly species, and diversity are lower than expected at the site downstream of Halligan Reservoir compared to other sites in the study area, indicating the community may be experiencing some stress. The reduced number of taxa and low diversity downstream of Halligan Reservoir is a common characteristic of tailwater benthic invertebrate communities due to the altered physical and chemical environment downstream of reservoirs.

The DEIS Section 4.8.3.4.2 analysis found that the macroinvertebrate multimetric index (MMI) scores improved in Segment 1 (Halligan Reservoir Outlet to the North Poudre Canal Diversion) from 43 in 2011 to 70 to 82 in 2015 (well above the attainment threshold). MMI scores collected by GEI in 2015 in Segment 2a (North Poudre Canal Diversion to Rabbit Creek) ranged from 76 to 79 (well above the attainment threshold). MMI scores in Segment 2b (Rabbit Creek to Seaman Reservoir Inlet) were 47 in 2005 and 67 in 2007 (the MMI score of 67 was above the threshold for Attainment in 2007). The data for Segment 3 (Seaman Reservoir Outlet to Confluence) suggest that the tailwater effect seen below Halligan Reservoir is also occurring downstream of Seaman Reservoir, resulting in a high density of a few species and relatively low diversity index values. A MMI score of 46 was calculated for the spring 2003 sample. Three samples from 2015 had MMI scores ranging from 64 to 72 (above the attainment threshold of 52), suggesting recent improvements in the macroinvertebrate community.

No macroinvertebrate sampling has occurred above Halligan Reservoir; however, one may assume a high MMI score in the reach above Halligan Reservoir due to the relatively pristine stream conditions including a healthy riffle-pool plan form, boulder-cobble-gravel substrate, and natural stream hydrology.

3.5.2 Halligan Project Effects on Aquatic Resources

The Halligan Project's influence on aquatic resources is closely tied to surface water hydrology, as described in Section 3.3. Therefore, both the beneficial and adverse effects on aquatic resources generally follow those described for surface water hydrology in Section 3.3. The DEIS Section 4.3.8 (Corps 2019) and supporting technical reports describe the Halligan Project's expected beneficial and adverse effects on the aquatic resources and river morphology of the North Fork (GEI 2016; WEST 2017b; City of Fort Collins 2017). In the DEIS, Halligan Project effects were evaluated by predicting the influence of flow changes on available habitat used by aquatic organisms, including riffle and pool complexes, which are special aquatic sites identified in the Section 404(b)(1) guidelines.

As discussed above in Inundation Effects (Section 3.3.2.1), the Halligan Project would inundate two sections on the North Fork: (1) permanent the inundation of a short (approximately 200 feet) section of the North Fork between the existing dam and the replacement dam (Downstream Permanently Inundated 200 feet); and (2) the intermittent inundation of an approximately 0.75 mile stretch of the North Fork upstream of the existing Halligan Reservoir (Upstream Intermittently Inundated 0.75 mile).

- **Downstream Permanently Inundated 200 Feet.** During construction the aquatic community in a short section (approximately 200-feet) of the North Fork would be temporarily disrupted during the construction of the replacement dam in between the existing and replacement dam. In addition, another portion of the reach, approximately 200 feet downstream of the replacement dam down to the temporary construction river crossing, will be impacted. Once construction is complete the approximately 200-feet between the replacement dam and the existing dam would be permanently inundated, converting the controlled river habitat to reservoir.
- **Upstream Intermittently Inundated 0.75 Mile.** DEIS Sections 4.8.3.1 and 4.8.3.4.1.1 discuss the intermittent inundation of the North Fork would transition the aquatic environment of the 0.75-mile free-flowing (lotic) aquatic habitat to an intermittently ponded (lentic) inlet channel. The transition would result from significantly higher levels of fine sediment which will eliminate pool habitat and reduces cobble and gravel habitat that could be used for fish spawning. DEIS Sections 4.8.3.1 and 4.8.3.4.1.1 identify the loss of approximately 0.75 mile of the North Fork, including approximately 3.5 acres of free-flowing riffle and pool complexes as major adverse effect.

DEIS Section 4.8.3.4.1.1 describes the North Fork as a coldwater stream community of fish, benthic macroinvertebrates, and algae that would be replaced with a reservoir community as a result of the Halligan Project. Many of the fish species, such as the recreationally important brown and rainbow trout, would still be able to use the reservoir habitat; however, some functions such as spawning would be eliminated in the inundated sections as described above in Section 3.3.2.1. Other species, such as longnose dace, prefer stream habitat and likely would not use the reservoir (Corps 2019; DEIS Section 4.8.3.4.1.1). The permanent inundation of the controlled stream below the existing dam and the intermittent inundation and permanent sedimentation of 0.75 mile of natural free-flowing stream, as well as associated lotic system functions, would be a permanent direct impact from the Halligan Project that would eliminate existing lotic aquatic habitat upstream.

DEIS Section 4.8.3.4.4 describes the benefit of improved stream flows from operation of the enlarged reservoir, including minimum winter and summer flow releases and peak flow bypasses (refer to Section 4.2.1 of this FWMEP) for a distance of approximately 22 miles along the North Fork below

Halligan Reservoir. The DEIS Section 4.8.3.4.1.3 states that the Halligan Project would maintain instream habitat for aquatic organisms throughout the year, thus eliminating dry riverbed conditions and resulting in major seasonal beneficial effects for aquatic resources from Halligan Reservoir downstream to the North Poudre Canal return flow (approximately 8 miles) on the North Fork with moderate beneficial effects from the North Poudre Canal return flow down to Rabbit Creek (approximately 2 miles), and minor benefits extending from the Rabbit Creek down to Seaman Reservoir, a total distance of approximately 12 miles. The Halligan Project would increase stream flows in winter and other traditionally low-flow periods, improve river connectivity during low-flow periods from a condition with frequent dry-up points, and increase downstream areas of riffle and pool complexes. The enlarged reservoir operations would eliminate almost all⁸ zero-flow days at frequent dry-up points and minimize extreme flow fluctuations from Fort Collins' use of the enlargement. The DEIS notes that additional flows would result in a more robust plant community and improve the fishery health of the North Fork. As described in the DEIS, about 5.8 to 12.1 acres of riffle and pool complexes in the North Fork would experience continuous flow and no zero-flow days. Table 3-1 summarizes Halligan Project effects on riffle and pool complexes on the North Fork.

Table 3-1. Summary of Halligan Project Effects on Riffle and Pool Complexes

Area	Effect	Riffle and Pool Complex Area (acres)
North Fork upstream of existing reservoir (DEIS Section 4.8.3.4.1.2)	Loss due to inundation	-3.5
North Fork between existing dam and replacement dam (based on geographic information system [GIS] evaluation by Jacobs)	Loss due to inundation	-0.3
North Fork downstream of replacement dam to Rabbit Creek 10 miles, which is 4 miles below the North Poudre Canal Diversion (DEIS Section 4.8.3.4.1.3)	Benefit from year-round flows	+5.8 to +12.1 ^[a]
Net Effect		+2.0 to +8.3^[a]

^[a] Varying calculations have been used to determine the area of restored riffle-pool complexes downstream of the North Poudre Canal Diversion.

3.5.3 Wetlands

Wetlands effects are regulated under the CWA and will be addressed through the SWA Section 404 permitting process. Wetlands conditions, effects, and mitigation are regulated by the Corps. They will be described in the FEIS, and are not addressed in this FWMEP. Fort Collins will prepare a wetlands mitigation plan independent of this FWMEP for future authorization by the Corps as part of the CWA Section 404 permitting process.

Wetland habitats exist around Halligan Reservoir and along the North Fork upstream and downstream of the reservoir. Wetlands provide an important habitat type for both terrestrial and aquatic wildlife of the region. Many species of amphibians, reptiles, birds, and mammals utilize these habitats at various times in their life. Several of these species are uniquely adapted to these aquatic environments. Wetland habitats are especially vital for migratory birds, and numerous big game species such as deer, elk, and bear will commonly use wetlands for food and shelter. The DEIS notes that the net impact on wetlands

⁸ See potential exceptions at end of this section 4.2.1.1 Winter Release Plan "Curtailment of the Winter Release Plan" and section 4.2.1.2 Summer Low-flow Plan "Curtailment of the Summer Low-flow Plan".

from the Halligan Project would be moderate. Although inundation would result in the long-term loss of 16.74 acres of wetland (10.92 acres of palustrine scrub-shrub wetlands, 4.89 acres of lacustrine littoral emergent wetlands, 0.021 acre of palustrine emergent wetlands, and 0.91 acre of forested wetlands) mostly along or below the ordinary high water mark of the existing reservoir, nearly 11 acres of wetland are expected to re-establish along the enlarged reservoir ordinary high water mark. The Halligan Project flow-related operational measures (Section 4.2.1) may improve river connectivity during low-flow periods between Halligan Reservoir downstream to the North Poudre Canal return flow on the North Fork, and provide more wetted area that would benefit approximately 22 miles of the North Fork, and may improve riparian wetlands.

3.6 Terrestrial Wildlife Including Big Game

Habitat within the Halligan Project Area supports a diverse array of mammals, and includes undeveloped and undisturbed forest, shrubland, and grassland areas, as well as riparian communities and wetlands. The DEIS identifies a variety of large and small mammals that range within the Project Area, including game species such as elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), Rocky Mountain bighorn sheep, mountain lion (*Puma concolor*), black bear (*Ursus americanus*), and pronghorn (*Antilocapra americana*). Rocky Mountain bighorn sheep are discussed in Section 3.7.

3.6.1 Current Conditions for Big Game

The DEIS describes similar conditions for big game species (elk, deer, and pronghorn). For elk, the Halligan Project is within CPW's Elk Data Analysis Unit E-4—the Red Feather-Poudre Canyon Elk Herd. The primary impact on elk habitat in this data analysis unit is the growth of small acreage rural subdivisions and the resulting loss of overall and winter elk range.

The DEIS indicates that both mule deer and white-tailed deer inhabit CPW's Deer Data Analysis Unit D-4—the Red Feather-Poudre Canyon Deer Herd, which encompasses the Halligan Project Area. Similar to elk, the primary impact on deer is the growth of rural subdivisions and small acreage developments that would result in the loss of deer overall and winter range. As described in the DEIS, CPW identifies potential water development projects within the Data Analysis Unit D-4 as potentially having a pronounced cumulative impact on overall and winter deer range for the Red Feather-Poudre Canyon Deer Herd. In the early 2000s, the deer herd population objective was decreased to reduce the prevalence of chronic wasting disease. The population objective has since been increased because chronic wasting disease is no longer affecting the herd.

Pronghorn are common in undeveloped grasslands and shrublands of eastern Colorado, including the area around Halligan Reservoir. The Halligan Project is within Pronghorn Data Analysis Unit PH33. As noted in the DEIS, CPW mapped pronghorn range covering Halligan Reservoir, and has identified a concentration area where winter population densities are greater than surrounding areas from the eastern end of the reservoir and extending to the north and east. The DEIS notes that CPW does not identify any significant issues related to this herd.

3.6.2 Current Conditions for Other Wildlife

The DEIS notes that grasslands and shrublands in and around the Halligan Project can potentially support healthy populations of small mammals, such as rabbits, squirrels, chipmunks, mice, and other rodents, and the predator species that feed on small mammals, such as coyote, fox, and badger. Riparian areas and wetlands can support additional species, including raccoon, muskrat, meadow vole, and Preble's meadow jumping mouse. Deciduous trees near riparian areas, as well as rock crevices, can

provide potential roosts for bats. Rocky outcroppings also provide feeding and general cover for a variety of animals.

3.6.3 Halligan Project Effects on Big Game and Other Wildlife

The long-term impacts of the Halligan Project on most small, medium, and large terrestrial mammals would be negligible or not measurable. As described in the DEIS, potential long-term big game range impacts would result from habitat inundation caused by new inundation from the enlarged reservoir (approximately 138 acres). As a result, some terrestrial vegetation and wildlife habitat would be replaced with open water habitat, thereby reducing habitat availability for terrestrial (for example, big game, small mammals, and upland migratory birds) species, while increasing habitat for aquatic species (for example, waterfowl). The access road, borrow pits, and dam footprint would result in a smaller permanent impact (approximately 27 acres). Temporary impacts (approximately 31.5 acres) would be related to construction and include removal of vegetation around the dam and reservoir, as well as facilities or areas that would be restored following construction, including access roads and staging areas. Proposed mitigation for vegetation and habitat loss impacts on the Cherokee State Wildlife Area (SWA) are discussed further in Section 4 of this plan.

The DEIS noted that indirect effects on wildlife and big game could involve stress and displacement of wildlife caused by noise and disturbance from construction activities, transportation of people and materials, and general human activity in the reservoir and NPIC diversion areas. In addition, vehicle and equipment emissions and fugitive dust also might displace wildlife. Proposed avoidance and minimization measures for noise and construction-related activities (that is, timing restrictions for North Poudre Canal and Calloway Diversions) are discussed in Section 4 of this FWMEP. There may be a shift in the movement of some big game species as a result of construction activities and disturbances that could result in increased collisions with vehicles. This displacement and disturbance of big game may place additional stress on individuals of these species; however, the DEIS determined that it is likely to have a negligible effect on elk, mule deer, white-tailed deer, and pronghorn populations. Wildlife resources at Halligan Reservoir could also be indirectly affected by the possible introduction or establishment of noxious weeds, soil erosion, and potential alteration of stream flows in the North Fork. The potential effects of altered flows along the North Fork because of the Winter Release Plan and Summer Low-flow Plan are expected to have an overall minor benefit to wetland and riparian vegetation on the North Fork. Noxious weed establishment and soil erosion would affect native vegetation communities. A change in vegetation resulting from the establishment of noxious weeds and soil erosion may result in a lower carrying capacity for some species in the area; however, it would be unlikely to result in complete loss of suitable habitat. However, the Project will minimize construction impacts through the development and implementation of a noxious weed management plan and revegetation and erosion control plans. The enlarged reservoir may also have a negligible to minor effect on wildlife movement as a result of inundation of existing wildlife trails on the North Fork upstream of the existing reservoir. The Corps anticipates that wildlife would acclimate quickly to these changes that would occur in the inundation area because the existing reservoir's water level varies seasonally.

The DEIS evaluated regional species of big game, other mammals, birds, reptiles, and amphibians for potential effects of the Halligan Project on individual species or supporting habitat. Based on that evaluation, it is expected that the Halligan Project would result in no or negligible adverse effects on the following species:

- Elk
- White-tailed deer
- Pronghorn

- Black bear
- Mountain lion
- Other small, medium, and large terrestrial mammals
- Raptors
- Waterfowl
- Migratory birds
- Bats
- Amphibians
- Reptiles

In the DEIS, the Corps assumed that long-term effects such as limiting range types, and suitable habitat within those range types, were the most relevant effects for big game species. The mule deer was the only big game species identified in the DEIS that would experience impacts on suitable habitat within a limiting range type as a result of the Halligan Project, with approximately 118 acres (approximately 0.09 percent) of impact on severe winter range. The DEIS notes that effects on mule deer movement from the Halligan Project, including inundation of the North Fork within the Cherokee SWA, would be negligible to minor because known migration corridors would not be affected.

Table 3-2 summarizes permanent and temporary impacts on big game range from the Halligan Project⁹ relative to range type in the data analysis unit (the geographic area that includes year-round range of a big game herd).

Table 3-2. Cumulative, Permanent, and Temporary Impacts of Halligan Project on Big Game Habitat

Range Type	Range Type in the DAU (acres), from DEIS Table 4-55	Permanent Impacts (acres) ^[a]	Temporary Impacts (acres)	Range Loss as Percentage of DAU	Range Loss as Percentage of GMU ^[b] (acres)	Effect Determination in DEIS
Bighorn sheep—overall range (Section 3.7) ^[c]	208,771	155.5	31.5	0.07%	0.15%	Negligible
Elk—overall range	208,771	165.0	31.5	0.08%	0.09%	Negligible
Mule deer—overall range	1,145,320	165.0	31.5	0.01%	0.09%	Minor
Mule deer—severe winter range	128,724	165.0 ^c	31.5	0.13%	0.15%	Minor
Mule deer—winter range	613,074	165.0	31.5	0.03%	0.09%	Minor
Pronghorn—overall range	109,535	165.0	31.5	0.15%	0.73%	Negligible
Pronghorn—winter range	174,203	165.0	31.5	0.1%	0.75%	Negligible

⁹ Permanent impacts on big game range presented here differ slightly from the impacts listed in Table 4-55 of the DEIS because of updated dam design elements.

Range Type	Range Type in the DAU (acres), from DEIS Table 4-55	Permanent Impacts (acres) ^[a]	Temporary Impacts (acres)	Range Loss as Percentage of DAU	Range Loss as Percentage of GMU ^[b] (acres)	Effect Determination in DEIS
White-tailed deer—overall range	239,940	22.7	13.6	0.01%	0.14%	Negligible

^[a] DEIS Table 4-55 presents slightly lower permanent impacts (up to 132.5 acres). This table presents estimated cumulative long-term direct effects would result from inundation (138 acres) and direct footprint impacts associated with dam replacement construction (27 acres), for a total of approximately 165 acres.

^[b] The Lone Pine bighorn sheep herd are in GMU S40, while the elk, deer, and pronghorn are part of GMU 191.

^[c] The DEIS based bighorn sheep impacts on DAUs RBS-1 for an overall range area of 208,771 acres. Based on input from CPW, bighorn sheep range has been further evaluated in this FWMEP based on the GMU level for the Lone Pine herd, as described in Section 3.7. Based on that analysis, Project-related habitat loss for bighorn sheep may be up to 0.15 percent of overall range.

DAU = data analysis unit

GMU = game management unit

3.7 Rocky Mountain Bighorn Sheep

3.7.1 Current Conditions for Bighorn Sheep

Halligan Reservoir lies within the known overall range and habitat use area of the Lone Pine bighorn sheep herd (also known as the S40 Herd). According to CPW, the Lone Pine herd is a low-elevation herd that uses a range of habitat throughout the year. CPW has expressed concerns that the current CPW species activity mapping (SAM) for the Lone Pine herd is incomplete based on recent CPW data collection efforts; thus, CPW has advised Fort Collins to use caution when applying CPW SAM data to this herd.

The current population of the Lone Pine herd has declined from an estimated 35 bighorn sheep in 2016, to 15 bighorn sheep in 2021. The cause for the population decline is unknown (CPW 2021b). Range maps based on the CPW SAM data were evaluated in the DEIS and indicate that Halligan Reservoir is within the bighorn sheep overall and summer range. Anecdotal evidence referenced in the DEIS has subsequently been confirmed by CPW that bighorn sheep use the area below Halligan Dam, Phantom Canyon, and adjacent habitat, and are frequently seen approximately 2.5 miles south of Halligan Reservoir and approximately 1 mile west of Phantom Canyon Ranch near Calloway Hill. In addition, members of Lone Pine herd use a linkage area that connects habitat east of Highway 287 to Phantom Canyon and farther southwest to the Lower Cherokee and Lone Pine units of the SWA. The bighorn sheep habitat areas as provided by CPW have been identified on Figure 3-3.

3.7.2 Lone Pine Herd Additional Data Evaluation

Fort Collins performed an additional evaluation of bighorn sheep conditions to support discussions with CPW. Figure 3-3 shows the best available data on the Lone Pine herd that were reviewed for the Halligan Project and mitigation strategy development. The habits of this herd, including home range, habitat use, production areas, and natural movement routes, have not been thoroughly studied. However, compilation of available data and local observations indicate that the Lone Pine herd covers more than approximately 16 square miles of viable habitat near the Halligan Project. CPW is using trail cameras and radio collars to collect Lone Pine herd range and movement data. This data collection is ongoing, and CPW does not expect to have quantitative data available in the near term (CPW 2021a).

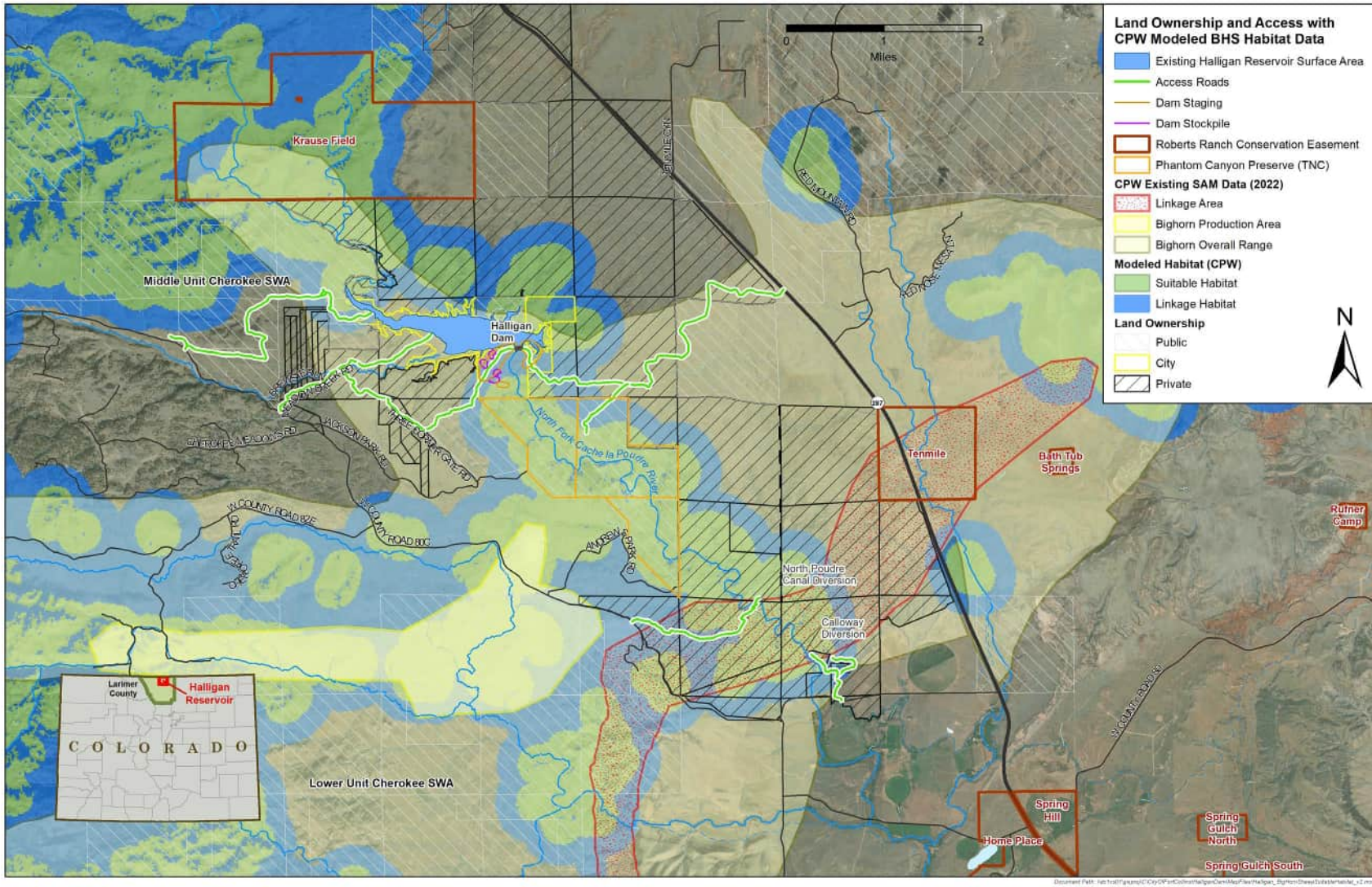


Figure 3-3. Halligan Project Elements and Bighorn Sheep Suitable Habitat

The following summarizes the current understanding of the Lone Pine herd range and habits around the Halligan Project Area.

- **Upstream of Halligan Reservoir**—Based on CPW data (CPW 2021b), the Lone Pine herd uses available habitat in the Cherokee Park area. Bighorn sheep have been documented as far north as the Middle Unit of the Cherokee SWA, Phantom Canyon, and south of County Road 74E (Red Feather Lakes Road).
- **Halligan Reservoir**—The extent of herd range use at and near the Halligan Dam is not well understood. To date, the areas immediately adjacent to Halligan Reservoir near the existing dam have not been mapped as suitable habitat by CPW (Figure 3-3). Suitable habitat is determined based on vegetative and topographical habitat features, namely steep rocky slopes with escape cover near open areas suitable for grazing. Field observations from CPW staff and the public indicate that bighorn sheep cross Phantom Canyon below Halligan Dam generally between North Poudre Canal Diversion and the Calloway Diversion with increased presence in the spring and fall months.
- **North Fork downstream of Halligan Reservoir**—Trail camera images and field observations document Phantom Canyon use by the Lone Pine herd throughout the year. Bighorn sheep are frequently seen approximately 2.5 miles south of Halligan Reservoir and approximately 1.0 mile west of The Nature Conservancy’s Phantom Canyon Ranch near Calloway Hill. The linkage area that connects the habitat east of Highway 287 along Stonewall Creek and the ridgeline to Phantom Canyon where it then widens in the vicinity of Calloway Hill on to the Cherokee SWA, including parts of Rabbit Creek Ranch. This linkage area is important because it provides suitable temporary habitats and allows for the movement of individuals or the Lone Pine herd population to known larger suitable habitat patches across a fractured landscape.

Surrounding areas—Ram bands have been seen east of Highway 287 along Stonewall Creek using prominent escarpments (Steamboat Rock area), and with annual fidelity, the herd uses private lands east of the Lone Pine Unit of the Cherokee SWA and east of Phantom Canyon. Near Stonewall Creek upstream of its confluence with the North Fork, local residents have observed individual rams annually from approximately March to October, east of Highway 287 on the 10-mile parcel of Roberts Ranch, as far north as the Steamboat Rock land feature, and east to approximately 1.0 mile east of Steamboat Rock. Rams have been hit and killed by vehicles on Highway 287 in this area (Thode, pers. comm. 2021).

3.7.3 Lone Pine Herd Management Challenges

According to CPW (CPW 2021b), an existing and ongoing challenge in managing the Lone Pine herd is the known proximity to domestic sheep grazing, which has the potential to introduce disease to wild bighorn sheep. Several land managers within the Lone Pine herd-occupied range along the North Fork River corridor use domestic sheep and goats for weed management. Although domestic sheep can be an effective vegetation management tool, this practice increases the chance of commingling between the Lone Pine herd and domestic sheep. Domestic sheep grazing has been occurring seasonally from late April through mid-July since 2016 on private land within the range of the Lone Pine herd. The greatest concern of commingling between the Lone Pine herd and domestic sheep is the transmission of deadly pathogens between domestic sheep populations and bighorn sheep. Fort Collins staff have been exploring opportunities to effectively separate the Lone Pine herd and domestic sheep in this area for several years; however, because of local interest, domestic sheep management practices have not changed in this area.

An additional challenge identified by CPW is the degradation of bighorn sheep habitat on the Cherokee SWA’s Lower Unit, Roy Brown Unit, and Lone Pine Unit over the past decade caused by invasive

cheatgrass (*Bromus tectorum*). Cheatgrass has diminished the quality of bighorn sheep habitat on the landscape where once high-value bighorn sheep habitat occurred. Figure 3-3 shows the best available data on the Lone Pine herd that have been reviewed for the Halligan Project and mitigation strategy development.

3.7.4 Halligan Project Effects on Rocky Mountain Bighorn Sheep

The direct and indirect effects from the Halligan Project described for terrestrial wildlife and big game in Section 3.6 generally apply to bighorn sheep. The DEIS notes that severe winter range is the limiting range type for bighorn sheep. As noted in the DEIS, because there is no loss of bighorn sheep severe winter range, both long- and short-term direct effects of the Halligan Project on bighorn sheep would be negligible, with no measurable or perceptible consequences to the Lone Pine herd from long-term habitat loss created by inundation.

However, CPW has asserted that the Lone Pine herd in the affected area is a low-elevation herd that has no defining seasonal range. This herd uses the different habitat types within the entire bighorn sheep range throughout the year based on the specific habitat requirements needed at the time. The overall habitat has a multitude of foraging, lambing, resting, mating, thermal cover, and predator avoidance areas that are used many times throughout the year in no specific season. Relative to direct permanent effects, the Lone Pine herd's S40 Unit has a total area of 272,892 acres, of which 99,286 acres are mapped as overall range for bighorn sheep. Direct habitat loss (155.5 acres) from the Project within the S40 Unit amounts to 0.15 percent loss of overall range within the Lone Pine herd's S40 Unit.

Indirect effects and temporary direct effects on bighorn sheep and other big game could involve displacement caused by noise and disturbance from construction activities, transportation of people and materials, and general human activity in the reservoir and NPIC diversion areas. In addition, vehicle and equipment emissions and fugitive dust may have an effect on bighorn sheep distribution. Displacement of bighorn sheep and emissions of dust may increase the likelihood of respiratory distress, making bighorn sheep more susceptible to disease. There may be a shift in the movement of bighorn sheep as a result of construction activities. The DEIS also acknowledges that a potential indirect impact of Halligan Dam rehabilitation is stress-related die-off of bighorn sheep. The DEIS Section 4.12.22, originally determined that indirect effects from Halligan Dam rehabilitation would be moderate. This was largely because of limited documentation of bighorn sheep in the vicinity of Halligan Reservoir, and because the Halligan Project Area is outside any known bighorn sheep concentration area and is a small part of the overall range.

CPW has recently collected data indicating that rams use the lower Phantom Canyon area. However, effects are expected to be minimized because the majority of work activity will be outside this resident bighorn sheep production area and work in the lower Phantom Canyon area would occur during winter months when there is minimal bighorn sheep activity in the area and domestic sheep and goats are not grazing on open range. In DEIS Section 4.12.2.2 the Corps recognized that the risk to bighorn sheep is difficult to predict because of the lack of site-specific data and factors unrelated to the Halligan Project, such as disease and drought. The Corps further noted that if the Halligan Project caused a die-off similar to what happened at Waterton Canyon (75 percent to 85 percent and 2-year continued lamb mortality), it would be a major long-term (greater than 20 years) indirect effect on the local bighorn sheep herd that may or may not be permanent.

CPW provided specific concerns regarding impacts on bighorn sheep posed by Halligan Project construction activities at the dam and the North Poudre Canal Diversion in a memorandum dated January 11, 2021 (CPW 2021a) and expanded upon these concerns in subsequent meetings with Fort Collins.

CPW identified two primary concerns for adverse impacts on bighorn sheep:

- **Direct disturbance and stress from construction activities**—Construction activities may disrupt bighorn sheep feeding or movement and can be negatively affected by fugitive dust, which can increase stress and the likelihood of disease.
- **Seasonal movement disruption causing increased risk for commingling with domestic sheep**—Construction activities could disrupt or alter bighorn sheep movements and push the Lone Pine herd into nearby domestic sheep and goat grazing allotments; this would increase the chance of commingling and pathogen transfer between domestic and bighorn sheep. This could increase the chance of a disease outbreak and a potential bighorn sheep die-off; the likelihood of disease outbreak increases even further when combined with the added stress from construction general habitat disturbances.

These temporary construction-related impacts could exacerbate the conditions in which bighorn sheep may commingle with domestic sheep used for weed management within the Halligan Project Area.

3.8 Special-status Species

The DEIS describes terrestrial species of concern that could be affected by the Halligan Project. These species of concern are federally listed as threatened or endangered under the ESA; identified as sensitive by the BLM; listed as threatened, endangered, or of special concern by Colorado; or listed as a Tier 1 species in *Colorado's State Wildlife Action Plan* (CPW 2015), which are species of highest conservation priority in the state. The DEIS focuses on those species that (1) have suitable habitat present within the Project Area (that is, within construction or inundation footprints); and (2) have been documented in the Project Area or their distributional range overlaps the Project Area according to CPW, Colorado Heritage Program datasets, or site-specific surveys. Available information about current conditions and potential impacts from the Halligan Project on special-status species is summarized in the following sections. Table 3-3 lists federal or state species of concern and summarizes the potential effects from the Halligan Project on each species based on the DEIS evaluation.

Table 3-3. Summary of DEIS Impact Evaluation of Halligan Project on Species of Concern

Species	Concern Listing	Impact of Halligan Project on Each Species, from DEIS ^[a]
Preble's	Federal and State, Threatened	Major impact; will be addressed through ESA consultation process and not included in this FWMEP
Ute ladies'-tresses orchid (<i>Spiranthes diluvialis</i>)	Federal, Threatened	No effect; will be addressed through ESA consultation process and not included in this FWMEP
American white pelican (<i>Pelecanus erythrorhynchos</i>)	BLM sensitive species	Minor benefit
Platte River Species (Five Species)	Federally listed	Unperceivable; will be addressed through ESA consultation process and not included in this FWMEP
Rocky Mountain bighorn sheep	State Tier 2, BLM sensitive species	Negligible direct effect, possibility of moderate to major indirect effect; discussed in Section 3.7 ^[b]

Species	Concern Listing	Impact of Halligan Project on Each Species, from DEIS ^[a]
Northern pocket gopher (<i>Thomomys talpoides macrotis</i>)	State, SOC	Minor effect, discountable and insignificant
River otter (<i>Lontra canadensis</i>)	State, Threatened	Minor benefit
Townsend's big-eared bat (<i>Corynorhinus townsendii pallescens</i>)	State SOC, BLM sensitive species	Minor effect
Bald eagle (<i>Haliaeetus leucocephalus</i>)	State SOC, BLM sensitive species	No permanent direct effects; minor benefit from increased foraging habitat
Golden eagle (<i>Aquila chrysaetos</i>)	State Tier 1, BLM sensitive species	Discountable and insignificant
Northern leopard frog (<i>Lithobates pipiens</i>)	State Tier 1, State SOC	Minor benefit
Common garter snake (<i>Thamnophis sirtalis</i>)	State Tier 2, State SOC	Minor benefit

^[a] Impacts are summarized here as none, beneficial, low, or moderate, based on detailed descriptions provided in the DEIS.

^[b] CPW has stated their concern that potential impacts on bighorn sheep could range from moderate to severe should a herd die-off occur.

SOC = species of concern

3.8.1 Current Conditions for Federally Listed Species

3.8.1.1 Preble's Meadow Jumping Mouse and Habitat

Preble's is a federal- and state-listed threatened species in Colorado. Pioneer Environmental Services (Pioneer) conducted an extensive trapping survey at Halligan Reservoir for Preble's meadow jumping mice between June and August of 2003 (WEST 2017a), which documented the presence of Preble's around the reservoir. Critical habitat for Preble's is designated along the lower portions of the North Fork starting at Halligan Dam and includes its tributaries and portions of the Poudre River. The enlarged Halligan Reservoir inundation area upstream of the existing dam is outside Preble's critical habitat. The replacement dam and portions of the construction areas would include small areas of critical habitat. Preble's impacts and mitigation measures will be addressed through the ESA consultation process, and are not included in this FWMEP.

3.8.1.2 Ute Ladies'-Tresses Orchid and Colorado Butterfly Plant

Ute ladies'-tresses orchid is a federally listed threatened species. Potential habitat for Ute ladies'-tresses orchid occurs along the North Fork and tributaries both upstream and downstream of the Halligan Reservoir. As documented in the DEIS, no Ute ladies'-tresses orchids were detected in surveys conducted at Halligan Reservoir from 2006 to 2008 (WEST 2017a). Additional evaluations conducted by Jacobs in 2021 (Jacobs 2021) were concentrated within potential Ute ladies'-tresses orchid habitat around the narrow riparian habitat below the existing dam. No Ute ladies'-tresses orchids were observed during the 2021 survey, and habitat was determined to be marginally suitable for Ute ladies'-

trusses orchid because of the presence of dense riparian grasses and dense overstory of willow and alder.

Colorado butterfly plant (*Oenothera coloradensis*) was previously federally listed as a threatened species; however, on December 5, 2019, the USFWS removed this species from the Federal List of Endangered and Threatened Plants because of recovery (USFWS 2019). No known populations of the Colorado butterfly plant occur within the Halligan Project Area. Therefore, this species is not further discussed in this FWMEP.

3.8.1.3 American White Pelican

The American white pelican is a BLM sensitive species and a Tier 2 species in the *State Wildlife Action Plan* (SWAP) (CPW 2015). The DEIS indicates that American white pelicans were observed on Halligan Reservoir; therefore, the reservoir is considered potential loafing or foraging habitat for this species. Halligan Reservoir is not within mapped American white pelican nesting areas.

3.8.1.4 Platte River Species

Because the Main Stem and North Fork are hydraulically connected to the Platte River System, ESA Section 7 consultation with the USFWS is required to determine any adverse effects that would occur on the five federally listed downstream species: least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), whooping crane (*Grus americana*), pallid sturgeon (*Scaphirhynchus albus*), and western prairie fringed orchid (*Platanthera praeclara*). These species are not further discussed in this FWMEP.

3.8.2 Current Conditions for State-listed Species

The DEIS evaluated reviewed state-listed species and species of concern using CPW species profiles (CPW n.d.) and the SWAP to identify information pertaining to habitat information and distribution. State-listed species and species of concern that could be affected by the Project are discussed in the following sections.

3.8.2.1 Rocky Mountain Bighorn Sheep

Rocky Mountain bighorn sheep is a BLM sensitive species and is listed as a Tier 2 species in the SWAP. Tier 2 species are defined as “species [that] remain important in light of forestalling population trends or habitat conditions that may lead to a threatened or endangered listing status, but the urgency of such action has been judged to be less” (CPW 2015). This species is considered a big game species; current conditions are discussed in Section 3.7.

3.8.2.2 Northern Pocket Gopher

The northern pocket gopher is a state species of concern. The Halligan Project Area includes suitable foothill shrubland habitat and is within the distributional range of this species.

3.8.2.3 River Otter

River otters are listed by Colorado as a threatened species. As described in the DEIS, the open water of the North Fork and Halligan Reservoir could provide habitat for the river otter, although the known range of the river otter ends approximately 16 miles south of the reservoir. The range of the river otter includes the Poudre River and a small section of the North Fork, from the confluence of these rivers to approximately 1 mile upstream of the Seaman Reservoir.

3.8.2.4 Townsend's Big-Eared Bat

Townsend's big-eared bat is a BLM sensitive species, a state species of special concern, and is listed as a Tier 1 species in the SWAP. The DEIS indicates that rocky outcrops and canyons downstream of the

Halligan Dam along the North Fork may provide roosting habitat, and the open water of Halligan Reservoir, scattering of sagebrush, and wetlands within the Halligan Project Area may provide Townsend's big-eared bats with foraging habitat. This species usually forages over water, at the edge of vegetation, and over sagebrush (Armstrong et al. 2011).

This bat species has been recorded downstream of the Halligan Dam in Phantom Canyon (Colorado Natural Heritage Program 2015). Bat conservation has received increasing attention with the general decline of bat populations caused by habitat loss, poisoning, and disease, including white-nose syndrome.

Bat Survey

On July 16, 2021, Jacobs biologists conducted a bat presence/absence survey below Halligan Dam. An auditory detection survey was completed, along with visual observation of bat feeding activity with the riparian area from the dam to 0.5 mile downstream of the dam. The single survey was conducted over a 3-hour period beginning at dusk (7:30 p.m. to 10:30 p.m.).

Several lone bats were detected with an auditory detection device, but no large concentrations of bats were observed. Table 3-4 summarizes the bat species detected based on audio signature, but variability occurs within species; therefore, identification has not been confirmed.

Table 3-4. 2021 Bat Survey Results

Species Detected	Number of Detections
Pallid bat (<i>Antrozous pallidus</i>)	1
Big brown bat (<i>Eptesicus fuscus</i>)	11
Red bat (<i>Lasiurus borealis</i>)	2
Hoary bat (<i>Lasiurus cinereus</i>)	1
Silver-haired bat (<i>Lasionycteris noctivagans</i>)	2
Western small-footed myotis (<i>Myotis ciliolabrum</i>)	1
Little brown bat (<i>Myotis lucifugus</i>)	6
Long-legged myotis (<i>Myotis volans</i>)	1
Unidentified detections	12
Total	37

The scattered occurrences of lone bat detections suggests that bats use the area below the existing Halligan Dam for foraging, but the presence or absence of day or night bat roosts could not be determined based on the limited survey.

3.8.2.5 Bald Eagles and Golden Eagles

The bald eagle is a state species of special concern and is a BLM sensitive species. The golden eagle is listed as a Tier 1 species in the SWAP and is also a BLM sensitive species. Both bald eagles and golden eagles are protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940. This prohibits the take; possession; sale; purchase; barter; offer to sell, purchase,

or barter; transport; export; or import of any part, nest, or eggs of alive or dead bald or golden eagles. State and federal recommendations outline seasonal limitations on nest encroachment or disturbance.

Bald eagles rely mainly on fish as their principal source of food during the summer months, frequently nesting and foraging along rivers and lakes. The DEIS notes that bald eagles are known to forage in areas of open water and were observed during field surveys of the Halligan Reservoir and the North Fork during the summer of 2020 and 2021. No bald eagle nests or winter roost sites occur within the Halligan Project Area, and the area is outside winter concentration, winter foraging, and winter range areas for bald eagles identified on CPW wildlife distribution maps (CPW 2020b).

Golden eagles primarily subsist on small mammals, such as rabbits, hares, ground squirrels, and prairie dogs. The DEIS notes that suitable golden eagle foraging habitat occurs within the entire Halligan Project Area except for the reservoir itself, which does not provide nesting or foraging habitat. The effects are anticipated to be temporary and are discussed in Section 3.8.4.5. Golden eagles were observed during field surveys of the North Fork downstream of the Halligan Dam. A nest was observed by Jacobs biologists, in summer of 2021, on a rocky vertical cliff wall approximately 0.5 mile downstream of the North Poudre Canal Diversion structure.

Raptor Nest Survey

On July 16, 2021, Jacobs biologists conducted a nest survey within and immediately adjacent to the inundation footprint of the enlarged reservoir and impact area for the new dam. Trees and shrubs, as well as grassland areas within or adjacent (within 50 feet) to the proposed access road connecting the Halligan Dam to Highway 287 were also surveyed. Additionally, nesting raptor surveys were conducted on June 23, July 16, and July 19, 2021. Biologists used binoculars to survey the visible 0.5-mile radius from the dam for raptor nests. No nests were located within or adjacent to the footprint of the existing dam. The following observations were made during the nest surveys:

- A lone bald eagle was observed perched frequently and for extended periods of time on power line poles above Halligan Dam and on rock outcroppings on the north side of the dam, but nesting activity was not observed, and a nest location was not apparent.
- A great horned owl (*Bubo virginianus*) was observed on several occasions below the dam, suggesting that an owl nest may be in Phantom Canyon below the dam.
- A red-tailed hawk (*Buteo jamaicensis*) nest was present near the Calloway Diversion. The nest appeared to be maintained and is presumed to be active, but no hawks were observed on the nest.
- Two magpie (*Pica nuttalli*) nests were located in trees adjacent to the access road, but the nests were not occupied at the time of the survey.
- As discussed previously, an active golden eagle nest was observed in Phantom Canyon about 0.5 mile downstream of the North Poudre Canal Diversion structure.

3.8.2.6 Northern Leopard Frog

The northern leopard frog is a Colorado species of special concern and is listed as a Tier 1 species in the SWAP. The DEIS notes that the Halligan Project Area supports aquatic environments, such as streams and wetlands, that would be suitable habitat for the northern leopard frog.

3.8.2.7 Common Garter Snake

The common garter snake is a species of special concern in Colorado and is listed as a Tier 2 species in the SWAP. Common garter snakes are typically found in aquatic and riparian habitats within or adjacent

to floodplains of streams and rivers. The DEIS notes that the Halligan Project Area supports aquatic environments, such as streams and wetlands, that would be suitable habitat for the common garter snake. Common garter snakes are typically found below 6,000 feet in elevation along the South Platte River and its tributaries in northeastern Colorado.

3.8.3 Halligan Project Effects on Federally Listed Species

The DEIS identified 11 terrestrial species of concern that have either been documented or have suitable habitat and ranges within the Halligan Project Area. No suitable habitat is present for black-tailed prairie dog (*Cynomys ludovicianus*) or burrowing owl (*Athene cunicularia*); therefore, these species are not evaluated further in this FWMEP.

Long-term direct effects on species of concern evaluated in the DEIS included habitat loss or disturbance and effects on foraging, reproduction, and distribution from inundation and construction. Temporary removal of vegetation associated with construction may have potential short-term effects on species of concern until areas would be revegetated. Indirect effects on species of concern would be related to effects on wetlands, riparian vegetation communities, and other vegetation resources along the North Fork and Main Stem resulting from changes to water flows. Short-term indirect impacts from construction may result from construction-related activity, noise, vibrations, lighting, and other disturbances.

3.8.3.1 Preble's Meadow Jumping Mouse and Habitat

Effects from the Halligan Project on Preble's habitat are regulated through the ESA and will be addressed through the development of a mitigation plan in coordination with the USFWS. Therefore, Preble's conditions, effects, and mitigation are not addressed in detail in this FWMEP. The DEIS determined that the Halligan Project would have a major permanent adverse impact on Preble's habitat as a result of inundation of riparian woodlands and shrublands. Based on the Modified Proposed Action the Project will permanently displace 5.26 acres of Preble's habitat around the existing reservoir edge and downstream of the existing dam within the footprint of the proposed dam. A Preble's habitat functional assessment, approved by the USFWS, found that the permanent effects equate to the loss of 4.04 functional units of habitat (much of the reservoir edge habitat has low habitat functional for Preble's). Temporary impacts on Preble's habitat (related to construction access) are estimated to be 0.47 acres (0.36 functional unit). Fort Collins has worked proactively to preserve habitat on the Roberts Ranch Conservation Area and has worked closely with the Preble's Species Conservation Team in the effort to establish a Preble's recovery population in the North Fork watershed. Many of the Halligan Project beneficial effects, mitigation, and enhancements described in this FWMEP would benefit Preble's habitat through increased stream flow and likely improved riparian conditions.

3.8.3.2 Ute Ladies'-tresses Orchid

The Halligan Project has the potential to impact wetland and riparian habitat that may be considered suitable for the Ute ladies'-tresses orchid. In the DEIS, the Corps determined that the Halligan Project would have no effect on the Ute ladies'-tresses orchid because no known occurrences of this plant were identified within the study area. Ute ladies'-tresses orchid conditions, effects, and mitigation are not addressed in detail in this FWMEP. However, many of the beneficial effects, mitigation, and enhancements described in this FWMEP could benefit Ute ladies'-tresses orchid habitat through increased stream flow and improved riparian conditions.

3.8.3.3 American White Pelican

American white pelicans were observed on Halligan Reservoir; therefore, the reservoir is considered potential loafing or foraging habitat for the American white pelican. Because loafing or foraging habitat

would be expanded through reservoir enlargement, the Halligan Project would result in a minor benefit for the American white pelican, as described in the DEIS.

3.8.3.4 Platte River Species

The CMP (City of Fort Collins 2019c), prepared as part of the DEIS, documented that effects on the five federally listed downstream Platte River species are expected to be unperceivable, and that the Halligan Project is not expected to result in any discernable changes to stream flow in the South Platte River. Fort Collins participates in the SPWRAP, which outlines a programmatic approach to Section 7 consultation with the USFWS. Currently, mitigation is not expected to be needed for South Platte River depletions. If mitigation measures are identified during this programmatic approach or from USFWS consultation, they will be incorporated into the mitigation strategy for the Halligan Project.

3.8.4 Halligan Project Effects on State-listed Species

3.8.4.1 Rocky Mountain Bighorn Sheep

Halligan Project impacts on bighorn sheep are discussed in detail in Section 3.7.

3.8.4.2 Northern Pocket Gopher

Although northern pocket gophers have not been documented within the study area, the DEIS indicated that the Halligan Project would result in a minor effect on the northern pocket gopher as a result of inundation of foothill shrublands suitable habitat. These effects would be discountable and insignificant because they would not have a noticeable effect on populations within the surrounding area because other suitable habitat is available. Temporary impacts anticipated are limited to temporary construction access and staging areas that will be reclaimed upon completion of the Project.

3.8.4.3 River Otter

Because the known range and sightings of the river otter do not overlap with the inundation areas of the Halligan Project, the DEIS Section 4.13.2.6 states that expanding the reservoir would not adversely impact this species. The DEIS Section 4.13.3.6 also states that a potential minor indirect benefit to river otters could result from the Halligan Project. More specifically, increased stream flows to the North Fork from the Winter Release Plan and the Summer Low-flow Plan could improve the fishery health and, in turn, would provide a larger, more stable food source for river otters. Because there is no documented occurrence of river otter in the section of the North Fork below Halligan Dam where construction would occur, nor in or near the inundation upstream (0.75 mile section) above the enlarged reservoir, no temporary impacts are anticipated.

3.8.4.4 Townsend's Big-eared Bat

The DEIS determined that roost habitat would not be directly affected by the Halligan Project, but construction noise and vibration associated with the Halligan Project may cause temporary disturbance effects on Townsend's big-eared bats using nearby roost habitat. Furthermore, overall effects to foraging habitat would be discountable and insignificant, and the Halligan Project would have a minor impact on Townsend's big-eared bat. Year-round winter and summer minimum stream flows (Section 3.3.2) provided by operations of the enlarged reservoir would enhance riparian foraging habitat below Halligan Reservoir for Townsend's big-eared bats.

3.8.4.5 Bald Eagles and Golden Eagles

The DEIS determined that the Halligan Project would not likely cause permanent direct effects on bald eagles. Although some foraging sites around Halligan Reservoir may be altered as a result of inundation, the expanded surface area of the enlarged reservoir would create new foraging areas, creating a minor

beneficial effect on bald eagles. Because there are no active nesting pairs, roost sites, or suitable winter habitat temporary impacts associated with construction activities such as noise, nighttime lighting, blasting, and potential batch plant operation impacts on foraging activities are anticipated to be minor (temporary avoidance) and short term in duration. Bald eagle use of the area is expected to return to preconstruction levels shortly after construction is completed. Increased reservoir surface area will provide increased foraging opportunity for bald eagles in the long term.

For golden eagles, expansion of Halligan Reservoir would reduce habitat for their prey base in inundation and construction areas. However, in the DEIS, impacts were considered discountable and insignificant because golden eagles are wide-ranging, and vast areas of open foothills shrubland and grassland for foraging would remain after reservoir expansion. Long-term direct effects on golden eagles would be minor. Temporary impacts associated with construction activities such as noise, nighttime lighting, blasting, and potential batch plant operation impacts on foraging activities are anticipated to be minor (temporary avoidance) and short term in duration. Golden eagle use of the area is expected to return to preconstruction levels following completion of replacement dam construction. Revegetation of temporary construction disturbance areas, and regrowth of a reservoir edge riparian community is anticipated to be completed within approximately 5 to 7 years.

3.8.4.6 Northern Leopard Frog

The Halligan Project supports aquatic environments, such as streams and wetlands, that could be suitable habitat for the northern leopard frog. However, northern leopard frog has not been observed around the reservoir and it is unlikely that leopard frog inhabits the reservoir edge wetlands given the inconsistent and fluctuating water levels, lack of emergent wetland vegetation (narrow reservoir edge wetlands are dominated by willow and cottonwood canopy), and general lack of suitable breeding habitat; steep rocky reservoir banks offer very little refuge or dispersal area for the leopard frog as water levels draw down in mid-summer and reservoir becomes disconnected from the minimal and narrow bands of emergent wetland vegetation that does exist around the reservoir. The DEIS indicates an overall minor beneficial effect from the Halligan Project on northern leopard frog habitat. The DEIS Section 4.12.3.11 indicates that some suitable habitat would be adversely affected because approximately 16.74 acres of wetlands would be inundated from the enlarged reservoir. New, similar habitat could be created at the new enlarged reservoir edge after soils and vegetation acclimate to the new hydrology. This process of reservoir edge riparian community re-establishment is anticipated to occur over approximately 5 to 7 years but may take longer if drought conditions persist after Project completion. Enlarging Halligan Reservoir would permanently displace riverine habitat on the downstream side of the existing dam, but because of the high energy associated with the current dam operations spillway and significant disturbance existing in this tight rocky canyon, the area immediately below the existing dam is not considered suitable for northern leopard frog.

Year-round winter and summer stream flows (Section 3.3.2) provided by operation of the enlarged reservoir would enhance habitat for the northern leopard frog in Phantom Canyon and the Livermore Valley. Lastly, the Halligan Project would compensate for the loss of any wetland habitat (to be determined through the Section 404 permitting process and not discussed in this FWMEP), which would also benefit the northern leopard frog by replacing poor reservoir edge habitat with wetlands that would provide equal or potentially greater northern leopard frog habitat function.

As noted in Section 4.12.2.1.5 of the DEIS, some mortality of reptiles and amphibian adults, juveniles, eggs, tadpoles, and larvae might occur during construction, but this would not likely result in a long-term decline of amphibians at Halligan Reservoir or along the North Fork. The removal of vegetation for construction, both long- and short-term, would potentially remove cover and foraging resources for

some reptiles and amphibians. Still other reptiles and amphibians might be killed or displaced as a result of construction activities. The Halligan Project might locally reduce species abundance during construction; however, it would not likely lead to large-scale species loss or require species protection due to habitat loss. Halligan Dam rehabilitation would have a negligible to minor effect on amphibians and reptiles.

3.8.4.7 Common Garter Snake

Typically, common garter snakes are found in aquatic and riparian habitats within or adjacent to floodplains or streams and rivers that occur below 6,000 feet in elevation (CPW n.d.). The DEIS indicates that the Halligan Project would affect suitable habitat for the common garter snake, and downstream segments of the North Fork are within the range of the common garter snake. However, because the reservoir is located approximately 6,300 feet in elevation, above the known range limit, the Halligan Project would not have negative effects on the common garter snake around the reservoir (Pioneer 2017a).

As described for other species, year-round winter and summer minimum stream flows (Section 3.3.2) provided by operation of the enlarged reservoir would enhance habitat for garter snakes on the North Fork. Therefore, the Halligan Project is expected to result in an overall benefit to the species, and species-specific mitigation measures are not proposed in this FWMEP.

3.9 Recreation

3.9.1 Current Conditions

Recreational use on Halligan Reservoir has historically been, and currently is, restricted to owners and guests of the Landowners Association for Phantom Canyon Ranches (LAPCR). Some public use may have occurred on portions of Halligan Reservoir that were thought to be in the Middle Unit of the Cherokee SWA. Since 1988, the LAPCR has had recreational and agricultural use rights to the surface of Halligan Reservoir and what is currently City-owned land in and around Halligan Reservoir, through lease agreements with NPIC and later Fort Collins. The current lease provides LAPCR with recreational use of the surface of Halligan Reservoir and recreational and agricultural use of City-owned land in and around Halligan Reservoir until construction of the Halligan Project concludes.

Other areas around Halligan Reservoir that provide recreational activity include the Cherokee SWA located west of the reservoir, which is used primarily for hunting and fishing, and the North Fork downstream of the reservoir, which is used for fishing by private property owners and guests of The Nature Conservancy's Phantom Canyon Ranch. Although a parking area near the inlet of Halligan Reservoir is accessible through the SWA, the surface of the Halligan Reservoir and Fort Collins-owned land in and around the reservoir is not open to public access.

3.9.1.1 Land Ownership

Land ownership and access around Halligan Reservoir and at potential mitigation sites is a key factor in Halligan Project activities, including ecological monitoring and mitigation. As part of Fort Collins' due diligence related to planned acquisition of property rights to build and operate the enlarged Halligan Reservoir, Fort Collins conducted detailed research on land ownership in and around Halligan Reservoir. This research identified isolated parcels in Section 29 and northeast $\frac{1}{4}$ of Section 32 that were thought to be held in fee title by CPW but were determined to be held in fee by a private entity or Fort Collins (Figure 3-4). The parcels total approximately 39 acres. Upper portions of the enlarged Halligan Reservoir would be located on portions of these lands, which are, for the most part, surrounded by the Cherokee SWA–Middle Unit. It was also determined that the parking area near the west side of Halligan Reservoir

in the northeast ¼ of Section 32 is located on property held in fee by Fort Collins. To Fort Collins’ knowledge, there is no agreement or easement in place that provides public access to the private entity’s or this portion of Fort Collins’ land.

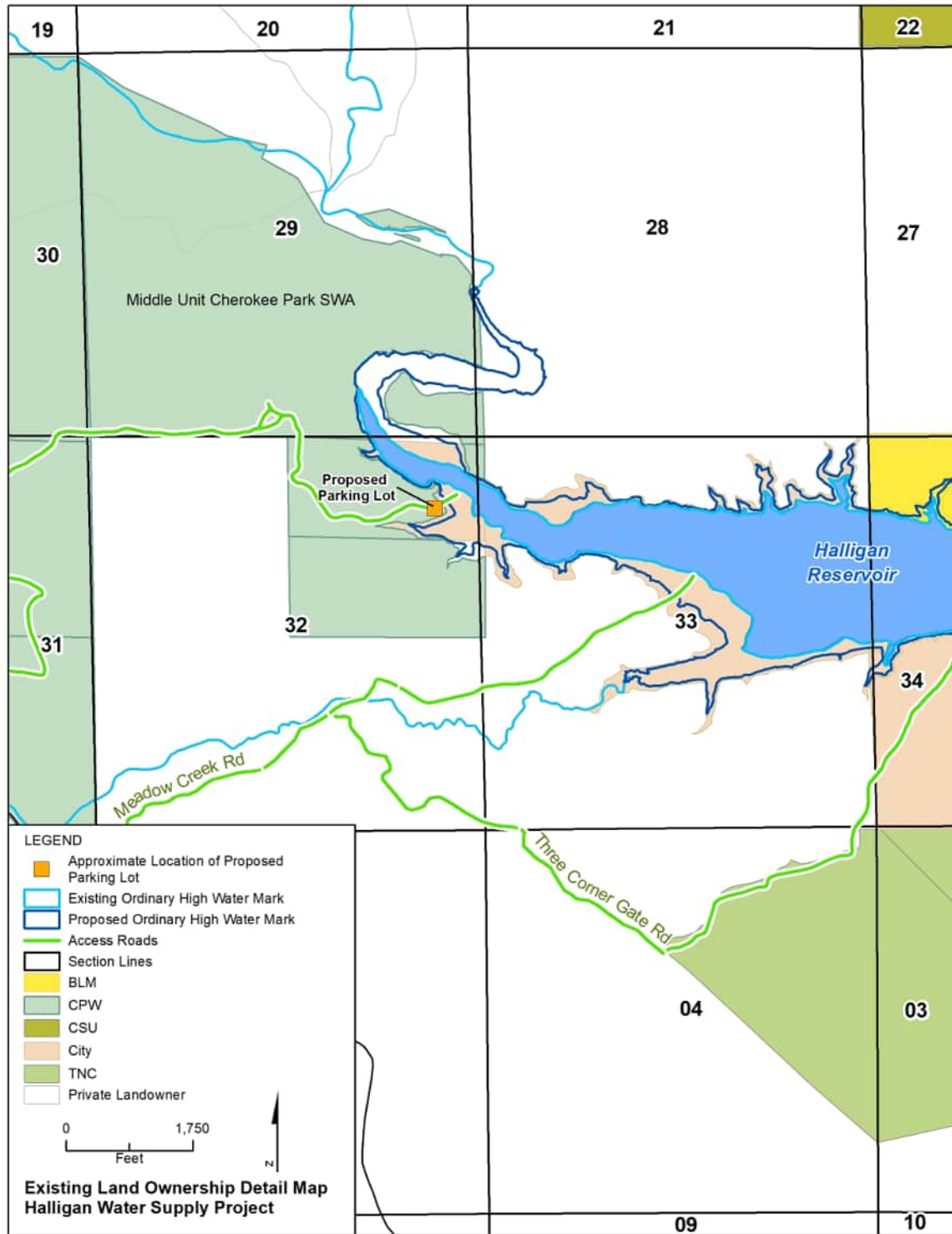


Figure 3-4. Sections 29 and 32 on the Western Edge of Halligan Reservoir

3.9.2 Halligan Project Effects on Recreation and Public Access

The DEIS Section 4.16.4.2 indicates that, overall, the Halligan Project would result in a mostly negligible effect on long-term land- and water-based recreational activity and related economic activity, although site-specific beneficial and adverse effects would occur.

When full, the enlarged Halligan Reservoir would inundate an approximately 0.75-mile reach of the North Fork upstream of the existing Halligan Reservoir, resulting in the loss of approximately 20 acres of potential hunting lands and river fishing along a 0.4-mile stretch of this reach.

Most of the primary inundation area along the North Fork in Sections 29 and 32, T11N, R70W, was historically believed by CPW to be in the Cherokee SWA since the acquisition of the land in the late 1960s/early 1970s. According to CPW the public has accessed this part of the inundation area for over 50 years¹⁰. Fort Collins staff was performing its due diligence in researching land ownership all around Halligan Reservoir and identified discrepancies in various deeds, including those in Sections 29 and 32. Following thorough title research of the inundation area, recorded title to the inundation area in these sections is privately owned or owned by Fort Collins. Additionally, the parking area near the west side of Halligan Reservoir in the northeast ¼ of Section 32 located on Fort Collins' property is within this primary area to be inundated by the enlarged Halligan Reservoir. None of the lands privately owned or owned by Fort Collins are authorized for public hunting or fishing. No publicly owned lands for authorized public hunting or fishing recreation will thus be technically impacted by the Project. However, public access could be affected until the access issues are resolved, as described in Section 4.3.7.1.

In addition to the primary inundation created by the ordinary high water mark of the enlarged Halligan Reservoir, Fort Collins is required by DWR (refer to Rule 7.9.3.3 in 2 CCR 402-1, *Division of Water Resources Rules and Regulations for Dam Safety and Construction*) to acquire fee ownership or an easement for lands that would be inundated by the modeled inflow design flood surcharge, which will include lands in Sections 29 and 32 that are part of the Cherokee SWA owned by CPW. Since the private entity or Fort Collins owns the land about 14 feet above the ordinary high water mark of the enlarged Halligan Reservoir, the only floods that will be above the private entity or Fort Collins' lands would have a recurrence interval of 1 in 100,000 (0.001%) and the maximum probable flood has a recurrence interval of 1 in 10,000,000 (0.00001%). Although this highly infrequent inundation will not be permanent, public use of these lands would be impacted while these lands are inundated, and until they are reclaimed following any flooding event, if necessary. It is estimated that approximately 21 acres of land owned by CPW would be inundated during the probable maximum flood for which Fort Collins would need a flood easement from CPW.

Because the surface of Halligan Reservoir is not open to the public for recreational use, construction of the Halligan Project would not impact public recreation on the reservoir. The LAPCR's private access to Halligan Reservoir (refer to Section 3.9.1) would be minimally impacted during construction and would be limited to specific times when the reservoir level would be drawn down near the end of construction for partial or total demolition of the existing dam. LAPCR currently would have no rights to access the surface of the enlarged reservoir following completion of construction. Fort Collins has no current plans to allow recreation on the surface of Halligan Reservoir following construction. If, in the future, surface water recreation is considered at the enlarged Halligan Reservoir, Fort Collins agrees to consult with

¹⁰ Fort Collins is evaluating if and the extent to which the public has accessed this part of the inundation area and makes no representations on this issue.

CPW. A safety buffer on the water out to approximately 300 feet upstream of the existing dam would likely be implemented during the construction period.

Wildlife watching, hiking, horseback riding, and other land-based activities occur on properties surrounding Halligan Reservoir. Construction activity, including noise and dust generation and increased traffic volumes (construction workers and trucks), may temporarily affect the quality of these experiences. However, construction activities would predominantly be confined to the area near the existing dam site, which is not within residential view.

3.9.3 Evaluation of Future Public Use of the Enlarged Halligan Reservoir

Fort Collins and CPW held multiple meetings to discuss the possibility of allowing public recreation on the enlarged Halligan Reservoir and some of the surrounding City owned land. From approximately 2016 through 2019, CPW and Fort Collins discussed various recreation concepts that included opening all or portions of Halligan Reservoir to public recreation after enlargement. The recreation concept included in the DEIS included reservoir access through the Cherokee SWA, whereby shoreline and surface water fishing opportunities with human-propelled watercraft would be available at the enlarged Halligan Reservoir to those with a valid hunting or fishing license, or SWA pass. The only public recreation access would be through the Cherokee SWA so this recreation concept anticipates the reservoir operating as a part of the administrative boundaries of the Cherokee SWA and is consistent with the existing regulations of the SWA.

To further evaluate the costs, benefits, and impacts of opening the enlarged Halligan Reservoir to public recreation, Fort Collins staff members, in conjunction with CPW staff input, used a framework adopted by Fort Collins' Natural Areas Department (Interagency Visitor Use Management Council 2016) to evaluate the impacts and benefits of recreation at and around the enlarged Halligan Reservoir. The study focused on the following topics:

- Ecological impacts
- Cultural resource impacts
- Social considerations
- Administrative considerations

At the conclusion of the analysis, Fort Collins staff members recommended that public recreation at the enlarged Halligan Reservoir not be pursued, even in a limited nature, predominantly because of ecological impacts that Fort Collins staff members anticipated based on DEIS analyses and their own professional experiences. Other elements that factored into the decision included the cost of providing safe recreational opportunities to this area, and the relatively narrow range of recreationalists who would benefit from the opportunity.¹¹ Fort Collins has agreed with CPW that recreational opportunities may be considered in the future, and ecological and other impacts would be re-evaluated at that time. Those discussions may include the reservoir being managed for recreation by CPW as a part of the Cherokee SWA.

¹¹ Access for public recreation at an enlarged Halligan Reservoir would be provided through Cherokee SWA, which requires a valid hunting, fishing, or recreational day use license to enter, as well as a high-clearance four-wheel drive vehicle. These access limitations do not fully align with Fort Collins' focus on equity and affordability to provide equal opportunities for its citizens.

4 Proposed Fish and Wildlife Mitigation Plan

This chapter constitutes the proposed mitigation plan for anticipated Halligan Project impacts on fish and wildlife resources. The impacts are summarized in Section 3 and described in greater detail in the DEIS and associated technical reports.¹² Avoidance, minimization, and compensatory mitigation measures have been developed to address fish and wildlife impacts identified in the DEIS, as well as other concerns identified by CPW staff specific to impacts on fish and wildlife resources.

The DEIS (Corps 2019) presented a draft CMP prepared by Fort Collins (City of Fort Collins 2019c) that includes both mitigation and enhancement measures. Based upon public comments received on the DEIS, comments from Project stakeholders, and discussions with CPW staff, this FWMEP builds upon and/or replaces many of the aquatic life and terrestrial wildlife components of the draft CMP. All measures included in this FWMEP are also summarized in the table contained in Appendix B. Mitigation areas are mapped in Appendix A. An updated final CMP will be prepared by Fort Collins for the Final EIS.

4.1 Mitigation Approach

Fort Collins has developed an approach to mitigation that will not only serve to satisfy regulatory requirements for protection of fish and wildlife, but also seeks to improve existing social¹³ and ecological conditions for the people and natural systems of the Poudre River watershed. This approach also applies to enhancement measures described in Section 5.

Fort Collins' mitigation objectives for the Halligan Project have been developed to comply with applicable regulatory requirements while acknowledging the importance of the Poudre River watershed to the Fort Collins community, as detailed in the *2020 Strategic Plan* (City of Fort Collins 2020a) and as follows:

- Avoid and minimize Halligan Project impacts on natural systems, to preserve ecological integrity
- Compensate for unavoidable Halligan Project impacts through mitigation measures that restore or replace locally important resources and function
- Improve ecological function of the North Fork system as a whole

Considering these mitigation objectives, and recognizing the important and localized ecological functions of the impacted resources, Fort Collins developed the following guidelines to identify and prioritize potential mitigation opportunities incorporated into this FWMEP:

- Account for the inherent benefits from the Halligan Project, including those anticipated to result from flow-related operational measures and the natural re-establishment of wetland and riparian communities at the enlarged reservoir shoreline and on the North Fork.
- Prioritize mitigation opportunities located near Halligan Reservoir and the North Fork to enhance or replace the natural functions in the same watershed and stream system, maintaining locally significant resources and ecological functions.
- Prioritize mitigation concepts that involve working with local partners.

¹² This FWMEP does not alter in any way the DEIS and associated technical reports and their descriptions of the Halligan Project's effects. To the extent that there are inconsistencies between the Halligan Project's effects as described in this FWMEP and the DEIS, any such inconsistencies will not be interpreted to reduce the mitigation Fort Collins intends to complete for the Halligan Project.

¹³ Refer to the Shared Vision Planning process in Section 2.4.1 regarding social conditions.

- Prioritize mitigation concepts that benefit whole systems or multiple resources.
- Identify and target local resources known to be in a degraded condition that can be improved to increase function and ecological benefit.

Fort Collins developed the mitigation measures presented in this FWMEP based on the mitigation objectives and guidelines to benefit numerous environmental components. Based on all of Fort Collins' work on the Halligan Project over the years, it is Fort Collins' position that this overall mitigation approach considers the entire ecological system, where the functional benefits of the mitigation actions taken together are greater than the sum of the Halligan Project's impacts on those individual parts. As an example, the Winter Release Plan and Summer Low-flow Plan will work together to essentially eliminate dry-up points along the North Fork and improve existing stream hydrology. These improvements would benefit not only the aquatic ecosystem, including fish and macroinvertebrates, but also the hyporheic zone hydrology of the stream. The resulting greater hydrologic connectivity would likely support the function of surrounding wetlands and riparian vegetation, which, in turn, would benefit wildlife that depend on healthy riparian environments.

This section provides a mitigation strategy for each affected fish and wildlife resource. In many instances, several mitigation strategies address one resource but likely have a ripple effect benefiting other resources. The mitigation and enhancement approach summarized in Sections 4 and 5, respectively, has been developed over decades, based on regulatory requirements, input from Project stakeholders, regional partners, environmental groups, and in coordination with CPW staff members.

4.1.1 Regulatory Mitigation Categories

Mitigation described in this FWMEP falls into one of the following three regulatory mitigation categories (defined in the Key Terminology section): avoidance, minimization, and compensatory mitigation.

Additionally, Fort Collins has developed enhancement measures that go above and beyond mitigation requirements and demonstrate Fort Collins' commitment to improving existing environmental conditions. Enhancement measures are described in Section 5.

Avoidance and minimization measures have been, and will continue to be, implemented during all Halligan Project stages, including planning and design, construction, and operations. Avoidance and minimization measures are described in Section 4.2. Compensatory mitigation measures will generally begin before or concurrently with the correlating impacts. Compensatory mitigation measures are described in Section 4.3. Early compensatory mitigation was completed through preservation of habitat at Roberts Ranch, as described in Section 4.3.1.

4.1.2 Changes from DEIS Conceptual Mitigation Plan

This FWMEP builds upon, updates, and/or replaces many of the aquatic life, terrestrial wildlife, and recreational components of the draft CMP presented in the DEIS (City of Fort Collins 2019c).

In response to comments on the CMP, Fort Collins has provided the following additional information in this FWMEP, or has finalized decisions about items that were not final when the CMP was issued:

- Specific details about how the flow-related operational measures will be implemented, including when they could be curtailed (refer to Section 4.2.1)
- Fort Collins' commitment to attempt to protect their releases from the enlarged portion of Halligan Reservoir to prevent that water from being diverted by exchange or otherwise (refer to Section 4.2.1)

- Recreation will not be pursued at the enlarged Halligan Reservoir as part of the Halligan Project at this time because of the reasons described in Sections 3.9.2 and 3.9.3
- Baseline monitoring of environmental conditions (water quality, temperature, riparian habitat, raptors and bats) was augmented in 2020 and 2021
- Conceptual sediment management measures have been developed to manage sediment both during construction and long-term operations
- A summary of preliminary best management practices (BMPs; that is, control measures) has been developed to manage and control stormwater and pollutants (refer to Section 4.2.3.7)
- Stream restoration on the North Fork as an enhancement for aquatic resources (refer to Section 5.1.1)
- Updated measures to mitigate anticipated water quality or temperature effects, or to enhance existing conditions
- Removal of alphanumeric codes: the CMP used a unique system of abbreviations to reference specific mitigation measures (for example, “SF1” for stream flow measure 1, the Winter Release Plan); this FWMEP uses descriptive names for each measure rather than abbreviations

The following mitigation measures, originally detailed in the draft CMP, are no longer viable based on new information obtained during Project development and design, and are no longer proposed as mitigation or enhancement measures:

Greenback Cutthroat Trout Reclamation and Diversion Structures Modification for Reintroduction—In the draft CMP, Fort Collins proposed the option of stocking an experimental population of native pure-strain greenback cutthroat trout to the 6-mile segment of the North Fork between Halligan Dam and the North Poudre Canal Diversion. Along with the proposed restocking effort, Fort Collins proposed creation of fish barriers at the North Poudre Canal and Calloway Diversions to maintain a genetically pure and isolated greenback cutthroat trout population. However, further analysis of temperature data, and a feasibility assessment by Fort Collins, in consultation with CPW staff, related to costs and sustainability associated with screening the outlet works and spillway, have determined the proposed Greenback reintroduction concept to be cost prohibitive and ultimately unsustainable in the long term. Fort Collins is, therefore, proposing to proceed with Option A described in the draft CMP: reconnecting larger habitat segments of the North Fork by providing fish passage around the North Poudre Canal Diversion and removing or modifying the Calloway Diversion to improve fish passage. This improved river connectivity will benefit a wide range of riverine aquatic species, with a primary focus on small-bodied native species.

Revegetation of Existing Tailings and Spoil Piles and Previously Disturbed Areas—In the draft CMP, Fort Collins proposed revegetating spoil piles left in place near the existing Halligan Dam as a result of construction of the dam in 1909. However, the Halligan Project now includes constructing a replacement dam downstream of the existing dam, which would result in inundation of the spoil piles and would eliminate the benefits of this previously proposed measure.

Fish population and aquatic habitat surveys—In the draft CMP, Fort Collins proposed working with CPW to conduct additional population surveys and field surveys of the amount and quality of available physical habitat for fish species in representative reaches of the North Fork between Halligan Dam and Seaman Reservoir. Following the draft CMP, Fort Collins evaluated existing aquatic habitat conditions in the North Fork (GEI 2019a, 2019b), and CPW has historic and recent fish population data as described in Section 3.5.1 of this FWMEP.

4.2 Avoidance and Minimization

Fort Collins has incorporated many elements into the Halligan Project to avoid and minimize environmental impacts. The Halligan Project is the culmination of decades of planning and balances Fort Collins' water supply needs with opportunities to minimize environmental impacts and improve existing conditions on the North Fork below Halligan Reservoir.

Appendix B provides a summary of each mitigation or enhancement measure and each measure's primary focus and secondary benefits.

4.2.1 Flow-related Operational Measures

Several flow-related operational measures will be included with the Halligan Project to collectively avoid and minimize impacts on stream functions while also improving certain stream functions that are currently degraded. These flow-related operational measures will re-establish perennial flow of 3 cfs to 5 cfs or more to the North Fork below the enlarged Halligan Reservoir, minimize abrupt changes to flows from the enlarged reservoir operations, and allow for peak flows to bypass the enlarged reservoir when Fort Collins could otherwise be diverting water to storage. The proposed flow-related operational measures include the following:

- Winter Release Plan
- Summer Low-flow Plan
- Ramping Rate Limitations
- Peak Flow Bypass Program
- End of Summer Flushing Event

The combined environmental benefits provided by these flow-related operational measures to the North Fork below the enlarged Halligan Reservoir are described in more detail in Section 4.2.1. These flow-related operational measures would have varying beneficial effects on the approximately 22 miles of the North Fork from the replacement Halligan Dam to Seaman Reservoir. They would result in moderate seasonal beneficial effects on aquatic resources from Halligan Reservoir downstream to the North Poudre Canal return structure (approximately 8 miles) on the North Fork (DEIS Section 4.8.3.4.1.2) with major beneficial effects from the North Poudre Canal return flow down to Rabbit Creek (approximately 2 miles; DEIS Section 4.8.3.4.1.3), and minor benefits extending from Rabbit Creek down to Seaman Reservoir (approximately 12 miles; DEIS Section 4.8.3.4.1.2). The Halligan Project would increase stream flows in winter and other traditionally low-flow periods, improve river connectivity during low-flow periods, and increase downstream areas of riffle and pool complexes (DEIS Section 4.8.3.4.1.3). The enlarged reservoir operations would eliminate almost all¹⁴ zero-flow days at frequent dry-up points and minimize extreme flow fluctuations from Fort Collins' use of the enlargement. Therefore, compensatory mitigation is not proposed for offsetting impacts on stream functions or stream flow because the Halligan Project's predicted impacts on stream functions and stream flow are sufficiently avoided and minimized through the operational measures. Nevertheless, in addition to the flow-related operational measures described in Section 4.2.1, Fort Collins has also committed to additional enhancement measures to improve current stream function and stream flow, which are described in Section 5.1.

To further benefit aquatic and other wildlife, circumstances may exist when, in consultation with CPW, Fort Collins will deviate slightly from the planned flow-related operational measures. Such modifications

¹⁴ See potential exceptions at end of this Section 4.2.1.1 Winter Release Plan "Curtailed of the Winter Release Plan" and Section 4.2.1.2 Summer Low-flow Plan "Curtailed of the Summer Low-flow Plan."

of timing, duration, and quantity of flow could occur, provided that any such modifications do not affect Fort Collins' storage and yield from the enlarged Halligan Reservoir and are consistent with all applicable permits and approvals, agreements, and decrees. This flexibility is needed to periodically modify flows, if necessary and when conditions are favorable, for the potential benefit of aquatic wildlife, as suggested by CPW. For example, per CPW's request, in certain years Fort Collins may change the period of the Summer Release Plan such that flows are decreased in October to help manage brown trout.

4.2.1.1 Winter Release Plan

As part of Halligan Project operations, Fort Collins will provide continuous releases of 3 cfs from its water stored in the enlarged Halligan Reservoir to the North Fork from October 1 through April 30 each year. This Winter Release Plan will be a means for Fort Collins to meet wintertime return flow obligations while providing a concurrent benefit to the aquatic environment. Based on analyses during the permitting process (GEI, 2016, 2018; Miller, 2017; WEST, 2017a, 2017b; City of Fort Collins, 2017; Pioneer, 2016a, 2016b, 2017b), it is projected that the Winter Release Plan will provide the following benefits:

- Eliminate almost all¹⁵ zero-flow days on the North Fork (in combination with the Summer Low-flow Plan [Section 4.2.1.2]).
- Result in beneficial effects on the North Fork for small-bodied native fish, in the form of a continuous, more longitudinally connected aquatic corridor compared to the existing zero-flow conditions.
- Create additional wetted channel area that will benefit small-bodied native fish, trout, and macroinvertebrates (these benefits vary along the North Fork, with benefits expected to be greatest in the Phantom Canyon below the North Poudre Canal Diversion structure).
- Re-establish basic habitat requirements for aquatic species through the reintroduction of perennial flow.

The Winter Release Plan includes reconstructing the North Poudre Canal Diversion similar to its current configuration, but to allow the bypass of Fort Collins' releases from the enlarged Halligan Reservoir so that the water remains in the North Fork. Currently, the North Poudre Canal Diversion does not allow for such flow bypasses.

The Winter Release Plan will also result in benefits that will offset the impact resulting from the inundation of approximately 0.75 mile of the CWCB's instream flow water right (Water Court Case 1985CW430) on the North Fork above Halligan Reservoir (as discussed further in this section).

Figure 4-1 shows a zero-flow condition that is common in Phantom Canyon below the North Poudre Canal Diversion under current operations of the existing reservoir. This flow condition will be significantly improved by implementing the Winter Release Plan.



Figure 4-1. North Fork, Zero-Flow in Phantom Canyon, May 2002

Source: Miller 2017

¹⁵ See potential exceptions at end of this section "Curtailement of the Winter Release Plan."

Operation of the Winter Release Plan

Fort Collins will release a minimum of 3 cfs from its share of water stored in the enlarged Halligan Reservoir from October 1 through April 30 every year (winter releases). Instrumentation will be installed at the dam and at or near the reconstructed North Poudre Canal Diversion to monitor the winter releases bypass of the North Poudre Canal Diversion. The Winter Release Plan will not prevent Fort Collins from releasing more than 3 cfs during this time period as may be needed to meet demands or for other operational, mitigation, or enhancement needs. However, such additional releases are not planned. Additional releases will be subject to ramping rates as discussed in Section 4.2.1.2.

The winter releases will be delivered down the North Fork to its confluence with the Main Stem and either “exchanged up” to the Fort Collins Intake(s) on the Main Stem or delivered downstream for other purposes. If the winter releases are exchanged, Fort Collins will divert a like amount of water at one of the Fort Collins’ Intakes. The amount of water diverted at Fort Collins’ Intake(s) will be the amount released from the enlarged Halligan Reservoir reduced by the administrative transit loss assessed by DWR. In certain rare conditions when inadequate flows exist in the Main Stem for Fort Collins to perform an exchange to its intake(s), Fort Collins may find an entity willing to accept the winter releases in exchange for transferring other water to Fort Collins. These trades will require an agreement between Fort Collins and the other entity, and such an agreement will be reached in the future.

Greeley may potentially divert and store the winter releases in Seaman Reservoir using its own exchange water rights. In these situations, Greeley would divert and store the winter releases and deliver a like amount of water to the Main Stem at some point above the downstream calling water right.

CPW has expressed concerns about anchor ice forming in the Exchange Reach between Fort Collins’ intakes and the confluence of the North Fork and Main Stem. Fort Collins operational staff has not experienced or heard of past instances of anchor ice forming in the lower part of the Poudre River canyon, because most icing issues occur in the upper reaches of the river. If the formation of anchor ice occurs in the Exchange Reach in the future during times when Halligan exchanges are made, Fort Collins agrees to consult with CPW to consider ways to avoid the issue such as, but not limited to, temporary curtailment of making those exchanges.

Protection of the Winter Releases

NPIC cannot divert the winter releases into the North Poudre Canal pursuant to an existing agreement with Fort Collins. Additionally, Fort Collins will attempt to protect the winter releases from Halligan Dam to Seaman Reservoir using the “Protected Mitigation Release” statute (CRS Section 37-92-102[8]). To acquire protection for these releases under this protection mechanism, Fort Collins will need to both reach an agreement with the CWCB and acquire a decree from the Water Court. Fort Collins will undertake a good faith effort to protect the winter releases under the Protected Mitigation Release statute; however, success is not guaranteed because it will depend on factors outside of Fort Collins’ control.

Per the statute, the protected mitigation releases will need “to reasonably avoid, minimize, or mitigate the impacts of the new reservoir capacity on fish and wildlife resources within the qualifying stream reach in accordance with a fish and wildlife mitigation plan.” Fort Collins will need to redivert and use the protected mitigation releases after they flow through the protected “qualifying stream reach.”

Because the protection of the winter releases (and release from the Summer Low-flow Plan as discussed below in Section 4.2.1.2) under the Protected Mitigation Release statute relies on other entities’ and the Water Court’s discretion beyond Fort Collins’ control, Fort Collins cannot guarantee a particular result. If Fort Collins does not successfully acquire a Water Court decree to protect the winter and summer

releases, the releases will not be protected from diversion under approved augmentation plans, substitutions, and exchanges, similar to Greeley’s potential diversion of the winter releases into the Seaman Reservoir as previously discussed. However, such diversions of the winter and summer releases will be unlikely for several reasons, including (1) they cannot be diverted into the North Poudre Canal pursuant to Fort Collins’ agreement with NPIC, (2) there are no other substantial diversion locations on the North Fork above Seaman Reservoir, (3) the entire area is very remote and difficult to access to divert water and to convey water that has been diverted, (4) there are numerous conservation easements in the area that make development difficult, and (5) there are few sources of augmentation and replacement water on the Main Stem and North Fork above the Phantom Canyon mouth. If Fort Collins fails to acquire a Water Court decree to protect Halligan Releases under the Protected Mitigation Release statute, or its agreement with NPIC changes such that Halligan Releases can be diverted into the North Poudre Canal, Fort Collins will consult with CPW in good faith to evaluate how Halligan Releases can be protected.

Curtailment of the Winter Release Plan

The Winter Release Plan will occur in almost all conditions. However, the Winter Release Plan will not be operated during emergency situations, maintenance occurrences, or when severe water restrictions are in place for Fort Collins’ water customers, as described further in Section 4.2.1.5.

4.2.1.2 Summer Low-flow Plan

As part of Halligan Project operations and to minimize impacts, Fort Collins will implement the Summer Low-flow Plan, which adjusts reservoir operations by forgoing diversions and/or releasing its water stored in the enlarged Halligan Reservoir to maintain a minimum continuous 5 cfs flow in the approximately 22 miles of the North Fork between the replacement Halligan Dam and Seaman Reservoir (as measured at three gaging stations along the North Fork, as described below) from May 1 to September 30 each year (summer releases). The minimum target of 5 cfs for the Summer Low-flow Plan was identified by Fort Collins as the amount of flow that could be maintained in the North Fork below the enlarged Halligan Reservoir without increasing the size of the reservoir. Based on analyses during the permitting process (GEI, 2016, 2018; Miller, 2017; WEST, 2017a, 2017b; City of Fort Collins, 2017; Pioneer, 2016a, 2016b, 2017b), it is projected that the Summer Low-flow Plan will produce the following results:

- Eliminate almost all¹⁶ zero-flow days on the North Fork (in combination with the Winter Release Plan, Section 4.2.1.1) which avoids and minimizes potential impacts on the aquatic ecosystem including stream temperature from the Halligan Project.
- Anticipation of stream temperature benefits for the North Fork, at times, are based on recognition that the Summer Low-flow Plan would increase flow rates on the North Fork in summer months at the times of the lowest current flow rates. A more thorough understanding of anticipated temperature effects of the Halligan Project on the North Fork will be developed through temperature modeling planned for the CWA Section 401 water quality certification application.
- Result in beneficial effects to the North Fork for small-bodied native fish in the form of a more longitudinally connected aquatic corridor compared to existing zero-flow conditions.

¹⁶ See potential exceptions at end of this section 4.2.1.1 Winter Release Plan “Curtailment of the Winter Release Plan” and section 4.2.1.2 Summer Low-flow Plan “Curtailment of the Summer Low-flow Plan”.

- Create additional wetted channel area that will benefit small-bodied fish, trout, and macroinvertebrates (these benefits vary along the North Fork per Table 3-3).
- Re-establish basic habitat requirements for aquatic species through the reintroduction of perennial flow.

The Summer Low-flow Plan involves bypassing the North Poudre Canal Diversion through a reconstructed North Poudre Canal Diversion so that the water remains in the North Fork. Currently, the North Poudre Canal Diversion does not allow for such flow bypasses.

The Summer Low-flow Plan will also result in benefits that will offset the impact resulting from the inundation of approximately 0.75 mile of the CWCB's instream flow water right (Water Court Case 1985CW430) on the North Fork above Halligan Reservoir (as discussed further in Section 3.3.2.3).

Figure 4-2 shows a zero-flow condition that is common near the mouth of Phantom Canyon during certain times of the year, which will be improved through the Winter Release Plan and Summer Low-flow Plan.



Figure 4-2. North Fork, Zero-Flow Conditions below Calloway Diversion, August 2018

Source: CPW

Operation of the Summer Low-flow Plan

Fort Collins will forgo diversions into and/or release water from its share of storage in the enlarged Halligan Reservoir to maintain a minimum continuous flow of 5 cfs in the North Fork between the replacement Halligan Dam and Seaman Reservoir from May 1 through September 30 every year. Fort Collins will install new instrumentation and continue to monitor flows at specific locations on the North Fork between the replacement Halligan Dam and Seaman Reservoir. Flow will be measured at the following three specific locations:

- The existing gage or new instrumentation at or below the replacement Halligan Dam
- A new gage in and/or slightly downstream of the bypass structure the bypass channel to be constructed on the North Poudre Canal Diversion
- The existing gage where West County Road 74E crosses the North Fork near Livermore

If the flows at any of the three gages drop below 5 cfs from May 1 through September 30, Fort Collins will modify flow operations to forgo diversions into and/or make releases from its portion of the enlarged Halligan Reservoir to increase the flow to at least 5 cfs at each of the three gages. The amount of time required for these minor adjustments will depend on the system installed. The intention during design will be to react within at least an hour or so, but if possible, sooner. Fort Collins understands that

maintaining 5 cfs at the gages may require releases greater than 5 cfs to compensate for potential losses in the North Fork.

Exchange of the Summer Releases – May through June

Similar to the winter releases, from May 1 to June 30, the Summer Low-flow Plan releases will be delivered down the North Fork to the confluence with the Main Stem and either “exchanged up” to Fort Collins’ Intake(s) on the Main Stem or delivered downstream for other purposes. If the summer releases are exchanged, when the releases reach the confluence of the Main Stem and the North Fork, Fort Collins will divert a like amount of water at one of the Fort Collins’ Intakes. The amount of water diverted at the Fort Collins’ Intake(s) will be the amount released from the enlarged Halligan Reservoir reduced by the administrative transit loss assessed by DWR. In certain rare conditions when inadequate flows exist in the Main Stem for Fort Collins to perform an exchange to its intake(s), Fort Collins may find an entity willing to accept the summer releases in exchange for transferring other water to Fort Collins. These trades will require an agreement between Fort Collins and the other entity, and such an agreement will be reached in the future.

Greeley may potentially divert and store the summer releases in Seaman Reservoir using its own exchange water rights. In these situations, Greeley would divert and store the summer releases and deliver a like amount of water to the Main Stem at some point above the downstream calling water right. Diversion and storage of Halligan summer releases by Greeley in Seaman Reservoir at times would occasionally interrupt the temperature benefits of the Summer Low-flow Plan in the approximately 1 river mile reach of the North Fork below Seaman Reservoir. To maximize the extent of this benefit for the North Fork, an operational agreement is being pursued with Greeley (discussed further in Section 4.2.1.3).

Modified Summer Release Exchange Plan – July through September

Fort Collins will not exchange Summer Low-flow Plan releases (up to 5 cfs) from Halligan Reservoir up to either of the Fort Collins Intakes. This hiatus on exchanges will occur each year from July 1 to September 30. This action will leave more water in the Main Stem upstream of the North Fork confluence and downstream to below the Hansen Supply Canal during times of the most critical temperature concern (July to September), minimizing Halligan Project temperature impacts in this critical season.

Protection of the Summer Releases

NPIC cannot divert the summer flows into the North Poudre Canal pursuant to an existing agreement with Fort Collins. Additionally, Fort Collins will undertake a good faith effort to protect the summer releases from Halligan Reservoir to Seaman Reservoir using the Protected Mitigation Release statute (per CRS Section 37-92-102[8]) in the same manner and subject to the same limitations as described for the winter releases (Section 4.2.1.1).

Curtailement of the Summer Low-flow Plan

The Summer Low-flow Plan will not be operated during emergency situations, maintenance occurrences, and when water restrictions are in place for Fort Collins’ water customers, as described further in Section 4.2.1.5.

4.2.1.3 Operational Agreement with Greeley/Seaman Reservoir Outlet Works Reconstruction

If the diversion and storage of Halligan Project summer releases by Greeley in Seaman Reservoir could be avoided, the river temperature benefits of the Summer Low-flow Plan could be extended to the approximately 1 river mile reach of the North Fork below Seaman Reservoir. To maximize the extent of this benefit on the North Fork, Fort Collins is pursuing an operational agreement with Greeley. The agreement would specify the need for Greeley to pass Halligan Releases, including the Winter Release and Summer Low-flow Plan of 3 cfs and up to 5 cfs directly through Seaman Reservoir. For this to be possible, upgraded outlet works may be needed in Seaman Reservoir. Greeley is currently in the process of upgrading their outlet works with support from federal funding. As part of the potential agreement, Fort Collins may provide additional funding support for further refinement of the new outlet works design for Seaman Reservoir. The goal of this additional funding would be to give the new outlet works the functionality and operational control to pass even the small Summer Low-flow Plan releases through Seaman Reservoir (that is, the refined new outlet works should allow for fine-scale management of releases on the order of 1 to 5 cfs).

In the event that Fort Collins cannot reach an agreement with Greeley to pass Fort Collins' Halligan Winter and Summer Low-flow Plan releases of 3 cfs and up to 5 cfs below Seaman Reservoir, and the CWA Section 401 water quality certification process determines that the Halligan Project has potential for occasional adverse temperature impacts on the North Fork below Seaman Reservoir that requires mitigation, Fort Collins commits to mitigating the identified temperature impacts attributable to the Halligan Project through stream restoration or other measures in a manner agreed to by Fort Collins, CDPHE, and CPW. If reasonably practicable, Fort Collins will mitigate the identified impacts along the river reach from Seaman Reservoir to the confluence with the Main Stem commensurate with Fort Collins identified impacts. If not reasonably practicable in the reach below Seaman Reservoir, Fort Collins will work with CDPHE and CPW to find other mitigation commensurate with the Halligan Projects identified impacts.

4.2.1.4 Ramping Rate Limitations

By applying ramping rate limitations, Fort Collins will seek to constrain existing and potential dramatic decreases and increases in the rate of discharge from Fort Collins' portion of the enlarged Halligan Reservoir to avoid and minimize impacts on aquatic species, particularly small-bodied native fish and rainbow trout. Such dramatic decreases and increases in the discharge of water below Halligan Dam resulting from Fort Collins' operation of its portion of the enlarged Halligan Reservoir could occur because of (1) the rate at which Fort Collins diverts water into the enlarged reservoir (thus affecting the amount of water flowing past the dam), and (2) the rate at which Fort Collins releases water from its portion of an enlarged Halligan Reservoir that Fort Collins previously stored. Fort Collins will seek to implement the ramping rate limitations by managing both such aspects of its operations.

The ramping rate limitations described in this section are intended to protect aquatic life, as well as people recreating (for example, fishing) downstream. Tempering sudden flow changes is consistent with The Nature Conservancy's (TNC's) environmental flow recommendations for the North Fork (TNC 2008). The ramping rate limitations will also help maintain a more natural descending limb of the North Fork hydrograph following peak flows by incorporating a more gradual decrease in outflow and establishing a lag time before returning the stream to a base flow level. The ramping rate limitations are based on an evaluation of operations at the existing Halligan Dam and, in part, on the statistical analysis of natural

ramping rates that are anticipated on the North Fork. The following ramping rate limitations (summarized) were developed in consideration of the following factors:

- 1) Needs of Fort Collins’ customers and additional legal obligations of Fort Collins
- 2) Operational compatibility
- 3) Mimicking natural hydrologic conditions to the extent feasible
- 4) Protecting small-bodied native fish and rainbow trout

Operation of the Ramping Rate Limitations

Fort Collins will limit dramatic decreases and increases in the discharge rate resulting from Fort Collins’ operation of its portion of the enlarged Halligan Reservoir as described in this section.

Ramping Rate Limitations to Decreasing Discharge Rates—The limitations on decreasing discharge rates resulting from Fort Collins’ operation of its portion of the enlarged Halligan Reservoir are intended to be protective of small-bodied native fish and rainbow trout that are susceptible to being stranded in discrete areas within the North Fork with sudden decreases in flow. According to the Ramping Rate Limitations for decreasing discharge rates resulting from Fort Collins’ operation of its portion of the enlarged Halligan Reservoir, the maximum allowable decrease in discharge rate is dependent on the starting discharge rate, which will be measured at the outlet works of the replacement Halligan Dam and/or the immediate downstream gage. The maximum allowable decrease to the discharge rate resulting from Fort Collins’ operation of its portion of the enlarged Halligan Reservoir, according to the Ramping Rate Limitations, is summarized in Table 4-1.

Table 4-1. Ramping Rate Limitations for Decreasing Releases from Fort Collins’ Portion of an Enlarged Halligan Reservoir^[a]

Starting Discharge Rate ^[b]	Maximum Down-ramp (Decrease) per Hour
Greater than 200 cfs	10% of starting discharge rate
Between 100 and 200 cfs	10% of starting discharge rate (maximum of 20 cfs)
Less than 100 cfs	10% of starting discharge rate (maximum of 10 cfs)

^[a] The replacement Halligan Dam will include an outlet works with a maximum capacity of 800 cfs; therefore, the maximum release flow is 800 cfs if the reservoir is not full.

^[b] The “starting discharge rate” is the discharge rate from the outlet works before any decrease in flow.

The following are example descriptions of how the ramping rate limitations will be implemented for decreasing discharge rates resulting from Fort Collins’ operation of its portion of the enlarged Halligan Reservoir:

- **Example 1: Decreasing discharge rate from 800 cfs to 50 cfs (for example, after the Peak Flow Bypass Program)**—The discharges from the enlarged Halligan Reservoir will decrease or be “ramped down” at a rate of 10 percent of 800 cfs per hour (cfs/hour) (80 cfs/hour), until a discharge rate of approximately 200 cfs is reached. This will be accomplished by managing how Fort Collins diverts water into storage in the enlarged Halligan Reservoir. At that point, a “reset” will occur and discharges from the reservoir will continue to decrease or “ramp down” at a maximum rate of 10 percent of 200 cfs (20 cfs/hour). As the discharges continue to decrease, another reset will occur at 100 cfs, and the discharge rate will decrease or be ramped down at a maximum of 10 percent of 100 cfs (10 cfs/hour) until the final discharge rate is reached (50 cfs). The total duration of this ramping event will be approximately 18 hours.

- **Example 2: Decreasing discharge rate from 90 cfs to 5 cfs**—The releases from Halligan Reservoir will decrease or be ramped down at a rate of 10 percent of 90 cfs per hour (9 cfs/hour) until the final discharge rate is reached. Again, this will be accomplished by managing how Fort Collins diverts water into storage in the enlarged Halligan Reservoir and how Fort Collins is making releases of water it previously stored in its portion of an enlarged Halligan Reservoir. The total duration of this ramping event will be approximately 10 hours.

Ramping Rate Limitations to Increasing Discharge Rates—The limitations to increasing discharge rates is intended to protect fish that could be swept downstream and to lower the risk to people recreating on the North Fork who could be exposed to rapid water level rises without the limitation in place.

According to the ramping rate limitations for increasing discharge rates, Fort Collins will limit changes to the rate at which reservoir discharges increase resulting from Fort Collins' operation of its portion of the enlarged Halligan Reservoir. Increasing discharge rates from the reservoir will be evenly distributed over a 4-hour period to more closely match hydrographic data above Halligan Reservoir and other unmanaged systems with similar precipitation and runoff regimes.

The following is an example description of how the ramping rate limitations will be implemented for increasing discharge rates resulting from Fort Collins' operation of its portion of the enlarged Halligan Reservoir:

- **Example: Increasing discharge rate from 5 cfs to 100 cfs**—The discharges from Halligan Reservoir will be increased or ramped up at a rate that is evenly distributed over a 4-hour period. In this case, the releases from the reservoir will be increased at 24 cfs/hour.

Exclusions to the Ramping Rate Limitations

The ramping rate limitations will not apply to water that is naturally spilling over the spillway of Halligan Dam because Fort Collins cannot control this amount of flow. Likewise, the ramping rate limitations will not apply to NPIC's diversion, storage, and releases of water in its portion of the enlarged Halligan Reservoir. NPIC can, and likely will, continue to operate its portion of the enlarged Halligan Reservoir as it does currently. Nevertheless, after construction of the Halligan Project, Fort Collins will attempt to reach an operational agreement with NPIC to operate all diversions to and releases from the enlarged Halligan Reservoir (both Fort Collins and NPIC's) to meet the ramping rate limitations (Section 5.1.1.5). The NPIC has indicated a preference to wait until after the enlarged Halligan Reservoir has been operational for a few years before considering such an agreement.

Occasionally, Fort Collins may be required by others or by maintenance exercises to deviate from the ramping rate limitations. Two such example scenarios when the ramping rate limitations might not be implemented are described as follows:

- DWR currently allows some flexibility in water rights administration that would allow ramping rates to occur at times when Fort Collins does not have the right to store water. However, if DWR guidance changes in the future, Fort Collins could be directed to cease diverting water into its portion of the enlarged Halligan Reservoir for water rights administration or other reasons. For example, if Fort Collins is diverting water into storage and the call on the river changes such that Fort Collins' water rights are no longer a priority, Fort Collins may be required to cease diverting immediately. Nevertheless, to the extent legal and practicable, if Fort Collins believes that the call on the river will change, and diversions into Halligan Reservoir will be curtailed, Fort Collins will attempt to ramp down diversions as described in this plan.
- Consistent with best practices, Fort Collins annually exercises the outlet valves to ensure full range of operation. These activities will likely occur annually during the spring runoff when water is spilling

over the spillway. In these instances, the valves will be fully opened for several minutes and then reduced back to the operational level.

Curtailement of the Ramping Rate Limitations

The ramping rate limitations apply only to discharges affected by Fort Collins' operation of its portion of the enlarged Halligan Reservoir and not to changes in the discharge rate from other factors. The ramping rate limitations will not be operated during emergency situations, maintenance occurrences, and when water restrictions are in place for Fort Collins' water customers, as described further in Section 4.2.1.7. As discussed above in "Exclusions to the Ramping Rate Limitations," the ramping rate limitations may also be curtailed as required by the Division of Water Resources in its administration of water rights and regulation of Halligan Dam safety. To the extent legal and practicable Fort Collins will attempt to ramp down diversions as described in this plan.

4.2.1.5 Peak Flow Bypass Program

Fort Collins will forgo all diversions into its portion of the enlarged Halligan Reservoir for 3 days coinciding as closely as practicable with the annual forecasted peak (runoff) flow event for the North Fork. The ramping rate limitations (Section 4.2.1.4) will be implemented on both sides of this 3-day Peak Flow Bypass Program, extending the bypass beyond 3 days.

The Peak Flow Bypass Program will avoid and minimize impacts on the aquatic ecosystem from the Halligan Project by maintaining some of the historical, pre-enlargement peak flows past the enlarged Halligan Reservoir. The Peak Flow Bypass Program will allow 3 days (in addition to ramping) of peak flows during times when Fort Collins could be diverting water into storage in the enlarged Halligan Reservoir. This Peak Flow Bypass Program is intended to mimic a natural, pre-enlargement stream flow for this 3-day period to support riverine and ecological processes in the North Fork, such as the following:

- Providing phenological cues to aquatic and riparian organisms for emergence of aquatic insects, spawning, the timing of flowering, and seed dispersal
- Facilitating natural seasonal sediment transport, channel shaping, and channel scour
- Recruiting and transporting woody debris and other organic materials
- Providing overbank flooding to maintain wetland and riparian habitat function, including seed transport and propagation of native cottonwood and willow species, sediment transport, formation and maintenance of aquatic habitat, and riparian area diversity and structure

Operation of the Peak Flow Bypass Program

Fort Collins will monitor the stream gage installed above the enlarged Halligan Reservoir (United States Geological Survey gage 06751145 on the North Fork), along with snowpack levels and weather conditions, to estimate when a peak flow of runoff above the enlarged Halligan Reservoir will occur. When the forecast peak flow has been estimated to within a few days, Fort Collins will forgo diverting water into storage into its portion of the enlarged Halligan Reservoir for 3 consecutive days. The ramping rate limitations described in Section 4.2.1 will be implemented on both the increasing and decreasing of flows for the 3-day bypass. The replacement Halligan Dam will include an outlet works with a maximum capacity of 800 cfs, which will allow operational passing of the full magnitude of the incoming peak flow via the outlet works, spillway, or a combination of each, in most years.

Operation of the Peak Flow Bypass Program will be limited to the snowpack-driven annual peak, which typically occurs during runoff between mid-May to early June (Natural Resources Conservation Service [NRCS] n.d.). Fort Collins will notify CPW in advance of the estimated peak flow bypass each year.

If the annual peak flow above Halligan Reservoir occurs when NPIC is filling its portion of the enlarged Halligan Reservoir, Fort Collins will wait to operate the Peak Flow Bypass Program until directly after NPIC fills its portion (that is, Fort Collins will bypass flows for 3 days, plus the ramping rate limitations on both increasing and decreasing bypass flows, before starting to fill its portion of the enlarged Halligan Reservoir). Conditions may be such that Fort Collins will be able to divert water to storage in its portion of the enlarged Halligan Reservoir before the peak flow occurs. In this scenario, Fort Collins will temporarily cease filling its portion of the enlarged reservoir during the estimated 3-day peak flow bypass period.

Circumstances may exist when, in consultation with CPW, Fort Collins will deviate slightly from the Peak Flow Bypass Program described herein, provided that any such modifications will not affect Fort Collins' storage and yield from the enlarged Halligan Reservoir and are consistent with all applicable permits and approvals, agreements, and decrees. These potential deviations could include changes to the timing or quantity of flow to manage sediment buildup in Halligan Reservoir following a wildfire event; changes to the timing or quantity of flow in a wet year to minimize predicted excessive spilling over the Halligan Dam; other modifications of timing, duration, and quantity of flow needed for emergency response; periodic maintenance; or for the benefit of the aquatic environment as determined in coordination with CPW.

Limitations of the Peak Flow Bypass Program

Fort Collins will not have any dominion or control over the bypassed water because it will not have been previously diverted or stored by Fort Collins. Therefore, as occurred historically, the peak flows will be available for diversion by NPIC at the North Poudre Canal Diversion or by Greeley at Seaman Reservoir under their respective water rights. Fort Collins understands that NPIC currently has rights to divert up to approximately 350 cfs at the North Poudre Canal Diversion, although current infrastructure may limit diversions to less than approximately 200 cfs.¹⁷ Peak flows greater than the amount that NPIC can legally and physically divert at the North Poudre Canal Diversion will flow past the North Poudre Canal Diversion.

Because estimating peak flow can be difficult given unpredictable weather conditions beyond Fort Collins' control (for example, hot, dry, or windy conditions that quickly evaporate snowpack; cool or wet conditions that create gradual runoff with no distinct peak; or unpredictable rain on snow events), the actual peak flow above the enlarged Halligan Reservoir might not be the same as the predicted peak flow used for this program. If in a particular year the peak flow is difficult to estimate given unpredictable or changing weather conditions, and is accidentally missed, the incoming flows will be passed through the enlarged Halligan Reservoir as soon as this condition is identified. If the peak flow bypass is operated prematurely, Fort Collins will not operate the Peak Flow Bypass Program again that year. To minimize these circumstances, Fort Collins will monitor its Peak Flow Bypass Program actions each year to evaluate how closely the estimated and bypassed peak coincides with the actual peak that occurred in a given year. This annual review will provide information to optimize the Peak Flow Bypass Program operations over time. If for some reason Fort Collins does not accurately anticipate the peak

¹⁷ Design criteria for reconstruction of the North Poudre Canal Diversion as part of the Halligan Project are expected to support diversions of 350 cfs.

flow, Fort Collins will consult with CPW or other parties on methods to improve its forecasting of peak flows on the North Fork, which will be paid for by Fort Collins.

Curtailement of the Peak Flow Bypass Program

The Peak Flow Bypass Program will not be operated during emergency situations, maintenance occurrences, and when water restrictions are in place for Fort Collins' water customers, as described further in Section 4.2.1.5.

4.2.1.6 End of Summer Flushing Event

An end of summer flushing event (flushing event) will be conducted following fall turnover of Halligan Reservoir each year that a turnover event occurs (turnover is anticipated to occur in all years of normal Halligan Project operations) to address potential iron coatings on river materials. The flushing event would be a release of a maximum of 30 acre-feet of water from Fort Collins' water in the Halligan Reservoir Enlargement to the North Fork over a short time duration. In years when releases occur for other reasons (for example, NPIC releases) that yield similar flow rates/durations following turnover, these flushing event releases by Fort Collins would not be needed and would not occur. Like other flow-related operational measures (Section 4.2.1), the flushing event will not be operated during emergency situations, maintenance occurrences, and when water restrictions are in place for Fort Collins' water customers as discussed in Section 4.2.1.5.

The intention of the flushing event would be to flush seasonal iron deposition (if it occurs) from sediment surfaces below the dam to minimize the potential adverse effects of such deposition, which is most likely to occur in late summer, if it were to occur. The goal is to release a maximum of 30 acre-feet of water at the lowest discharge rate from the outlet of the enlarged Halligan Reservoir that is practicable to successfully mobilize the iron deposits. Targeting lower effective flow rates is desirable to avoid unintended adverse consequences on small-bodied fish and inadvertent sediment release. For example, a possible release schedule would be to release about 80 cfs for 4 hours.

To avoid unintended adverse effects on small-bodied native fish and sediment, Fort Collins will seek CPW input regarding the planned rate, ramping, and timing of the release each year. Fort Collins would also monitor iron and habitat conditions immediately below the enlarged reservoir for 5 years to determine if this flushing event is effective and/or necessary. This monitoring will consist of visual checks for iron deposition on sediment in the vicinity of the NBH sampling station (and photographic records of any observed deposition) as well as continued sampling at NBH for dissolved and total iron. However, if it is determined at the end of the first 5 years following construction (in consultation with CPW) that this operation is no longer needed, then the releases and special monitoring (observations of iron deposition) will end.

4.2.1.7 Water Supply Shortage Events and Curtailement of Measures

To balance the protection of fish and wildlife that benefit from the flow-related operational measures described in Chapter 4, with the health and safety of the customers who rely on Fort Collins to provide high-quality, reliable drinking water, the flow-related operational measures described Sections 4.2.1 and 5.1.1.1 can be curtailed during certain instances that threaten Fort Collins' ability to provide that water. Curtailement can occur during emergency situations, maintenance occurrences, and when water restrictions are in place for Fort Collins' water customers, as described below. When appropriate in limited instances like planned maintenance, Fort Collins will notify CPW of curtailement events to consider potential timing to limit impacts on aquatic resources.

Emergency Situations

Curtailment of the flow-related operational measures described in Chapter 4 can occur, at Fort Collins' discretion, during emergency situations, such as flooding, wildfires, infrastructure failures or other limitations, or other instances that threaten the ability of Fort Collins to deliver high-quality drinking water safely to its customers. The frequency of anticipated curtailment for emergency situations is difficult to define because these situations are outside of Fort Collins' control. However, over the past 20 years, temporary curtailment due to an emergency likely would have occurred only for approximately 2 months coinciding with the 2012 High Park Fire. In contrast, certain emergency situations likely will not require curtailment of the flow-related operational measures described above. For example, the 2020–2021 Cameron Peak Fire and associated water use restrictions likely would not have required curtailment of Fort Collins' operations of its portion of the enlarged Halligan Reservoir because of the time of year that it occurred. Curtailment of the measures due to emergencies is anticipated to be infrequent and short in duration.

Maintenance Occurrences

Curtailment of the flow-related operational measures described in Chapter 4 can occur, at Fort Collins's discretion, during maintenance events such as inspections, repairs, or planned maintenance of the Halligan Dam infrastructure and related appurtenances. The number and extent of these occurrences will generally be minimized by advanced planning, including consultation with CPW to limit impacts on wildlife if any operational or mitigation commitments need to be modified. Maintenance activities will inherently be short in duration because they will likely disrupt Fort Collins' and NPIC's ability to deliver water to their customers and shareholders. Therefore, curtailment that occurs because of maintenance activities is also anticipated to be infrequent and short in duration. In addition, for non-emergency maintenance activities, the ramping rates limitations (Section 4.2.1.4) will be implemented.

Watering Restrictions

Curtailment of the flow-related operational measures could occur, at Fort Collins' discretion, during periods when a water shortage is projected and Fort Collins' water customers are required to restrict their landscape watering through mandatory water restrictions to 2 days a week or fewer. This would balance the benefits provided to the aquatic environment from the flow-related operational measures, with the ability to reliably provide water to Fort Collins' customers.

Such curtailment corresponding with customers limiting landscape watering to 2 days per week or fewer is consistent with the Level 1 action level described in the *Water Shortage Action Plan* (City of Fort Collins 2020b). Although changes to future Fort Collins policy may influence changes to future mandatory water restriction levels, curtailment of the flow-related operational measures described previously will be independent of those future planning criteria and will instead be tied to the restrictions currently associated with a Level 1 action level in the 2020 plan (City of Fort Collins 2020b). For example, if future planning incorporates a new description of a Level 1 water restriction that is 3 days per week, curtailment of the flow-related operational measures will occur only when water restrictions limit watering to 2 days per week or fewer.

The frequency of such curtailment is expected to depend primarily on the occurrence of drought in the region. Common technical platform (CDM and DiNatale 2013) modeling indicates that mandatory restrictions will be required infrequently (mandatory restrictions occurred twice in an 86-year modeling period). Fort Collins' actual adoption of mandatory restrictions also occurs infrequently; recent information indicates that mandatory restrictions have been required about once every 7 to 10 years (three times in the last 20 years) and ranged in duration from 2 to 18 months. The voluntary watch level

of restrictions implemented by Fort Collins in summer 2021 to address uncertainty about the availability and quality of Poudre River source water following the 2020 Cameron Peak Fire, likely would not have resulted in a curtailment of the flow-related operational measures.

4.2.1.8 Combined Environmental Effects of Flow-related Operational Measures

Overall, the Halligan Project and proposed ramping rate strategy discussed in this FWMEP include operational flow measures and peak flow bypass that will minimize negative effects of current Halligan Reservoir operations, including dry-up conditions and current significant temperature fluctuations below Halligan Reservoir dam (thermal shock). The operational flow measures will allow both perennial flows and peak flows. The peak flows are needed to help maintain a more natural stream morphology and overbank connectivity. These measures have been designed to collectively improve connectivity and function to portions of the North Fork below the enlarged Halligan Reservoir that currently have little to no flow during certain times of the year. The measures will provide perennial flows, minimize abrupt changes in flows resulting from operations of the enlarged Halligan Reservoir, and maintain flows that help support critical stream functions. Numerous analyses have been conducted to evaluate the potential effects of the Halligan Project on the North Fork and its associated aquatic and biological communities, including but not limited to analysis of flows and aquatic habitat availability under various flow scenarios (GEI 2016, 2018; Miller 2017; WEST 2017a, 2017b; City of Fort Collins 2017; Pioneer 2016a, 2016b, 2017b). The analyses show that implementing the minimization measures is anticipated to have an overall (net) benefit to North Fork aquatic resources, including increased ecological function of the stream system and associated riparian zone of the North Fork. The minimization measures include the following:

- **Combination of the Winter Release Plan and the Summer Low-flow Plan** - Eliminate nearly all zero-flow days on the North Fork between the enlarged the Halligan Reservoir and Seaman Reservoir and restore continuous flow to approximately 5.8 to 12.1¹⁸ acres of riffle and pool complex area (Corps 2019). The combined Winter Release Plan and Summer Low-flow Plan will improve the transport of nutrients, organic material, and native seed through the stream system while also providing a net increase of at least 2.3 acres of riffle and pool habitat (the difference between the minimum 5.8-acre gain and 3.5-acre loss because of inundation), in the stretch of the North Fork between the enlarged Halligan Reservoir and Seaman Reservoir. The Summer Low-flow Plan will also provide a stream temperature benefit on the North Fork during the lowest summer flow rates, which often correspond to the times of current stream temperature standard exceedances (especially July through September). Further, the Modified Summer Release Plan will extend some of the avoidance benefits of the Summer Low-flow Plan to Segment 10a of the Main Stem.
- **Ramping Rate Limitations** - Limit abrupt changes to discharges resulting from Fort Collins' operation of its portion of the enlarged Halligan Reservoir to minimize the potential for stranding or flushing of small-bodied native fish and rainbow trout and to more closely mimic natural changes to the hydrography.
- **Peak Flow Bypass Program** - Allow for a period of high flows to pass the enlarged Halligan Reservoir to provide important functions for the maintenance of aquatic and riparian habitats, including those discussed in Section 4.2.1.5.

In whole, the flow-related operational measures described in this section (in addition to other measures described in Sections 4 and 5 of this FWMEP), could minimize impacts from the Halligan Project to

¹⁸ Varying calculations have been used to determine the area of restored riffle pool complexes downstream of the North Poudre Canal Diversion (Reach NF4, also known as Segment 2a). The larger area considers the entire length of NF4, and the smaller area considers only the 1.9-mile segment of NF4 above the North Poudre Canal return flow (refer to Corps, 2019 for more information).

current conditions in the North Fork below Halligan Reservoir and may provide some beneficial and long-term improvements (“functional lift”) to the aquatic resources when compared to existing conditions. To quantify and assess the functional lift and long-term benefits of the Project at this time and into the future is difficult without an in-depth analysis of current and future conditions and a project monitoring plan.

4.2.2 Infrastructure Design Measures

Numerous aspects of the design of the replacement Halligan Dam and associated Project infrastructure provide opportunities to improve current operations for environmental benefit, avoid and minimize Project impacts, and allow mitigation measures such as the flow- and sediment-related operational measures described in this FWMEP. One key measure incorporated into the design of the outlet works is inclusion of a two-outlet system, a primary and an auxiliary outlet. A series of gates will be located at the intake on the upstream side of the replacement Halligan Dam and at the valve house located on the downstream side of the dam. This design ensures redundancy in operational function and will allow the gates to be closed from multiple locations in the event one gate becomes inoperable, particularly in an emergency. Gate redundancy also allows for maintenance work, structural inspections, or emergency work at the replacement Halligan Dam or outlet works to be conducted without drawing down the reservoir pool elevation. Although this design was not developed specifically as a Project mitigation measure, it is a key improvement over the existing dam that will avoid potential sediment releases associated with drawing down the reservoir for regular inspections and maintenance.

4.2.2.1 Multilevel Outlet Structure

A multilevel outlet works (MLOW) for Halligan Reservoir that would allow water to be released from one or more elevation higher than the bottom has been discussed since the CMP was put forth in the DEIS. An MLOW is a tool that can, in some cases, allow for beneficial additional management controls on the quality of water released from a reservoir, particularly at times of stratification. At this time, however, an MLOW is not expected to be necessary from the perspective of aquatic life mitigation efforts. Therefore, based on CPW comment, the MLOW is not a commitment in the FWMEP, but the need for an MLOW may be revisited through the CWA Section 401 water quality certification process.

During the 401 Certification process modeling and analysis findings will be reviewed to assess whether such a structure would provide effective and practical water-quality management options for mitigating anticipated Project water-quality impacts. Currently anticipated decision factors regarding “effective and practical water-quality management options” include consideration of reservoir stratification, concentration gradients, operations, and net benefit to aquatic resources. For example, model results will be evaluated to determine whether operational flexibility to release water from the epilimnion in summer months will provide adequate water quality benefit when weighed against any additional stress on aquatic life because of the release of warmer water from the top of the reservoir. CWA Section 401 water quality certification model findings will be shared, and CPW and CDPHE will be consulted on this decision, as part of the CWA Section 401 water quality certification process.

4.2.2.2 Outlet Conduit Sizing

To allow for the peak flow bypass mitigation measure (Section 4.2.1.5), Fort Collins incorporated an enlarged outlet conduit, which is larger than necessary to meet demand-based releases. The enlarged outlet will be constructed to release up to 800 cfs. Streamflow gage measurements and Project modeling indicate inflows into Halligan Reservoir rarely get above 800 cfs, with only 0.46 percent of days being higher and most of these days the enlarged reservoir will be full and spilling.

4.2.3 Construction-related Measures

Fort Collins will implement multiple measures to avoid and minimize impacts on fish and wildlife related to construction of the Halligan Project.

4.2.3.1 Big Game Interference Minimization

Fort Collins aims to avoid and minimize the Halligan Project’s potential impacts on wildlife within the Halligan Project Area when feasible. Figure 4-3 shows an elk herd foraging in the Livermore area. The Halligan Project includes many construction-related measures designed to avoid and minimize impacts on big game, including the following measures that are described elsewhere in this report:



Figure 4-3. Foraging Elk Herd

Source: CPW

- Construction scheduling to ensure efficient Project delivery, to limit temporal impacts and number of seasons during which habitat is disturbed (Section 4.2.3.13)
- Construction carpooling (Section 4.2.3.11)
- Management of fugitive dust during construction (Section 4.2.3.7)
- Minimizing construction disturbance areas and the number and footprint of construction access roads (Sections 4.2.3.9, 4.2.3.10, and 4.2.3.14)
- Reclamation and revegetation of temporarily disturbed areas (Section 4.2.3.9)
- Implementation of a noxious and invasive weed management plan for construction and reclamation activities (Section 4.2.3.15)

Compensatory mitigation and enhancement measures specific to bighorn sheep are described in Sections 4.3.3 and 5.2.3.

4.2.3.2 Preconstruction Botanical Surveys

Previous botanical surveys have not located Ute ladies’-tresses orchid (Figure 4-4) in the area of Halligan Reservoir (WEST 2016b; Jacobs 2021). To further minimize the possibility of Project impacts on this federally threatened plant, botanical surveys will be conducted at a minimum of a year before construction. Surveys will focus on areas that will likely be disturbed by the Halligan Project and that could support the orchid, and be performed during the growing season (July and August). Results of preconstruction surveys will be submitted to USFWS as required by the ESA; CPW will be provided a courtesy copy of results. If Ute ladies’-tresses orchid is found during preconstruction surveys, Fort Collins will develop a plan to avoid the plants and the habitat or remove and relocate the plants before construction disturbance.



Figure 4-4. Ute Ladies’-tresses Orchid

Source: P. Hickey

4.2.3.3 Preconstruction Bat Surveys

Visual and auditory detection surveys for bats (Figure 4-5) were conducted in the area of Halligan Dam and up to 0.5 mile downstream of Halligan Dam in 2021 (Jacobs 2021). Several lone bats were detected during the surveys, but no large concentrations of bats were identified. The scattered occurrence of lone bat detections suggests that the area below Halligan Dam is used for foraging, but evidence of a bat colony or identification of roosting locations was not observed during this brief presence/absence survey. To minimize the possibility of Project impacts on bats, additional surveys are warranted, including a survey for roosting sites near the dam. This additional bat survey work will be conducted in the year before construction commences for the Halligan Project. Surveys will focus on areas that will likely be disturbed by Halligan Project construction activities. If surveys indicate the presence of an active bat roost near the Halligan Dam, Fort Collins will consult with CPW on appropriate mitigation measures.

4.2.3.4 Migratory Bird and Raptors Surveys

Nest surveys were conducted in the area of Halligan Dam and along access roads in 2021 (Jacobs 2021). Additional monitoring for migratory birds and raptors will be performed every other year before construction, the year before the start of construction, and annually during construction with a focus on areas of suitable habitat within planned or proposed disturbance areas in the immediate Halligan Project Area. Before and during construction activities, Fort Collins may use bird nesting deterrents during nesting season to reduce the risk of nesting activities during construction. Deterrent measures may include modifying or removing attractive nesting habitat (for example, trees, shrubs, tall grass) within potential disturbance areas during inactive periods to reduce the potential for construction-related impacts during active nesting periods. Before Project implementation, Fort Collins will provide CPW an opportunity to review and comment on Project specifications related to migratory bird and raptor nesting avoidance and minimization. If eagle or other raptor nests are identified, Fort Collins will consult with CPW and their buffer guidelines for nesting raptors to determine measures to minimize the potential adverse impacts of the construction activity. If avoidance and minimization techniques are unsuccessful and a taking is necessary, Fort Collins will follow any applicable permit and mitigation requirements at the time of the taking.

4.2.3.5 Raptor Nesting or Roosting Platforms

Fort Collins will include nesting or roosting platforms (Figure 4-6) near Halligan Reservoir to encourage eagles and other raptors, such as osprey, to use the reservoir. The platforms will also minimize any temporary loss of perching locations from the inundation of shoreline



Figure 4-5. Townsend's Big-Eared Bat

Source: CPW



Figure 4-6. Raptor Nesting Platform in Laporte, Colorado

Source: Colorado Department of Transportation

trees while new shoreline habitat becomes established. The final design and location of nesting or roosting platforms will be developed in coordination with CPW.

4.2.3.6 Stormwater Management Plan

Fort Collins will develop a stormwater management plan in compliance with local and state requirements and as required by the National Pollutant Discharge Elimination System, Construction General Permit, COR400000, before construction, which will include all necessary stormwater management controls and best practices, temporary sediment and erosion control during construction, and medium-term sediment and erosion control during vegetation re-establishment. Targeted planning and successful execution of the stormwater management plan will reduce the potential for water quality degradation of the North Fork and its associated aquatic ecosystem. Additionally, a non-stormwater discharge permit and monitoring plan will be prepared, if required, before the start of construction.

4.2.3.7 Best Management Practices

Fort Collins proposes to employ standard construction BMPs (also called control measures) typically included in federal, state, and local permit requirements to reduce potential construction-related impacts on upland and aquatic habitats, fish, and water quality. BMPs will be implemented at Project construction areas, including dam construction and staging/stockpile areas, along access roads, the North Poudre Canal Diversion structure, and mitigation or enhancement sites that involve Fort Collins-led construction. At a minimum, standard dust and erosion control measures, sediment control measures, aquatic nuisance species measures, and the application of non-stormwater-related control measures will be implemented.

The following sections list and briefly describe some of the BMPs that may be implemented during construction to control erosion and sedimentation. Additional measures may be incorporated if those described differ from permit conditions defined in the CWA Section 401 water quality certification and CWA Section 404 permit, or if site conditions warrant them.

Erosion Control Measures

Erosion control or soil stabilization includes measures that are designed to prevent soil particles from detaching and becoming transported in stormwater runoff. Erosion control BMPs protect the soil surface by covering and/or binding soil particles. The following practices will be implemented to provide temporary and/or final erosion control during construction:

- Preserve existing vegetation where practicable
- Control the area of soil-disturbing operations to the extent practicable to limits shown on plans
- Control erosion in concentrated flow paths by applying erosion control blankets, check dams, erosion control seeding, or alternate methods
- Apply permanent erosion control to the remaining disturbed soil areas before the completion of construction

The following temporary erosion control BMPs may be implemented to control erosion on the construction site:

- Preservation of existing vegetation, when practicable, through barrier fencing
- Hydraulic mulching or hydroseeding of disturbed areas, and reseeding and revegetating with native vegetation following construction

- Application of soil binders to aid in minimizing wind and rain erosion
- Covering of soil stockpiles, exposed areas, or inactive areas with geotextiles, mats, soil binders, or linear erosion controls to prevent erosion from wind or rain events
- Earthen berms, drainage swales, or slope drains constructed to direct stormwater away from disturbed areas
- Velocity dissipation and/or streambank stabilization measures to prevent scour in discharge areas
- Soil roughening to minimize erosion and allow for moisture retention and aid in seed germination and vegetative growth
- Soil stabilization measures such as wood chips, rip rap, rock, or gravel to stabilize soil and prevent erosion

Sediment Control Measures

The following temporary sediment control BMPs may be implemented to control sediment on the construction site:

- A silt fence, wattle, fiber roll, gravel bags, or other type of perimeter control may be installed around the limits of construction
- Sediment basins and/or traps will be used to remove sediment before releasing water back to the river or reservoir at a controlled rate
- Check dams constructed of fiber roll, gravel bags, or rock may be used in combination with swales to control velocity of flows through the swales
- Passive treatment may be used to allow settlement of suspended sediment and potential passive treatment through a media filter, before discharge
- Measures may be installed on roads and at construction exit points to reduce sediment track-out by construction vehicles and equipment, including water bars, rock material, and reusable rockless track-out control mats
- Stabilized construction roads may be constructed through the site to minimize dust and erosion and help contain vehicle traffic to designated drive areas

Dust Suppression Measures

A plan for controlling fugitive dust will be developed and implemented to minimize fugitive construction dust generated from the use of access roads and construction areas. Water and/or EPA-approved drinking water and wildlife-safe dust palliatives will be used to stabilize construction roadways, reduce fugitive dust emissions, and control and suppress dust in construction and access road areas. To reduce the potential for wildlife conflicts on construction roads, magnesium chloride will not be used because it can attract big game, such as bighorn sheep.

Non-stormwater Controls and Waste and Materials Management

The following non-stormwater control BMPs may be implemented to control sediment on the construction site:

- Water conservation practices will be used during construction in a manner that avoids causing erosion and the transport of pollutants offsite.
- Dewatering operations related to water captured from construction areas will comply with applicable local and Project-specific permits and regulations. Water from dewatering operations will meet all discharge requirements and water quality certification before water is allowed to leave the site.
- Temporary stream crossings will be constructed to prevent construction equipment from tracking sediment and other pollutants into the stream. Temporary stream crossings will be constructed in a way to minimize impacts on stream banks and stream bottom substrate. It may be necessary to install blankets between the existing substrate and temporary fill or to use clean gravel material to construct a crossing.
- Clear water diversions will be used to intercept clear surface water runoff upstream of the construction area and transport it around the work area to a discharge location downstream with minimal water quality degradation. Clear water diversions used may include diversion ditches, berms, slope drains, K-rails, rock bags, gravel bags, sandbags, wood, geotextile and rubber bladders, earthen cofferdams, filter fabric, turbidity curtains, swales, pipes, or flumes along with numerous proprietary designs. The selection of which diversion or isolation technique to use will depend upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the Halligan Project during each construction milestone.
- Washing of construction vehicles and equipment onsite will be done in a manner that captures wash water, not allowing it to discharge to Halligan Reservoir or the North Fork. Containment of wash water will minimize any potential release of contaminated wash water.
- To prevent the potential spread of invasive aquatic species in Halligan Reservoir, the North Fork, or the Main Stem, contractors will follow State of Colorado requirements for inspections and decontamination. If heavy equipment used for the Halligan Project was previously used in another stream, river, lake, pond, or wetland, a specific procedure will be implemented to ensure that all mud and debris is removed from equipment prior to entering the construction site (for example, tracks, turrets, buckets, drags, teeth). Additional discussion of aquatic nuisance species and decontamination to avoid their spread is in Section 4.2.3.16.
- Fueling activities will be done by a mobile fueling service within the specified fueling areas for the construction site, which will be located away from wetlands, drainages, and riparian areas which are also associated with higher quality wildlife habitat for a variety of species.
- Construction vehicle maintenance and repair will be conducted in an area with minimal potential to discharge to receiving waters. Repairs may be conducted in the active construction areas, if necessary, but soil in the area will be protected before any maintenance work. Contamination of stormwater or construction water during the concrete curing process will be prevented. Weather will be monitored before concrete pours to avoid potential rain events that may wash fresh concrete into waterways. Proper perimeter controls and washout procedures will be used during the concrete finishing process. For example, chemical curing or wet blanket or similar method will be used that maintains moisture while minimizing the discharge.

- Chemicals and waste material will be stored properly to avoid non-stormwater discharge.
- Construction operations will occur near Halligan Reservoir and the North Fork. Therefore, care with materials and equipment will be observed to ensure that equipment and/or materials do not enter these waters.
- Demolition of existing structures will occur near Halligan Reservoir and the North Fork. Care with trash and equipment will be observed to avoid and minimize potential for demolished materials to enter these waters.
- Because of the remote location and need for concrete processing, a temporary batch plant will be placed onsite for concrete activities. The plant will be contained to minimize the release of any pollutants. Perimeter controls will be placed around the batch plant, and raw materials will be stored in a manner to minimize the release of materials from rain or wind events.
- If a temporary aggregate plant is needed, water used in the processing of aggregates will be stored in ponds and recycled. Ponds will also capture sediments from stockpiles. Pond levels will be managed so that they do not result in non-stormwater discharge. Stormwater run-on will be minimized and diverted around the aggregate processing area.

Materials Management and Waste Management

Materials management control practices include implementing procedural and structural BMPs for handling, storing, and using construction materials to prevent the release of those materials into stormwater discharges. The amount and type of construction materials to be used at the site and waste materials generated will be identified as the site development plan progresses.

Waste management includes implementing procedural and structural BMPs for handling, storing, and ensuring proper disposal of wastes to prevent the release of those wastes into waterways. Materials and waste management pollution control BMPs will be implemented to minimize stormwater contact with construction materials and wastes and to prevent materials and wastes from being discharged offsite. The following BMPs may be implemented to handle materials and control construction site wastes associated with construction activities:

- Materials will be stored at designated areas and in a manner that prevents the release of pollutants, such as metals, chemicals, or organic matter.
- Workers on the site will be informed about the materials stored onsite and their various health and safety properties. Procedures for improving the effectiveness of material use while lowering inherent environmental risks will be developed and implemented.
- Stockpiles will be located in an area where environmental impacts are minimized. Perimeter controls will be put in place to prevent the migration of stockpiled materials. Stockpiles will be stabilized for wind and covered if rainfall is anticipated.
- Plans and/or practices will be developed and implemented specific to the following:
 - Spill prevention
 - Materials handling
 - Solid waste management
 - Hazardous waste management
 - Contaminated soil management
 - Concrete waste management

- Sanitary waste management
- Liquid waste management
- Revegetation plan
 - CPW will have an opportunity to review and comment on the revegetation plan.

4.2.3.8 Existing Dam for Construction Sediment Control

Leaving the original dam in place during construction to act as a coffer dam provides strong control of sediment to allow for avoidance of an inadvertent major release of sediment during construction. The existing dam will continue to function normally during the entire time the replacement dam is being constructed; therefore, drawdown of the reservoir will not be necessary during construction. Once the replacement dam is complete, Fort Collins anticipates that a coffer dam will be put in place around the existing dam during the brief (a few months or less) demolition period. Fort Collins is exploring whether to fully or partially remove the existing dam. The determination of full versus partial demolition will consider demolition methods and their potential direct and indirect resource impacts. If full demolition is not pursued, certain elements of the existing dam may be retained following construction of the replacement Halligan Dam and would generally be submerged following filling of the enlarged reservoir. Design of the existing dam elements, if retained, would incorporate features to maintain reservoir mixing and avoid or minimize potential impacts on water quality, such as notching the existing dam to the reservoir bottom and removing the upper portion of the existing dam. At this time, details on the extent, methods, and impacts related to dam demolition are not known. Fort Collins will consult with CPW as needed on the dam demolition.

4.2.3.9 Construction Disturbance Minimization and Reclamation

Fort Collins will reclaim temporarily disturbed areas following construction completion. Materials stockpile and borrow areas created on Fort Collins' property may be left in place for long-term operations and maintenance of the enlarged Halligan Reservoir. Reclaiming disturbed areas to their current condition will reduce the permanent footprint of the Halligan Project and reduce the potential for long-term ecological degradation. Revegetation and monitoring is described in Sections 4.2.3.7 and 4.2.3.15.

4.2.3.10 Access Road Minimization and Reclamation

To construct the Halligan Project, and to implement some of the mitigation measures described herein, construction equipment access to the site features will be required. Access roads are shown in the detailed Project Area maps presented in Appendix A. To minimize disturbance to local residents, wildlife, and undisturbed lands, Fort Collins proposes using existing roads whenever possible.

To accommodate larger vehicles and equipment necessary to construct the Halligan Project, existing roads will require some or all of the following: temporary widening to accommodate two-way truck traffic in some locations, placement of new culverts at drainage crossings, grade modifications, and road stabilization. Fort Collins proposes to reclaim access roads to their current condition following construction completion. Widened roads and turnouts created on Fort Collins property may be left in place for long-term operations and maintenance of the enlarged Halligan Reservoir; widened roads may be left in place on private property if requested by the landowner. Using existing roadways and reclaiming widened roadways to their current condition will reduce the permanent footprint of the Halligan Project and reduce the potential for long-term ecological degradation.

4.2.3.11 Traffic Impact Minimization

The Halligan Project is in a relatively remote location that is inaccessible to public traffic. Traffic impacts on residents will be limited to predominant ingress and egress from Highway 287, with less ingress and egress from Larimer County Road 80C (Cherokee Park Road). To minimize impacts on traffic on Highway 287, Fort Collins will construct a temporary or permanent turn lane and/or an acceleration lane. This minimization measure will be designed and implemented in coordination with the Colorado Department of Transportation and Larimer County.

Given the complexity of construction activities associated with the Halligan Project, large amounts of staff will be required to access the construction zone throughout Project construction. When appropriate and feasible, such as during shift changes, Fort Collins will incorporate carpooling of staff to and from construction areas. Carpooling of staff will reduce traffic on access roads and minimize air quality impacts, greenhouse gas emissions, potential wildlife and vehicle collisions, and fugitive dust during construction.

Fort Collins' efforts to minimize traffic impacts on wildlife as noted here, as well as Sections 4.2.3.1, 4.2.3.7, and 4.2.3.9, will minimize impacts on wildlife by using existing roads, reducing traffic-related equipment emissions and noise, reducing fugitive dust, reducing the potential for wildlife vehicle collisions, and reducing displacement and disturbance of habitats adjacent to construction activities and access roads. Construction of a temporary river crossing on the North Fork below the replacement dam will minimize traffic along County Road 80C by allowing direct access to the west side of Halligan Dam during construction (Section 4.2.3.14).

4.2.3.12 Construction Impact Minimization that will Benefit Wildlife

Construction of certain elements of the Halligan Project are anticipated to occur throughout all hours of the day or night during certain construction milestones. However, Fort Collins proposes to minimize nighttime construction activities that have the potential to generate increased noise levels, such as blasting, and will proactively respond to noise complaints. Lighting impacts associated with Halligan Project nighttime construction activities will be minimized in consideration of both local residents and wildlife. Lighting during construction will be limited to what is necessary for safety and security on the Project site during construction. Lighting will be angled and shielded to avoid light pollution and impacts on neighbors and wildlife. Noise will be minimized to the extent practicable during construction; Fort Collins plans to fit equipment with mufflers and apply construction standard practices for noise construction (the specific practices will depend on equipment used). Fort Collins' contractors will comply with Larimer County ordinances or approved variance requests through the county that may include noise shielding and reduction of after-hours activities.

4.2.3.13 Construction Timing Restrictions at the North Poudre Canal and Calloway Diversions

To minimize potential construction-related disturbance to bighorn sheep spring and fall movements, Fort Collins and CPW have agreed to implement a 1-year construction window for both the North Poudre Canal and Calloway Diversions. During the 1-year construction window, Fort Collins will perform work in two phases. During the first phase, work on the access road construction, and staging equipment and materials at the North Poudre Canal and Calloway Diversions will occur in July and August. Then during the second phase, both the North Poudre Canal and Calloway Diversions construction work will commence in November and conclude in March before spring movements by bighorn sheep through the mapped linkage area (Figures 3-3 and 4-8) between the two diversion structures. To the extent reasonably possible, all work will be completed within one construction season beginning in November and ending the following end of March (Figure 4-7). In the unlikely event of an

unforeseen occurrence such as extreme snow, Fort Collins will coordinate with CPW to develop a revised schedule.

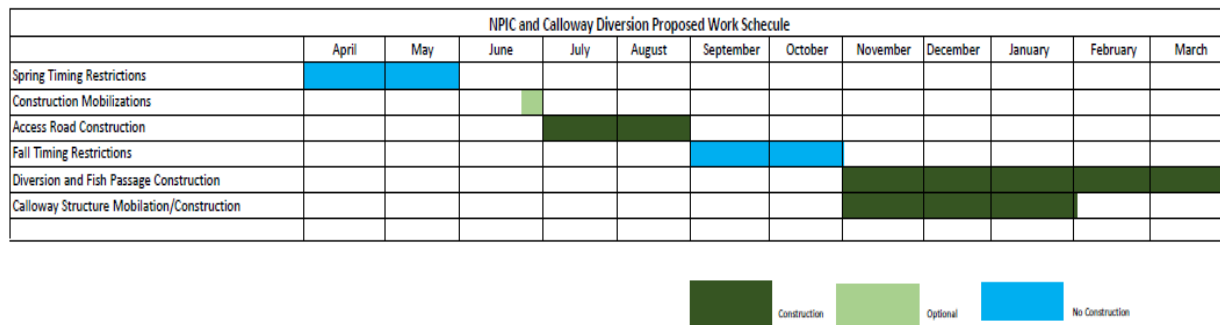


Figure 4-7. Proposed Construction Schedule to Avoid and Minimize Bighorn Sheep Disturbance at North Poudre Canal and Calloway Diversions

4.2.3.14 Limited Use of Western Access Road

Following completion of the temporary construction access crossing of the North Fork below the Halligan Dam, which is planned in the first year of construction, use of the western access road (Figure 1-3) intersecting Larimer County Road 80C (Cherokee Park Road) will be reduced to only occasional or as-needed access from April to July in the second and subsequent years of construction to reduce construction vehicle disturbance to wildlife in the area. Occasional use of the access road may be required for construction access and material deliveries during certain construction milestones.

4.2.3.15 Noxious and Invasive Weed Control and Revegetation

Fort Collins will develop a noxious and invasive weed management plan for construction activities, in coordination with the Larimer County Weed District. No domestic sheep or goats will be used for weed control on City owned property or easements Fort Collins grants to others in the vicinity of Halligan Reservoir. Noxious weed BMPs, including chemical, cultural, and mechanical measures, will be implemented during all construction phases for all Halligan Project disturbance areas, including access roads and buffers. Equipment will be cleaned so that it is free of accumulated soils that may carry noxious and invasive weed seeds to the Halligan Project Area. Restoration and revegetation will be completed for all temporarily disturbed areas using native plants. These disturbance areas will be monitored after construction to ensure successful re-establishment of vegetation in accordance with Construction General Permit requirement to stabilize all disturbed soil areas (Section 4.2.3.9) before completion of the Halligan Project. Specific revegetation/restoration details will be identified following final design.

4.2.3.16 Aquatic Nuisance Species

Fort Collins will take a proactive approach to preventing the introduction of aquatic nuisance species into Halligan Reservoir, the North Fork, and the Main Stem. Non-native species and invasive species pose a threat to ecosystems, and Fort Collins will minimize the risk of spreading aquatic nuisance species through implementation of BMPs to prevent the potential spread of these species in Halligan Reservoir and in the rivers. Fort Collins will implement specific procedures to ensure that all equipment is cleaned of mud and debris (for example, tracks, turrets, buckets, drags, teeth), and inspected to confirm they are free of aquatic nuisance species. Specific decontamination measures for equipment or materials that were used in any stream, river, lake, pond, or wetland within 14 days of the start of the Project to prevent the spread of New Zealand mudsnails (*Potamopyrgus antipodarum*), zebra mussels (*Dreissena*

polymorpha), quagga mussels (*Dreissena bugensis*), invasive plant species, and other aquatic nuisance species will follow the most current guidance from CPW and are expected to include one or more of the following methods: (1) Remove all mud and debris from equipment (tracks, turrets, buckets, drags, and teeth) and spray/soak in a 1:15 solution of Quat 4 or Super HDQ Neutral institutional cleaners and water. Keep equipment moist with the solution for at least 10 minutes, or (2) remove all mud and debris from equipment (tracks, turrets, buckets, drags, and teeth) and continuously spray/soak equipment with water that is hotter than 140 degrees Fahrenheit for at least 10 minutes. Hand tools, boots, and any other equipment that will be used in the water will be cleaned, as well.

4.2.3.17 Bighorn Sheep Habitat and Collaring Measures

Fort Collins developed bighorn sheep mitigation measures in consultation with CPW to mitigate potential direct and indirect effects of the Halligan Project within the Lone Pine herd range. The goals of Fort Collins' bighorn sheep mitigation package include the following:

- Avoid potential impacts by improving bighorn sheep habitat opportunities and water access in areas away from Project construction, as described in this section
- Monitor movements of the Lone Pine herd before, during, and after construction to fill a data gap around herd habits and to support implementation of other bighorn sheep mitigation measures through a collaring study, as described in this section
- Avoid and minimize construction-related direct and indirect impacts through a set of BMPs (Section 4.2.3.7) and construction timing restrictions (Section 4.2.3.13)
- If, despite the forgoing measures, the Project results in one or more mortalities of a bighorn sheep in the Lone Pine herd, financially compensate CPW for that unavoidable resource loss (Section 4.3.3)

As discussed in Section 3.8.4.1, comingling with domestic sheep and goats is the largest anticipated threat to bighorn sheep. Fort Collins has explored numerous options to either permanently or temporarily remove domestic sheep and goat grazing from the area around Halligan Reservoir. To date, Fort Collins' attempts have been unsuccessful, as discussed with CPW in multiple meetings in 2021 and 2022. Fort Collins is willing to continue exploring opportunities toward that goal of removing domestic sheep from around Halligan Reservoir; however, a specific implementable mitigation measure has not been identified.

4.2.3.18 Bighorn Sheep Habitat Improvements

To improve bighorn sheep habitat opportunities and water access on the Cherokee SWA, Fort Collins will provide CPW with \$250,000 for chemical treatment to abate invasive cheatgrass over at least 500 acres, along with installation of two remote passive water sources. Fort Collins intends to provide to CPW enough funding to complete a minimum of one round of cheatgrass treatment over 500 acres and the installation of two water features at least 2 years before the start of Project construction in an effort to entice bighorn sheep away from construction areas and areas at times used for the grazing of domestic sheep. Any remaining monies up to the \$250,000 earmarked for vegetation and habitat restoration could be used by CPW for habitat treatment on additional acreages within the Cherokee SWA.

CPW has identified several areas within the Cherokee SWA that would provide the largest benefit to bighorn sheep habitat and foraging through cheatgrass mitigation. Trail cameras will be deployed during and after treatment to identify how well the treatment worked. The habitat treatment targets cheatgrass seed germination, allowing for higher quality native forage to grow, which, in turn, may keep the Lone Pine herd within the boundaries of Cherokee SWA longer and away from domestic sheep during the April to July grazing period. The treatment should not alter normal migration routes, habitat

range use, or lambing areas. The objective is to begin the cheatgrass mitigation treatments on a minimum of 500 acres commencing at least 2 years before the start of the Halligan Project and continue as needed through construction and up to 2 years postconstruction.

CPW will install two water features in high-use bighorn sheep areas within or near the area(s) treated to control cheatgrass. Fort Collins anticipates that CPW will install either two water guzzlers for precipitation capture or one water guzzler and one stock-tank type structure that uses water from a spring that CPW holds rights to develop. These features will passively (that is, external power source not needed) provide water sources away from Halligan Project disturbances and are expected to provide benefit before, during, and after construction. The water features will be used to enhance bighorn sheep habitat in areas that may be underused due to lack of water resources and within a reasonable distance of the priority habitat restoration area noted previously.

4.2.3.19 Bighorn Sheep Collaring Study

Fort Collins will provide CPW additional funding of up to \$120,000 to support global positioning system (GPS) collaring of bighorn sheep from the Lone Pine herd to track their movements before, during, and immediately after Halligan Project construction. GPS collaring study results will support evaluation of whether construction may influence herd habits, in particular with respect to interactions with domestic sheep and/or other bighorn herds. CPW will implement the collaring study. GPS collar monitoring studies are needed to assess disease risk and habitat restoration needs for the Lone Pine herd by gathering data on herd landscape use (habitat, spatial, and temporal), recruitment, and overall health. Depending upon the Lone Pine herd size, up to a maximum of 15 GPS collars may be deployed. The preconstruction portion of the GPS collaring study will begin no less than 2 years before the anticipated start of the Halligan Project construction. GPS collars are expected to have a 2-year life and collect data approximately every 4 hours. Preconstruction collaring data will be considered viable for 5 years. Should construction be pushed beyond that initial 5-year window, a second GPS collar study would start 1 year from the start of construction. The intent of the second preconstruction GPS collar study is to have accurate and recent data on the Lone Pine herd's movements before construction. The Lone Pine herd will be fitted with GPS collars during all of the construction with collars having an anticipated 2-year battery life. The final phase will be a 2-year postconstruction GPS collaring event to evaluate postconstruction movement and habitat use.

4.2.4 Halligan Reservoir Sediment Management Plan

A sediment management plan will be developed for Halligan Reservoir that will provide guidelines for postconstruction reservoir operations (including low water level operations) to avoid adverse sediment release events. Operating the reservoir, particularly at low water levels, in accordance with a plan developed by sediment experts is intended to avoid adverse sediment release events like the one in 1996 (described in Section C3.4). CPW will be given an opportunity to comment on the draft sediment management plan.

4.3 Compensatory Mitigation Measures

The goal of mitigation is to avoid and minimize adverse impacts of a project, and then compensate for any unavoidable impacts that remain. Fort Collins proposes a robust set of measures described in Section 4.2 that will not only avoid and minimize adverse effects from the Halligan Project but also will result in a net improvement of the aquatic ecosystem in the North Fork. However, because of the nature and scope of the Halligan Project, some unavoidable impacts are expected and will be offset through compensatory mitigation.

Fort Collins, in consultation with CPW, CDPHE’s WQCD, cooperating agencies, and other stakeholders, has developed the compensatory mitigation measures described herein to compensate for impacts from the Halligan Project that cannot be avoided or minimized. This section presents compensatory mitigation measures specific to fish and wildlife resources, organized by general resource category. The natural resource mitigation measures are highly interrelated and typically serve to mitigate impacts on several ecological functions through one measure. Some of these connections (or overlaps) of mitigated functions are explained with each measure. The table in Appendix B summarizes each avoidance, minimization, and compensatory mitigation measure.

Throughout Project planning and mitigation proposal development, Fort Collins’ focus for compensation has been to mitigate as close to the location of Halligan Project impact as practicable. Compensatory mitigation for fish and wildlife will occur near the Halligan Project Area or in the North Fork watershed.

4.3.1 Preservation as Early Compensatory Mitigation Measure

In 2003 to 2004, as an act of early mitigation in anticipation of the Halligan Project, Fort Collins led the purchase and preservation of a permanent conservation easement of a 4,557-acre property known as Roberts Ranch, which comprises several disconnected parcels (Figure 4-8) in the Livermore Valley. The preservation of the Roberts Ranch property was the first step in Fort Collins’ compensatory mitigation approach for the Halligan Project. Fort Collins acquired an undivided 60 percent interest in the conservation easement by funding 60 percent (or \$1.8 million) of the \$3 million cost in partnership with Larimer County, Great Outdoors Colorado, TNC, and the Roberts family. The easement covers 4,557 acres of high-quality wildlife habitat and rangelands near Halligan Reservoir and is also adjacent to 14,000 acres of other state and locally protected lands (Figure 4-8). This early conservation effort provides the following benefits:

- Direct and indirect ecological benefit to wildlife resources affected by the Halligan Project, including long-term preservation of suitable habitat for big game ungulates, as well as the federally and state threatened Preble’s meadow jumping mouse and the federally threatened Ute ladies’-tresses orchid
- Land preservation and conservation in perpetuity of habitat for wildlife and rare and native plants, and conservation of the diverse forest, shrubland, meadow, and riparian vegetative communities
- Approximately 2 decades of land preservation before disturbance from the Halligan Project construction activities
- Preservation of areas within the linkage area for the Lone Pine bighorn sheep herd where individual rams have been observed annually by local residents from approximately March to October on parcels of Roberts Ranch east of Highway 287 (Thode, pers. comm. 2021), and limitations on grazing such that species other than cattle or horses cannot be grazed on the property unless approved by TNC in areas where use of cattle or horses is impractical
- Conservation of more than 8.8 miles of perennial streams
- Direct connectivity to 14,000 acres of adjacent state and locally protected lands

In addition to these benefits, this early mitigation effort removed 4,557 acres of property from future development, which equates to approximately 120 to 250 residential units based on Larimer County Rural Open Development standards (Larimer County 2021), and eliminated the potential to increase agricultural development within the area. To preserve this land at today’s market rates, the cost to Fort Collins will be approximately \$2.6 million dollars. By protecting the Roberts Ranch property in 2004, Fort Collins commenced mitigation efforts early, which has already preserved a threatened ecosystem and the ecological functions it provides for almost 2 decades.

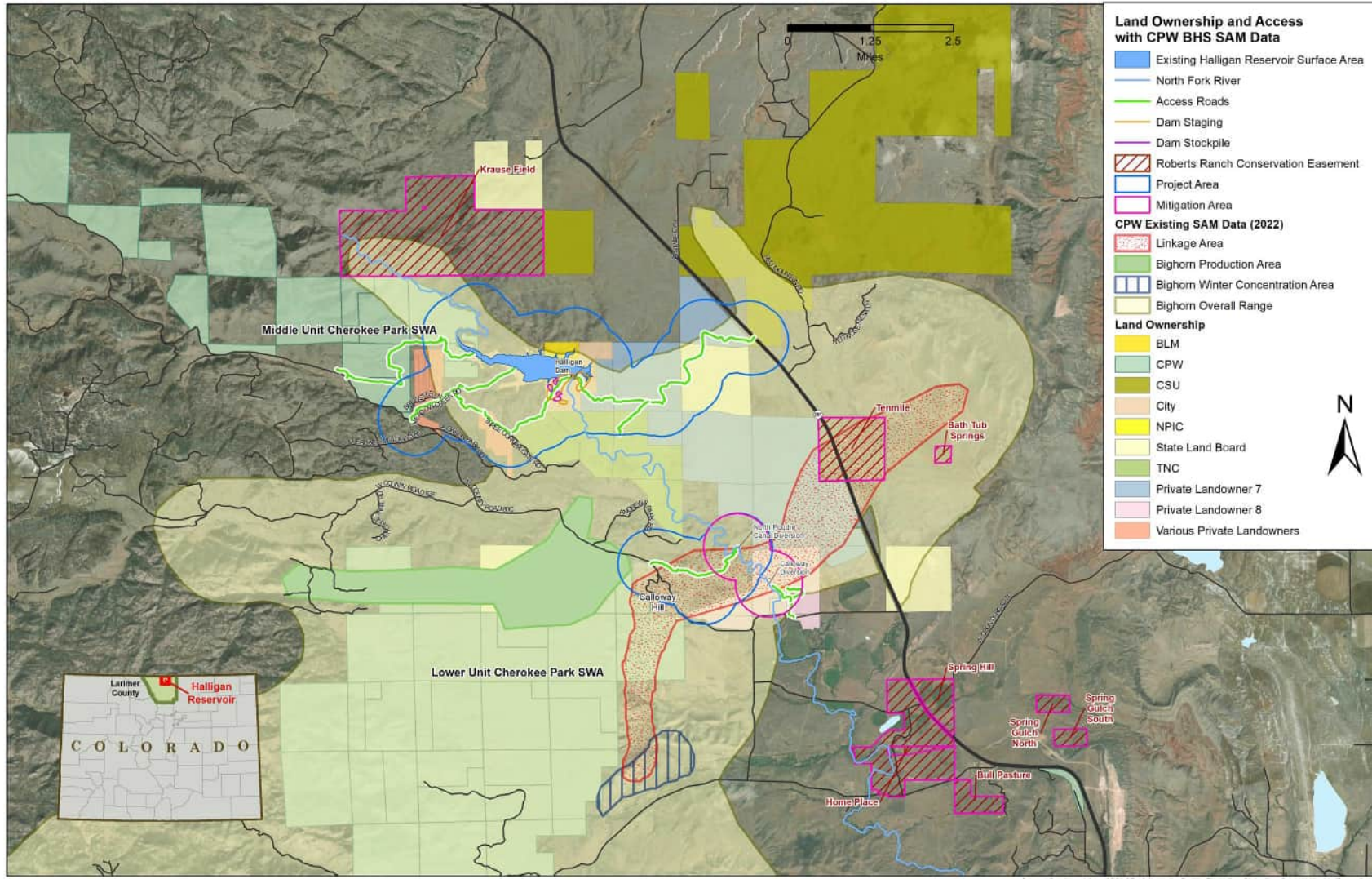


Figure 4-8. Land Ownership and Mitigation Areas around Halligan Reservoir

4.3.2 Fish Passage at the Fort Collins Intake at Gateway Park

Fort Collins will construct fish passage around the Fort Collins Intake diversion structure at Gateway Park (Figure 4-9) to increase connectivity for trout and other large-bodied fish species on the Main Stem and to compensate for impacts on Main Stem fisheries associated with flow changes as a result of the Halligan Project. The fish passage will be designed, in consultation with CPW, and to CPW's Research and Design Guidelines, *Fish Passage and River Structures* (CPW n.d.) to provide reliable upstream fish passage and will help to provide additional connectivity upstream of the Fort Collins Intake, and Fort Collins will consult with CPW on the design of the structure. The majority of diversions related to the Halligan Project will take place at the Fort Collins' Intake at Gateway Park on the Main Stem. This diversion structure is located approximately 0.5 mile upstream of the confluence with the North Fork. The diversion structure currently acts as a barrier to fish movement, preventing the migration of fish past the structure. With this action, Fort Collins will compensate for reduction of flows on the Main Stem in the Exchange Reach between the Fort Collins Intake(s) and the North Fork confluence.



Figure 4-9. Fort Collins Intake at Gateway Park

Source: City of Fort Collins

4.3.3 Compensatory Mitigation for Halligan Project Impacts on Bighorn Sheep

Fort Collins will avoid and minimize potential Project effects on bighorn sheep through the habitat improvements and movement tracking collaring study described in Sections 4.2.3.17, 4.2.3.18, 4.2.3.19 and through construction timing restrictions described in Section 4.2.3.13. Additional construction-related measures to avoid and minimize impacts on terrestrial wildlife, including bighorn sheep, are described in Section 4.2.3.7. If, despite these efforts, construction of the Halligan Project causes mortality to bighorn sheep in the Lone Pine herd, Fort Collins will offset this unavoidable impact through monetary compensation to CPW.

Fort Collins will provide monetary compensation of \$7,300 per sheep to CPW for any Lone Pine herd bighorn sheep that experience mortality during Project construction and 2 years postconstruction. Although not all mortality experience during the construction period is anticipated to be caused by the Project, as a conservative approach Fort Collins is willing to assume that mortalities during the construction period and 2 years postconstruction will be compensated. Additionally, if Lone Pine herd mortalities are observed in the 2 years following the end of construction, Fort Collins will compensate CPW \$7,300 per sheep.

CPW has concerns that the Halligan Project construction may cause Lone Pine herd sheep to change movement patterns such that they act as a vector for disease transmission from domestic sheep to the Lower Poudre herd. Fort Collins will work with CPW to develop an adaptive management approach to monitoring bighorn sheep movements to assess disease transmission, and will compensate CPW for

Lower Poudre herd bighorn sheep that were exposed to respiratory disease because of the Halligan Project during and 2 years after construction.

4.3.4 Compensatory Mitigation for Halligan Project Impacts on Stream Temperature

Fort Collins will commit \$200,000 of funding for stream restoration efforts along the Main Stem to compensate for potential Project-related temperature increases. Note that this commitment is separate from the \$200,000 enhancement commitment for the North Fork described in Section 5.1.1.6; however, these funding commitments may be combined or used independently. The restoration will be focused on either enhancing aquatic life habitat or funding a fish passage project, or both. This money is committed as a compensatory mitigation for unavoidable temperature impacts on the Main Stem. If the money is used toward fish passage at the Munroe Diversion, this would allow for more natural fish behavior and the opportunity to seek spawning habitat upstream of the diversion. Combined with the Gateway Park Diversion fish passage, this would link more than 20 miles of upstream fish habitat year-round. Funding of a future stream restoration project is another example of adherence to Fort Collins' guiding principles of mitigation (refer to Section 5.1.1.6), focusing on the improvement of degraded resources, focusing on improving whole systems and benefiting multiple (aquatic) resources, and working in partnership with those who have common goals. Fort Collins and CPW will have final approval authority on any use of funds.

4.3.5 Compensatory Mitigation for Halligan Project Impacts on Wetlands

Compensatory mitigation and monitoring for wetlands will be described in a separate mitigation plan yet to be developed for approval by the Corps. Wetland mitigation for Halligan Project impacts may include restoration, mitigation banking, or other measures that benefit fish and wildlife. Wetland mitigation measures are not detailed in this FWMEP or the accompanying appendix table.

4.3.6 Special-status Species

Potential impacts of the Halligan Project on special-status species, including federally and state-listed species, are described in Section 3.8. Fort Collins seeks to avoid and minimize any adverse impacts on any special-status species. Halligan Project mitigation measures, such as the preservation of Roberts Ranch (Section 4.3.1), and the numerous avoidance and minimization measures (Section 4.2) will adequately mitigate potential Halligan Project effects on state-listed species; therefore, no additional species-specific compensatory mitigation measures have been proposed.

4.3.6.1 Preble's Meadow Jumping Mouse

Mitigation and monitoring of Halligan Project impacts on Preble's are being developed in consultation with USFWS and are described in the *Halligan Water Supply Project Preble's Meadow Jumping Mouse Mitigation Plan* (Jacobs 2022).

4.3.6.2 Ute Ladies'-tresses Orchid

Because the Ute ladies'-tresses orchid is not anticipated to occur within the Halligan Project Area (refer to Section 3.8.3.2), Fort Collins does not propose compensatory mitigation. Avoidance and minimization measures described in Section 4.2 will be implemented, including preconstruction botanical surveys (Section 4.2.3.2). Furthermore, indirect benefits to potential habitat are anticipated with the implementation of wetland and riparian mitigation and enhancements associated with the Halligan Project.

4.3.6.3 Platte River Species

Fort Collins participates in the SPWRAP, which outlines a programmatic approach for USFWS Section 7 consultation that is described in the Platte River Recovery Implementation Program. Currently, mitigation is not expected to be needed for South Platte River depletions. If additional mitigation measures are identified during this programmatic approach or based on USFWS consultation, they will be incorporated into the mitigation strategy for the Halligan Project.

4.3.6.4 State-listed Species

Fort Collins seeks to avoid and minimize any adverse impacts on any state species of concern, which were described in Section 4.2.3. Effects on state-listed and other species of concern from Fort Collins' Proposed Action may include temporary displacement because of noise disturbance from construction activities, transportation of people and materials, and increased human activity in the area of Halligan Reservoir. In addition, vehicle and equipment emissions and fugitive dust may also displace state-listed or species of concern. This displacement and disturbance of state-listed or species of concern may result in additional stress on individuals which could lead to mortality of individuals. Some species, such as those dependent on riparian communities, will likely experience a beneficial effect from the Halligan Project as a result of the flow-related operational measures that will be implemented downstream of the enlarged Halligan Reservoir.

The Halligan Project will use numerous avoidance and minimization measures described in Section 4.2, including preconstruction bat surveys (Section 4.2.3.3) and migratory bird and raptor surveys (Section 4.2.3.4). If preconstruction surveys determine that the Project will likely adversely affect a state-listed species, then Fort Collins will consult with CPW on timing, temporary habitat modification, and other measures that may help to further avoid or minimize site- and species-specific adverse effects. Mitigation measures, such as the preservation of Roberts Ranch will adequately mitigate potential Halligan Project effects on state-listed species. As described in Section 4.3.1, the conservation easement on the Roberts Ranch encompasses 4,557 acres over 10 discrete parcels (Figure 1-1). According to the CPW species activity mapping data (CPW 2020b), all 10 parcels are within the overall ranges of several of the state-listed species and other Tier 1 and Tier 2 species. Specifically the conservation area provides potential habitat for bald eagle, northern pocket gopher, black-tailed prairie dog, Townsend's big-eared bat, common garter snake, and northern leopard frog, all of which are state-listed species. In addition all 10 parcels provide vegetative communities that support the life cycle of one or more state species including: wetlands, stream, riparian zones, rock outcroppings, and short grass prairie communities. Therefore, no additional species-specific compensatory mitigation measures have been proposed.

4.3.7 Recreational Resources

Anticipated Halligan Project impacts on recreational resources are described in Section 3.9.2. Because the surface of Halligan Reservoir is not open to the public for recreational use, the Halligan Project will not change the public's ability to recreate on the reservoir. The LAPCR's private access to the Halligan Reservoir (refer to Section 3.9.1) will be minimally affected during construction and will be limited to specific times when the reservoir level will be drawn down near the end of construction for partial or total demolition of the existing dam.

The enlarged Halligan Reservoir will inundate approximately a 0.75-mile reach of the North Fork upstream of the existing Halligan Reservoir, resulting in the loss of approximately 20 acres of potential hunting lands and river fishing along a 0.4-mile stretch of this reach, as described in Section 3.9.2. Fort Collins is proposing the following mitigation related to recreation.

4.3.7.1 Reconciliation of Title Chain Confusion

As discussed in Section 3.9, in recent years, Fort Collins discovered that approximately 39 acres of land in the eastern half of Section 29 and in the northeastern quarter of Section 32 that were thought to be owned by CPW are owned by Fort Collins and a private party (Figure 3-4). Upper portions of the enlarged Halligan Reservoir will be located on portions of these lands. For the most part, these lands are surrounded by the Cherokee SWA–Middle Unit and according to CPW, these lands have been accessed by the public for over 50 years¹⁹. Fort Collins intends to acquire these lands for the enlarged Halligan Reservoir.

After acquiring these lands, Fort Collins will seek an agreement with CPW to convey an easement to CPW across these lands for public use, provided that the surface of the enlarged reservoir will not be opened to public access at this time. Any such agreement and conveyance will be subject to applicable laws, including statutes applicable to CPW, and the Fort Collins Municipal Code Chapter 23 (Public Property), Article IV (Disposition of Property), Division 2 (Real Property).

If, separate from the current processes to enlarge Halligan Reservoir, the reservoir is opened to public recreation at a point in the future, any recreation plan proposed by Fort Collins that will affect the Cherokee SWA will be developed in conjunction with CPW and will consider impacts on fish and wildlife habitat, including impacts on any access through the Cherokee SWA. The recreation plan will also consider and compensate for the resource needs for CPW to stock and manage Halligan Reservoir for public angling access, if CPW determines it will maintain a public fishery.

4.3.7.2 Funding of Public Access Lease with Roberts Ranch

Fort Collins will contribute funding to CPW to support a lease of the Krause Field parcel of Roberts Ranch. The Krause Field parcel is located north of Halligan Reservoir and the Cherokee SWA, as shown on Figure 4-8. The Krause Field parcel was conserved as a part of the Roberts Ranch conservation easement secured by Fort Collins and partners in 2003 and 2004 (refer to Section 4.3.1). CPW has been pursuing a lease allowing primitive foot access for hunting and fishing on the Krause Field parcel. Fort Collins understands that this lease will provide public access to over 2,200 acres of hunting and approximately 1 mile of river access and fishing, which includes the North Fork and potentially stretches of its tributaries, Dale Creek and Bull Creek.

Fort Collins agrees to a one-time reimbursement in the amount of \$135,000 for CPW to pursue a long-term lease (in process) of the Krause Field parcel.

4.3.7.3 Parking Area Establishment of State Wildlife Area

A primitive parking area used to provide public access to the adjacent SWA is located on Fort Collins' property in the northeast quarter of Section 32. The parking area falls within an area previously thought to be owned by CPW. This parking area will be inundated by the enlarged Halligan Reservoir. Fort Collins will provide funds to create a new parking area in kind on CPW land outside of the inundation area, to provide comparable access to this general location (Figure 3-4). The new parking area will be primitive and similar in form to the existing parking area.

4.3.8 Instream Water Rights

The enlarged Halligan Reservoir will inundate approximately 0.75 mile of the North Fork upstream of the current reservoir where the CWCB holds an instream flow water right, as described in Section 3.3.2.2. Because of the additional stream flow that will be provided downstream, Fort Collins' commitment to

¹⁹ Fort Collins is evaluating if and the extent to which the public has accessed this part of the inundation area and makes no representations on this issue.

protect those associated releases from Halligan Reservoir for approximately 22 miles downstream using the Protected Mitigation Release statute (CRS Section 37-92-102[8]), and the aquatic resource enhancements described in Section 5, no additional compensatory mitigation is proposed for impacts on the CWCB's instream flow water rights as part of this FWMEP.

4.4 Mitigation Costs and Schedule

Estimated costs and schedule for the mitigation components of this FWMEP follow in Appendix B.

This FWMEP includes a comprehensive description of all of Fort Collins' planned mitigation and enhancement measures for the Halligan Project that are related to fish and wildlife. Appendix B presents Fort Collins' total estimated mitigation and enhancement costs for all measures and denotes those that CPW staff believe are attributable to the Commission's recommendations pursuant to CRS Section 37-60-122.2 via separate cost columns.

Appendix B includes notes describing the mitigation commitments in the table being at a summary level and the text of this report shall take precedent over any discrepancies between the table and the FWMEP text. Also, capitalized costs in the table are the sum of the capital cost plus any annual operations and maintenance costs capitalized over the life of the commitment, or 50 years for those commitments that are perpetual. In addition, some of the costs in the table are firm not-to-exceed monetary commitments and the amounts are presented in 2022 dollars and will be increased in the amount of the U.S. Bureau of Labor Statistics Consumer Price Index for Denver-Aurora-Lakewood from January 1, 2023 to the date of final payment under the FWMEP obligation.

5 Proposed Fish and Wildlife Enhancement Plan

This chapter constitutes the proposed enhancement plan for fish and wildlife resources in the general Halligan Project area. Enhancement measures were developed based on comments received on the DEIS, discussions with CPW staff, and discussions with other Halligan Project stakeholders. The enhancements described in this chapter will improve both existing and future anticipated conditions of the aquatic and terrestrial environment without regard to causation. These measures integrate with Fort Collins' vision and overarching goals for the Halligan Project and demonstrate Fort Collins' ongoing commitment to improve existing conditions in the Poudre River watershed. Chapter 4 of this FWMEP describes the approach used to identify and develop mitigation and enhancement measures.

This enhancement plan updates, builds upon, and/or replaces some of the measures presented in the draft CMP (City of Fort Collins 2019c) released with the DEIS (Corps 2019). The measures described in this enhancement plan have been updated since the development of the CMP. Some enhancement measures are similar to or directly replace measures described in the CMP. New enhancement measures have also been developed and described herein that were not presented in the draft CMP. All measures included in this FWMEP are summarized in the table contained in Appendix B.

5.1 Enhancement Measures

Fort Collins is committed to incorporating the voluntary enhancements described in the following sections into the Halligan Project. These enhancement measures are not required to meet regulatory mitigation requirements, and are above and beyond the measures presented in Chapter 4 that Fort Collins will undertake to avoid, minimize, or compensate for impacts resulting from the Halligan Project.

5.1.1 Aquatic Resources Enhancements

5.1.1.1 Temporary Environmental Pool

Between the time that Halligan Reservoir is enlarged and the time when Fort Collins grows into its future demand levels associated with the Halligan Project, Fort Collins will dedicate an annually variable storage volume in the enlarged Halligan Reservoir to release for environmental benefits downstream. This annually variable volume of water dedicated for environmental benefits is referred to as the temporary environmental pool (TEP).

The purpose of the TEP is to enhance the environmental benefit, or functional lift, of the flow-related operational measures described in Section 4.2.1. The primary objective of the TEP is to positively affect stream health in the North Fork from the replacement Halligan Dam to Seaman Reservoir. In general, the TEP will be used to benefit whole stream health, with the ability to focus on specific river functions, or single-species management in select years. Use of the TEP will be informed by first principles of river ecology.

Operation of the Temporary Environmental Pool

Fort Collins will determine the volume of water available for the TEP each year. Volumes in the range of 500 to 1,000 acre-feet are expected to be available; however, the actual volume available could increase or decrease after information is gained from the first several years of operation of the enlarged Halligan Reservoir. The annual volume of water available is expected to be reduced or eliminated over time, as water demand for Fort Collins' water customers increases. The TEP is currently anticipated to be operated through 2065, although it could occur sooner or later than that depending on when Fort Collins grows into its future demand levels associated with the Halligan Project.

Fort Collins will determine the volume of water available to be dedicated on an annual basis based on water demand and water supply outlook. The volume and targeted window for releases will be determined before July 1 each year. The window for releases will typically be from July 1 to the following April 30. The ramping rate limitations described previously will apply to such releases. The releases will be operated and used pursuant to Fort Collins' water rights decrees.

Releases from the TEP will be made from the enlarged Halligan Reservoir and conveyed down the North Fork. The TEP releases will be made only if Fort Collins can place them to decreed beneficial uses for the releases under Fort Collins' water rights. Fort Collins will determine the water right(s) to which the TEP releases are attributed. This may include uses further downstream on the Poudre River (for example, to Rigden Reservoir) that could potentially provide secondary benefits to the river. Fort Collins will not redivert the TEP releases until after they have reached the confluence with the Main Stem.

Decisions regarding the volume of water allocated each year will be made by Fort Collins. The primary stakeholders for the TEP will be Fort Collins and CPW; however, a small group of technical advisers, resource experts, and/or other stakeholders may be developed to guide decisions related to the best use of the TEP. The best use of this water will be determined based on decreed beneficial uses of the water rights and current conditions at that point in time and the greatest ecological concerns or issues, with one of the priorities being management of small-bodied native fish species downstream of Halligan Reservoir. Operational targets for use of the TEP could be set for several years at a time to address multiple ecological priorities. If CPW or another entity identifies additional water rights for storage in the enlarged Halligan Reservoir and allocated to the TEP, Fort Collins will consider specific proposals in good faith, after all required permits have been issued for the Halligan Project.

Protection of the Temporary Environmental Pool Releases

NPIC cannot divert the TEP releases into the North Poudre Canal pursuant to an existing agreement with Fort Collins. Additionally, Fort Collins will attempt to protect the TEP releases from Halligan Reservoir to Seaman Reservoir using the Protected Mitigation Release statute (CRS Section 37-92-102[8]) in the same manner as described here for the Winter Releases Plan (Section 4.2.1.1). Fort Collins will undertake a good faith effort to protect the TEP releases under the Protected Mitigation Release statute. However, success is not guaranteed because it will depend on factors outside of Fort Collins' control.

Curtailement of the Temporary Environmental Pool

Fort Collins may need to curtail or stop TEP releases in the event of maintenance, drought, or emergency situations. Fort Collins may also modify the release schedule if another water resource need develops within the Fort Collins' water system. As such, the storage volume of the TEP may vary significantly each year, and it will not be operated during water supply shortages (refer to Section 4.2.1.7). Again, the annual volume of water available is expected to be reduced or eliminated over time, as water demand for Fort Collins' water customers increases.

Fort Collins may need to curtail or stop TEP releases in the event of maintenance, drought, or emergency situations. Fort Collins may also modify the release schedule if another water resource need develops within the Fort Collins' water system. As such, the storage volume of the TEP may vary significantly each year, and it will not be operated during water supply shortages (refer to Section 4.2.1.5). Again, the annual volume of water available is expected to be reduced or eliminated over time, as water demand for Fort Collins' water customers increases.

5.1.1.2 Joint Operations

Fort Collins will continue to entertain opportunities for operational synergies with other managed water deliveries in the Poudre River watershed in order to potentially provide targeted benefits to the watershed. For example, Fort Collins might consider a temporary (that is, 1 year) water trade with an irrigation company or another municipal water provider that temporarily increases releases from the Halligan enlargement in exchange for other water sources that can be used by Fort Collins. Joint operations will not compromise the commitments in the FWMEP. Fort Collins may consider engaging CPW in these discussions when appropriate.

5.1.1.3 Fish Passage at the Reconstructed North Poudre Canal Diversion

The North Poudre Canal Diversion (Figure 5-1) is located in Phantom Canyon, approximately 6 river miles downstream of Halligan Reservoir on the North Fork. The structure currently acts as a barrier to upstream fish passage, preventing the migration of fish past the structure. As part of the Halligan Project, Fort Collins will reconstruct the North Poudre Canal Diversion so that Fort Collins' releases (refer to Section 4.2.1) can be bypassed by that structure and remain in the North Fork. To provide increased connectivity for small-bodied native species and trout in the North Fork, Fort Collins will incorporate fish passage into or around the reconstructed North Poudre Canal Diversion, in the form of a fish ladder, bypass channel, or other infrastructure. Fish passage will be designed, in consultation with CPW, and to CPW's Research and Design Guidelines, *Fish Passage and River Structures* (CPW n.d.) to provide reliable fish passage at the North Poudre Canal Diversion and connect an extensive reach of the North Fork.



Figure 5-1. North Poudre Canal Diversion Structure

Source: Jacobs

5.1.1.4 Channel Improvements and Modification of the Calloway Diversion

The Calloway Diversion (Figure 5-2) is located on the North Fork at the mouth of Phantom Canyon, approximately 7.5 river miles downstream of Halligan Reservoir. The diversion is no longer used. Although water passes the structure, it acts as a barrier to fish passage, preventing the migration of fish past the structure. As an additional measure to further enhance the fisheries of small-bodied native fish on the North Fork, Fort Collins will seek to modify and/or partially remove the diversion structure in collaboration and agreement with the landowners, CPW, and other stakeholders.



Figure 5-2. Calloway Diversion Structure

Source: Jacobs

Proposed plans should follow CPW's Research and Design Guidelines, *Fish Passage and River Structures* (CPW n.d.)

The current concept that Fort Collins has developed for the area around the Calloway Diversion, in collaboration with landowners, CPW, and other stakeholders, includes removal of the center portion of the structure, while leaving the sidewalls of the structure in place. This modification will allow for full river connectivity while maintaining a portion of the historical structure. Over time, this portion of the channel will heal and be re-established to a more natural condition while enhancing river connectivity for aquatic organisms, including macroinvertebrates, small-bodied native fish, and trout. This action is also considered a voluntary enhancement measure for North Fork temperature. The action will remove an existing large, sediment-trapping pool that increases residence time and warming at low flow rates. Removal of the center portion of the existing diversion will also remove the barrier to fish passage, allowing more natural fish behavior, including the potential to seek thermal refuge upstream. Further, the channel improvements will result in a more natural thalweg, including pools that can serve as areas of thermal refuge in times of low flow and adult holding and overwinter habitat. Fort Collins will pursue an agreement in good faith with the landowners and other stakeholders to complete this Project.

5.1.1.5 Ramping Rate Limitations for NPIC's Pool in an Enlarged Halligan Reservoir

The ramping rate limitations described in Section 4.2.1.4 apply only to Fort Collins' operation of its portion of the enlarged Halligan Reservoir; they do not apply to operation of NPIC's portion of the reservoir. Therefore, Fort Collins will commit to making a good faith effort to reach an agreement with NPIC to adhere to the same ramping rate limitations. Previous discussions with NPIC indicate that it would prefer to explore any such commitments after the enlarged reservoir is operational for several years. At that time, Fort Collins will re-engage in discussions with NPIC about ramping their diversions and releases to match those rates Fort Collins has committed to.

5.1.1.6 North Fork Stream Restoration

Fort Collins will commit \$200,000 of funding for stream restoration efforts along the North Fork. The restoration will be focused on either enhancing habitat for small-bodied native fish or salmonids. Funding a future stream restoration project is another example of adherence to Fort Collins' guiding principles of mitigation (refer to Section 4), such as focusing on the improvement of degraded resources, focusing on improving whole systems and benefiting multiple (aquatic) resources, and working in partnership with those who have common goals. Note that this commitment is separate from the \$200,000 mitigation commitment for the Main Stem described in Section 4.3.4; these funds may be combined or used independently. Fort Collins and CPW will have final approval authority on any use of funds.

5.2 Surface Water Quality Enhancement

5.2.1 Sediment-related Operational Measures

In addition to the Peak Flow Bypass Program described in Section 4.2.1.5, and the sediment management plan described in Section 4.2.4, the following sediment-related operational measures are planned for Halligan Reservoir to avoid future adverse sediment release events.

5.2.1.1 Bottom Release from Halligan Reservoir when Spilling

Water will be released from Halligan Reservoir through the bottom outlets at times when the reservoir is spilling over the dam. This should allow for reduced retention of sediment in Halligan Reservoir, allowing for appropriate sediment transport downstream to the North Fork (as directed by the total maximum daily load [TMDL]). Avoiding buildup of sediment behind the dam should, in part, help avoid an adverse sediment release event like the one that occurred because of operations in 1996.

This measure is also considered a voluntary enhancement in terms of river temperature for its parallel benefits in reducing the risk of thermal shock below the Halligan Reservoir dam. As described in Section 3.4.2, thermal shock can occur below the Halligan Reservoir dam under current Halligan Reservoir dam operations. The Halligan Project has an inherent benefit of reducing the current frequency of thermal shock below Halligan Reservoir dam because no spilling is anticipated (per DEIS flow modeling) to occur in summer or fall months (that is, at times when the reservoir is thermally stratified). Bottom releases during spilling would provide further enhancement in terms of further reducing the risk of thermal shock because such releases would serve to blend top and bottom temperatures, minimizing the sharp temperature change in releases, in the unanticipated event that the reservoir does spill at a time of thermal stratification with the Halligan Project.

5.2.2 Passive Aeration in Outlet Structure

Fort Collins will incorporate design measures for the replacement Halligan Dam that include passive physical aeration. This will increase DO concentrations in water released to the North Fork, enhancing conditions for aquatic life immediately below the reservoir. As described in Section 3.4.2.3, DO concentrations at levels of concern to aquatic life are not anticipated below Halligan Reservoir; however, there is the potential for small decreases in DO in the Halligan Reservoir hypolimnion in the latter part of the summer. Because adverse impacts on aquatic life are not anticipated in terms of oxygen below Halligan Reservoir, inclusion of passive aeration in the outlet structure is considered to be a voluntary enhancement, as opposed to mitigation. Design measures are being evaluated that would increase DO include an updated stilling basin, a stepped spillway, and a turbulent discharge area with energy dissipation. This aeration will be applied to releases from both Fort Collins' and NPIC's portion of the enlarged Halligan Reservoir.

5.2.3 Terrestrial Resources Enhancements

5.2.3.1 Prohibition of Domestic Sheep and Goat Grazing on City Owned Lands Near Halligan Reservoir

An existing and ongoing challenge in CPW's management of the Lone Pine bighorn sheep herd is the known proximity of bighorn sheep to domestic sheep grazing (CPW 2021b). Several land managers within the Lone Pine herd-occupied range along or near key components of the Halligan Project use domestic sheep to control larkspur (*Delphinium species*), which are toxic to cattle. Although domestic sheep can be an effective vegetation management tool, this practice increases the chances of commingling between the Lone Pine herd and domestic sheep. The greatest concern of such commingling is the transmission of deadly pathogens between domestic sheep and goat populations and the Lone Pine herd. Therefore, as a measure to help reduce the long-term risk of disease transmission, Fort Collins will not allow during construction of the Halligan Project domestic sheep and goat grazing on all Fort Collins-owned lands around Halligan Reservoir and on any easements Fort Collins may grant on their lands around Halligan Reservoir. Fort Collins may explore making such prohibitions permanent.

5.2.3.2 Advocate for Cessation of Domestic Sheep and Goat Grazing on Private Lands Near Halligan Reservoir

Landowners near the Halligan Project Area periodically allow domestic sheep and goat grazing on their property to control larkspur, which are toxic to cattle and horses. Commingling of domestic sheep and goats with bighorn sheep is linked to disease transmission to bighorn sheep, which can result in bighorn sheep mortality. Fort Collins will engage with local landowners to advocate for both the temporary cessation of domestic sheep and goat grazing during construction, as well as for the permanent

cessation of domestic sheep and goat grazing near the Halligan Project Area. Ceasing domestic sheep and goat grazing on private property around the Halligan Project Area will avoid the potential for disease transmission from domestic sheep and goats to bighorn sheep.

5.3 Fort Collins Ecological Resource Monitoring

5.3.1 Streamflow Monitoring

As part of Halligan Project operations, Fort Collins has already installed one of two new North Fork streamflow gages associated with the Halligan Project. The first gage, located above the future inlet of the enlarged Halligan Reservoir, was installed by Fort Collins in fall 2020 in coordination with the United States Geological Survey. An existing stream gage is located below the Halligan Dam that will remain in the future. The second gage will be installed by Fort Collins at or below the bypass channel to be constructed on the North Poudre Canal Diversion to monitor streamflow and inform North Poudre Canal Diversion and Halligan Reservoir operations. In addition, Fort Collins will also rely on the existing Livermore gage located where the North Fork crosses West County Road 74E. Streamflow monitoring data will enhance the existing dataset that is available for public use and will also be used by Fort Collins to help inform operational decisions for the enlarged Halligan Reservoir.

5.3.2 Sediment, Macroinvertebrates, and Water Quality Monitoring

Sampling for sediment (percent fines and salmonid spawning habitat) and macroinvertebrates (TIV_{SED}), downstream of Halligan Reservoir will be conducted following protocols in WQCD Policy 98-1 (in agreement with Policy Statement 10-1, Aquatic Life Use Attainment, Methodology to Determine Use Attainment for Rivers and Streams). This sediment sampling will continue for a period of 5 years following the build out of Halligan Project operations, after which time the need to continue sampling will be reconsidered in coordination with CPW and WQCD. This sampling will help monitor sediment relative to standards and identify any new impairment or worsening conditions. This information can be used to determine appropriate response actions per the sediment management plan (Section 5.2.1.1), as needed.

Additionally, real-time oxygen and temperature data from multiple elevations in Halligan Reservoir during summer months will be needed to support operational decision-making for the MLOW, if an MLOW is installed (as discussed in Section 4.2.2.1). Real-time oxygen and temperature data from multiple elevations in Halligan Reservoir during summer months would be used to help manage water quality of releases to the North Fork with an MLOW. As such, this monitoring will be conducted as a critical component of the MLOW mitigation element, if an MLOW is installed.

Fort Collins will also monitor iron immediately below the enlarged reservoir for 5 years to determine if the flushing event (described in Section 4.2.1.6) is effective and/or necessary. This monitoring will consist of visual checks for iron deposition on sediment in the vicinity of the NBH sampling station (and photographic records of any observed deposition) as well as continued sampling at NBH for dissolved and total iron. However, if it is determined at the end of the first 5 years following construction (in consultation with CPW) that this operation is no longer needed, then the releases and special monitoring (observations of iron deposition) will end.

5.3.3 Bighorn Sheep Collaring Study

Collaring and tracking of the Lone Pine herd will be conducted before, during, and after the Halligan Project construction as part of the avoidance and minimization mitigation measures described in Section 4.2.3.18 and the compensatory mitigation measure described in Section 4.3.3.

5.4 Enhancement Costs and Schedule

Estimated costs and schedule for the mitigation components of this FWMEP follow in Appendix B.

This FWMEP includes a comprehensive description of all of Fort Collins' planned mitigation and enhancement measures for the Halligan Project that are related to fish and wildlife. Appendix B presents Fort Collins' total estimated mitigation and enhancement costs for all measures and denotes those that CPW staff believe are attributable to the Commission's recommendations pursuant to CRS Section 37-60-122.2 via separate cost columns.

Appendix B includes notes describing the mitigation commitments in the table being at a summary level and the text of this report shall take precedent over any discrepancies between the table and the FWMEP text. Also, capitalized costs in the table are the sum of the capital cost plus any annual operations and maintenance costs capitalized over the life of the commitment, or 50 years for those commitments that are perpetual. In addition, some of the costs in the table are firm not-to-exceed monetary commitments and the amounts are presented in 2022 dollars and will be increased in the amount of the U.S. Bureau of Labor Statistics Consumer Price Index for Denver-Aurora-Lakewood from January 1, 2023 to the date of final payment under the FWMEP obligation.

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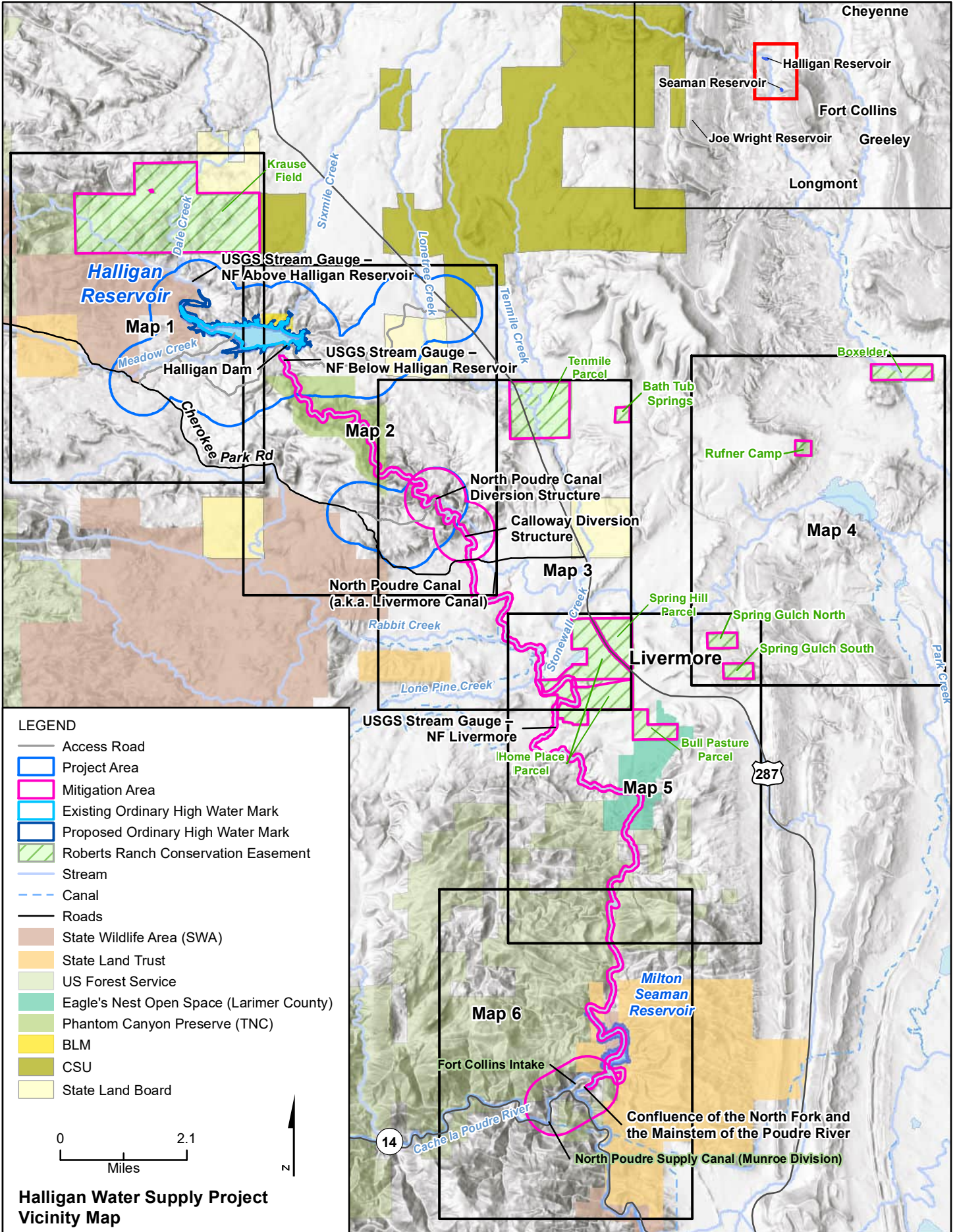
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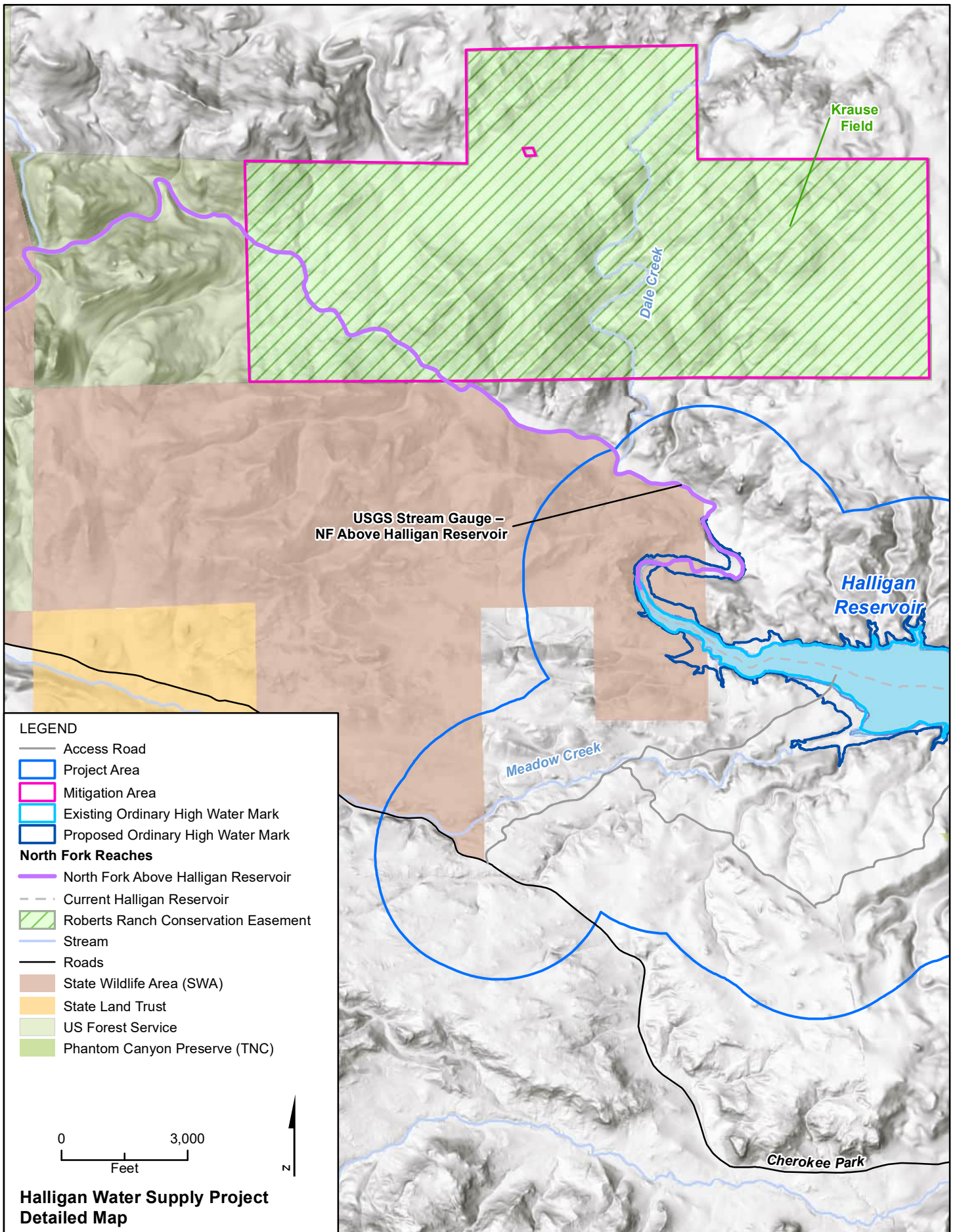
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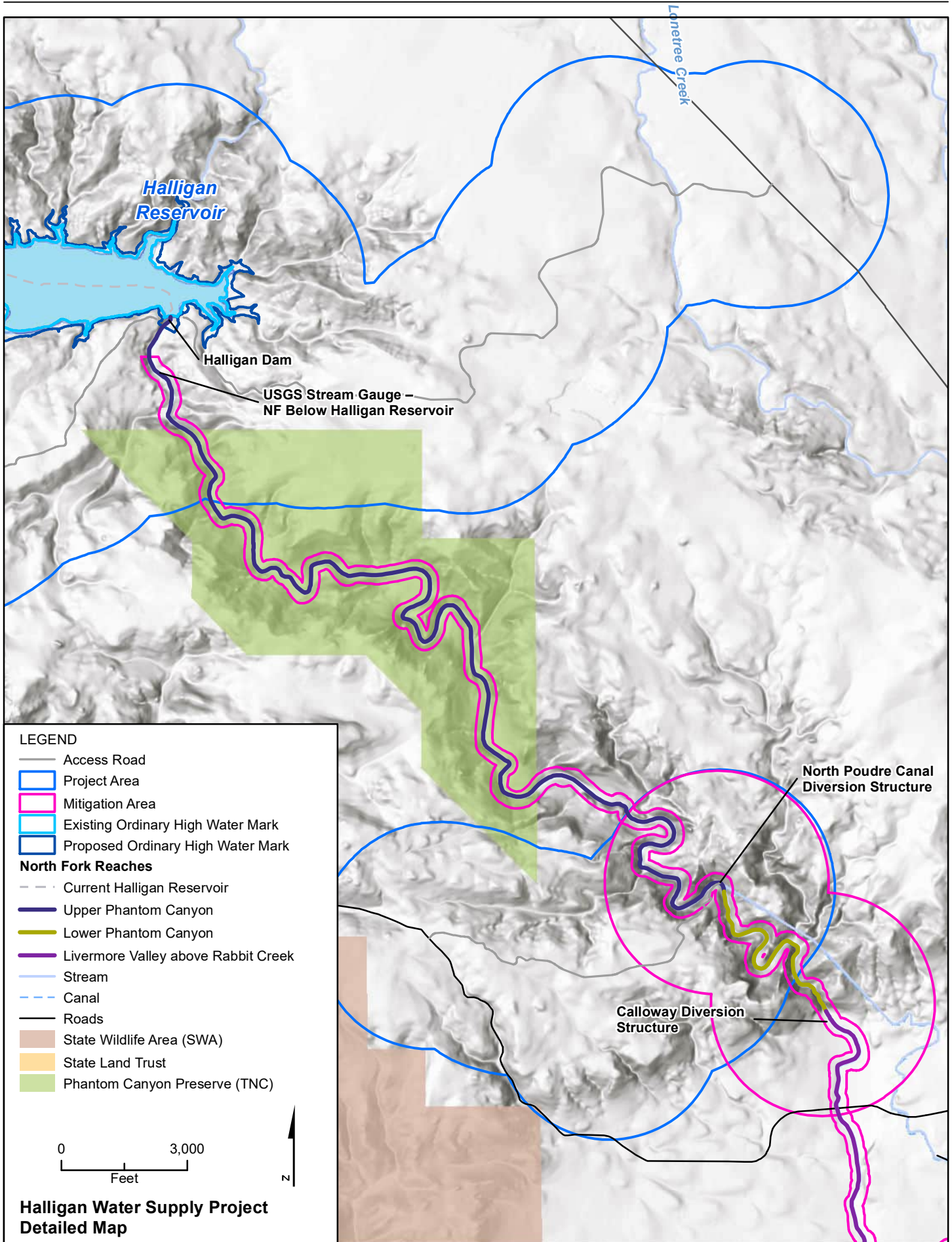
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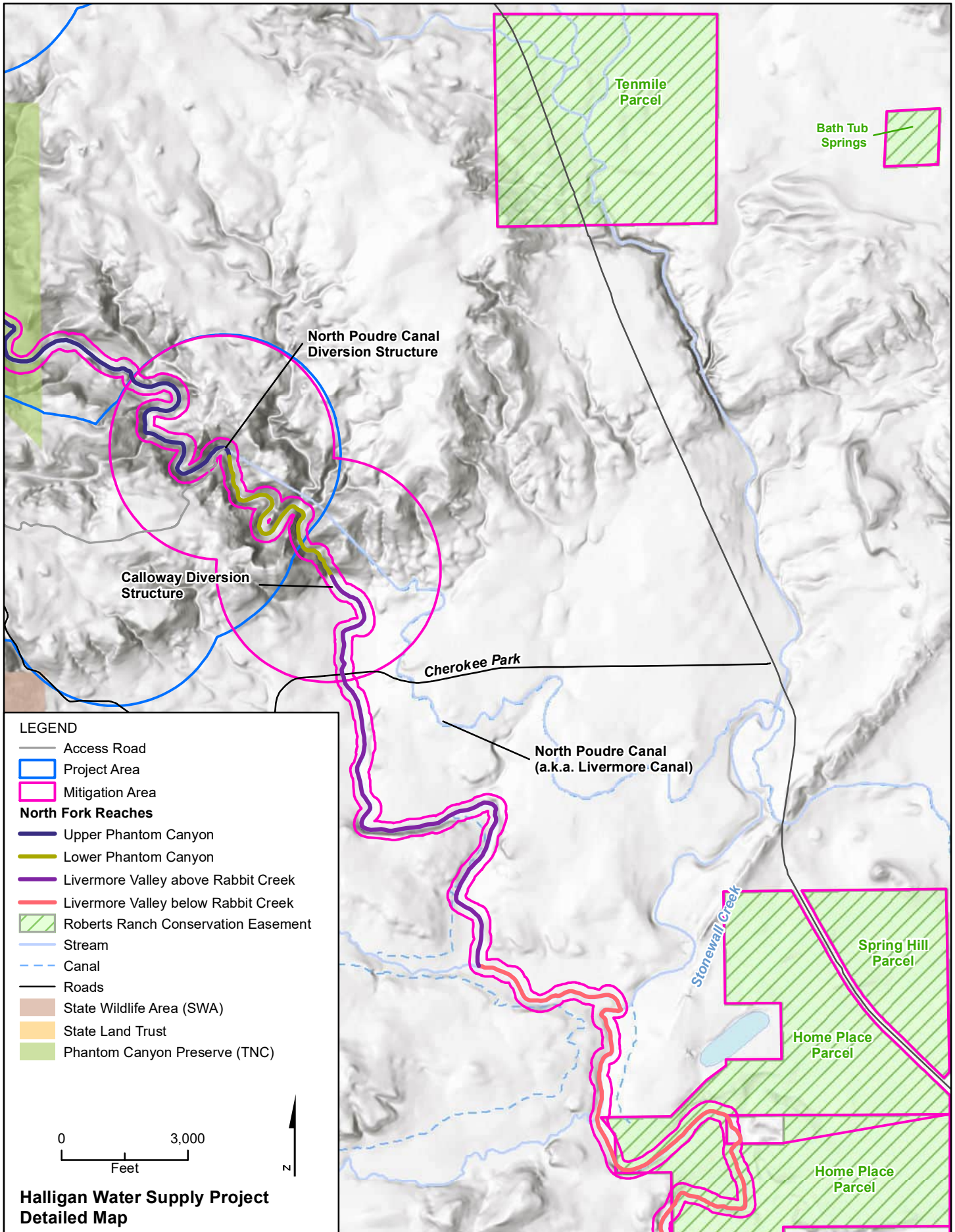
Appendix A Mapbook

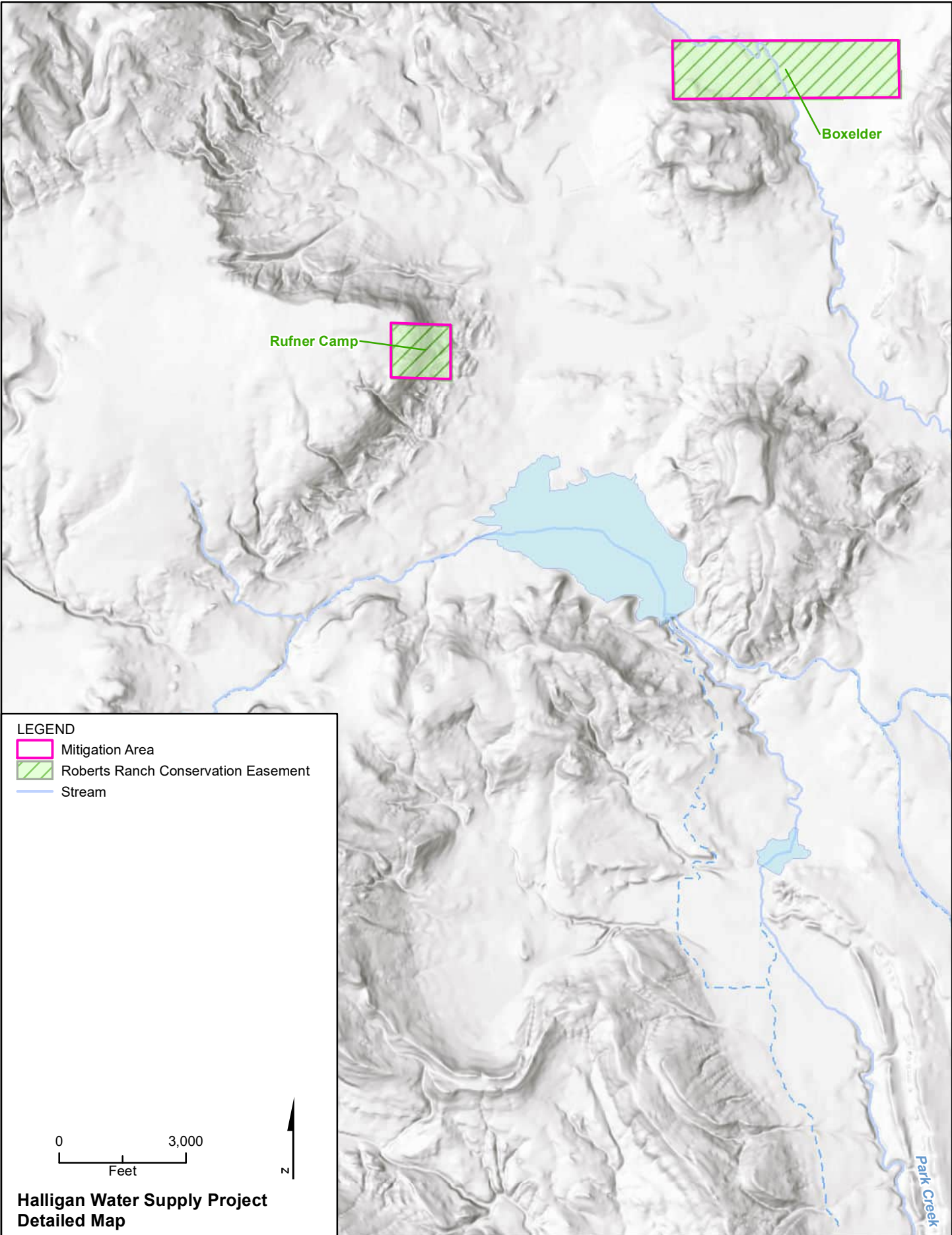


Halligan Water Supply Project Vicinity Map









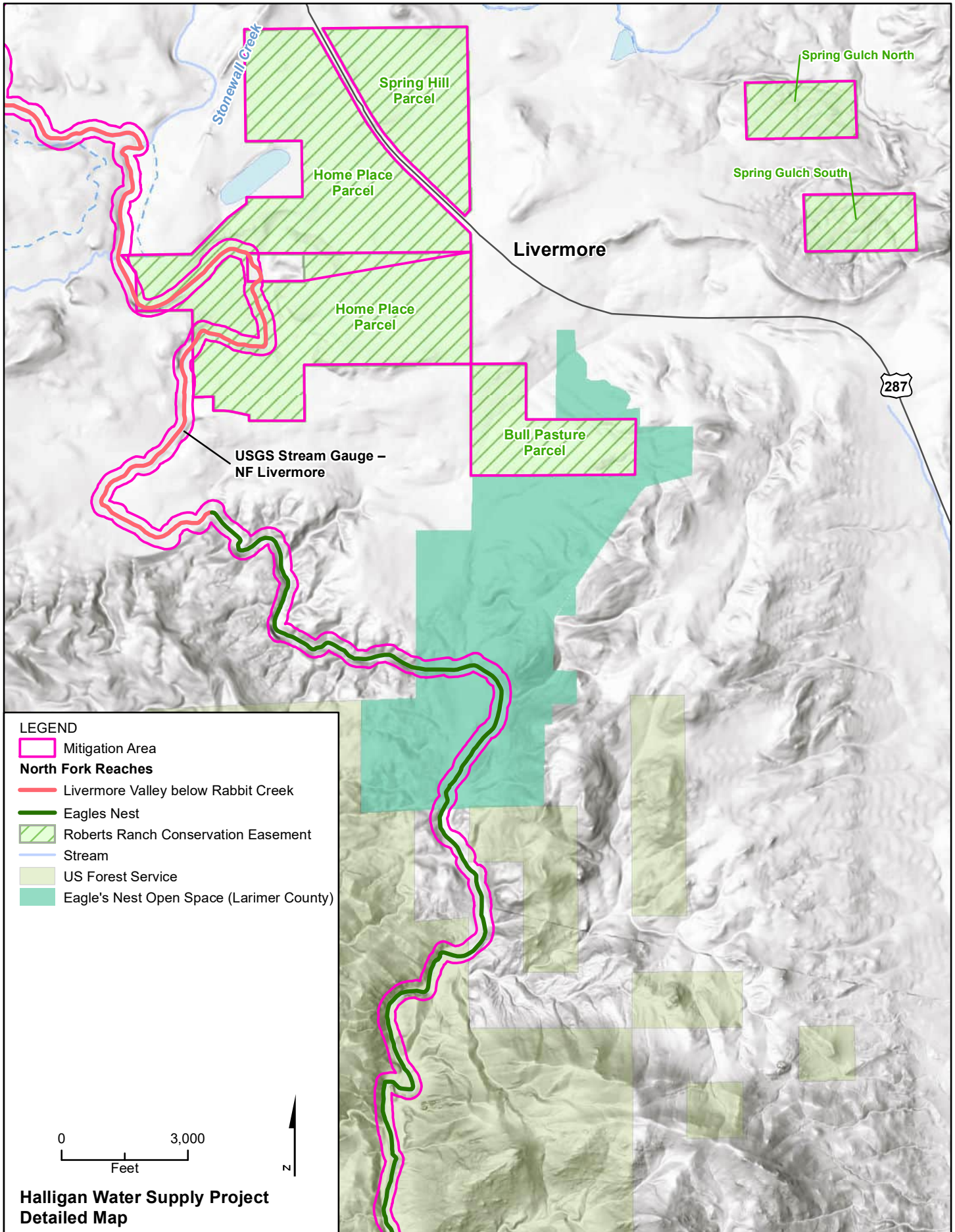
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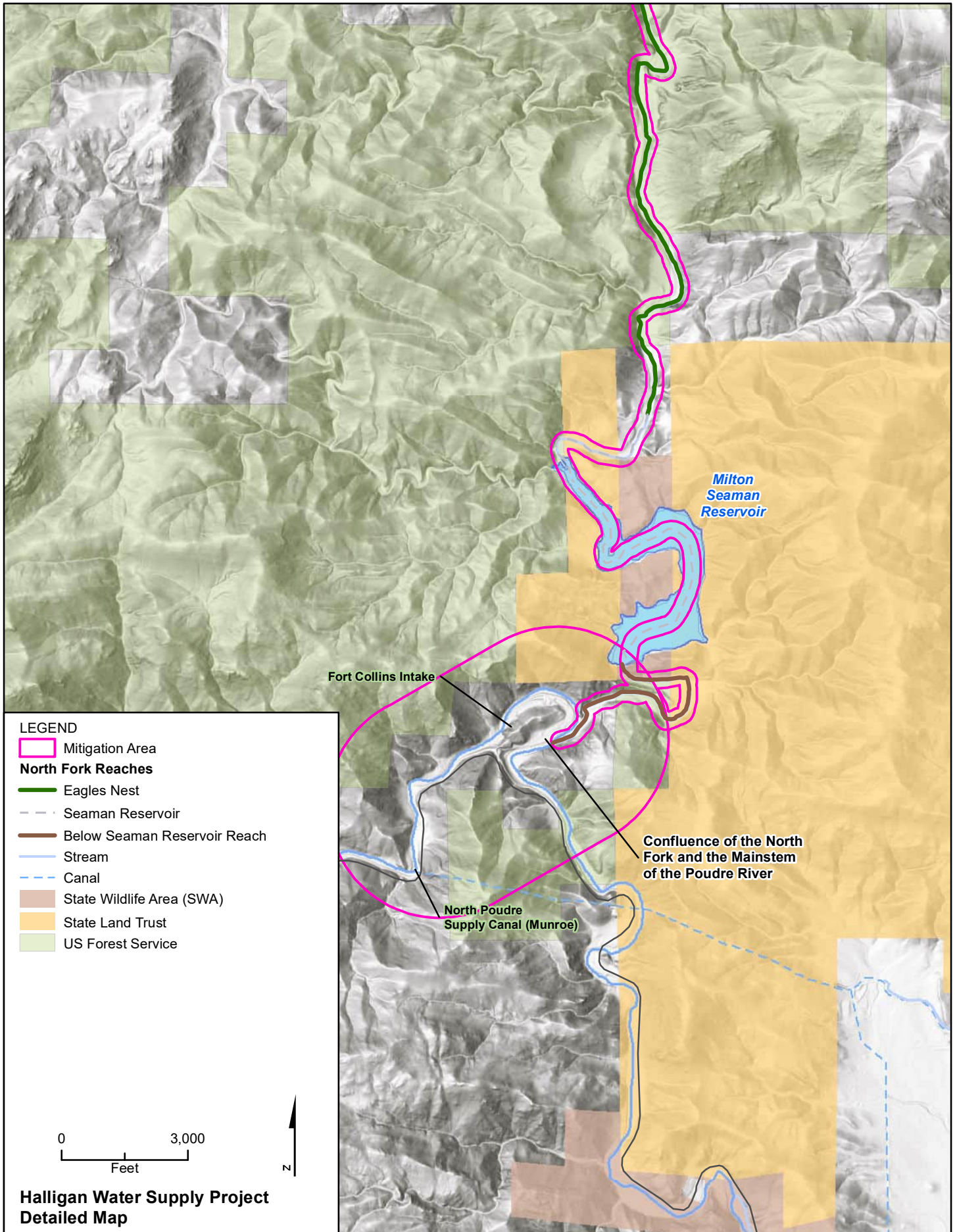
- Mitigation Area
- Roberts Ranch Conservation Easement
- Stream

0 3,000
 Feet



**Halligan Water Supply Project
 Detailed Map**





Appendix B

Summary of Mitigation Measures

Appendix B. Summary of Mitigation Measures

Table B-1. FWMEP Measures and Costs

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Avoidance and Minimization Mitigation Measures	Winter Release Plan	4.2.1.1	<p>As part of Halligan Project operations, Fort Collins will provide continuous releases of 3 cfs from its water stored in the enlarged Halligan Reservoir to the North Fork from October 1 through April 30 each year.</p> <p>NPIC cannot divert the winter releases into the North Poudre Canal pursuant to an existing agreement with Fort Collins. The Halligan Project involves reconstructing the North Poudre Canal Diversion similar to its current configuration but to allow the bypass of Fort Collins' releases from the enlarged Halligan Reservoir so that the water remains in the North Fork.</p>	<p>The Winter Release Plan will result in benefits to the North Fork by eliminating almost all zero-flow days on the North Fork (in combination with the Summer Low-flow Plan [Section 4.2.1.2]). Provide a continuous, more longitudinally connected aquatic corridor compared to the existing zero-flow conditions, create additional wetted channel area that will benefit small-bodied native fish, trout, and macroinvertebrates, and re-establish basic habitat requirements for aquatic species through the reintroduction of perennial flow.</p> <p>The Winter Release Plan will also result in benefits that will offset the impact resulting from the inundation of approximately 0.75 mile of the CWCB's instream flow water right (Water Court Case 1985CW430) on the North Fork above Halligan Reservoir.</p>	\$1,654,375	\$0
Avoidance and Minimization Mitigation Measures	Summer Low-Flow Plan	4.2.1.2	<p>Fort Collins will implement the Summer Low-Flow Plan, which adjusts reservoir operations by forgoing diversions and/or releasing its water stored in the enlarged Halligan Reservoir to maintain a minimum continuous 5 cfs flow in the approximately 22 miles of the North Fork between the replacement Halligan Dam and Seaman Reservoir (as measured at three gaging stations along the North Fork) from May 1 to September 30 each year (summer releases).</p> <p>NPIC cannot divert the winter releases into the North Poudre Canal pursuant to an existing agreement with Fort Collins. The Halligan Project involves reconstructing the North Poudre Canal Diversion similar to its current configuration but to allow the bypass of Fort Collins' releases from the enlarged Halligan Reservoir so that the water remains in the North Fork.</p>	<p>The Summer Low-Flow Plan will result in benefits to the North Fork by eliminating almost all zero-flow days on the North Fork (in combination with the Winter Release Plan, Section 4.2.1.1), which avoids and minimizes potential impacts on the aquatic ecosystem, including stream temperature from the Halligan Project.</p> <p>The Summer Low-flow Plan would increase flow rates on the North Fork in summer months at the times of the lowest current flow rates with anticipation of stream temperature benefits for the North Fork. Provide a continuous, more longitudinally connected aquatic corridor compared to the existing zero-flow conditions, create additional wetted channel area that will benefit small-bodied native fish, trout, and macroinvertebrates, and re-establish basic habitat requirements for aquatic species through the reintroduction of perennial flow.</p> <p>The Summer Low-Flow Plan will also result in benefits that will offset the impact resulting from the inundation of approximately 0.75 mile of the CWCB's instream flow water right (Water Court Case 1985CW430) on the North Fork above Halligan Reservoir.</p>	\$830,875	\$0
Avoidance and Minimization Mitigation Measures	Modified Summer Release Exchange Program	4.2.1.2	<p>Fort Collins will not exchange Summer Low-flow Plan releases (up to 5 cfs) from Halligan Reservoir up to either of the Fort Collins Intakes. This hiatus on exchanges will occur each year from July 1 to September 30.</p>	<p>This action will leave more water in the Main Stem upstream of the North Fork confluence and downstream to below the Hansen Supply Canal during times of the most critical temperature concern (July to September), minimizing Halligan Project temperature impacts in this critical season.</p>	\$645,000	\$0

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Avoidance and Minimization Mitigation Measures	Operational Agreement with Greeley	4.2.1.3	Fort Collins is pursuing an operational agreement with Greeley. The agreement would specify the need for Greeley to pass Halligan Releases, including the Winter Release and Summer Low-flow Plan of 3 cfs and up to 5 cfs directly through Seaman Reservoir. For this to be possible, upgraded outlet works may be needed in Seaman Reservoir. Greeley is currently in the process of upgrading their outlet works with support from federal funding. As part of the potential agreement, Fort Collins may provide additional funding support for further refinement of the new outlet works design for Seaman Reservoir. The goal of this additional funding would be to give the new outlet works the functionality and operational control to pass even the small Summer Low-flow Plan releases through Seaman Reservoir (that is, the refined new outlet works should allow for fine-scale management of releases on the order of 1 to 5 cfs).	<p>Fort Collins is pursuing the Greeley Agreement because, if the diversion and storage of Halligan Project summer releases by Greeley in Seaman Reservoir could be avoided, the river temperature benefits of the Summer Low-flow Plan could be extended to the approximately 1 river mile reach of the North Fork below Seaman Reservoir.</p> <p>In the event that Fort Collins cannot reach an agreement with Greeley to pass Fort Collins' Halligan Winter and Summer Low-flow Plan releases of 3 cfs and up to 5 cfs below Seaman Reservoir, and the CWA Section 401 water quality certification process determines that the Halligan Project has potential for occasional adverse temperature impacts on the North Fork below Seaman Reservoir that requires mitigation, Fort Collins commits to mitigating the identified temperature impacts attributable to the Halligan Project through stream restoration or other measures in a manner agreed to by Fort Collins, CDPHE, and CPW. If reasonably practicable, Fort Collins will mitigate the identified impacts along the river reach from Seaman Reservoir to the confluence with the Main Stem commensurate with Fort Collins identified impacts. If not reasonably practicable in the reach below Seaman Reservoir, Fort Collins will work with CDPHE and CPW to find other mitigation commensurate with the Halligan Projects identified impacts.</p>	\$1,150,000	\$0
Avoidance and Minimization Mitigation Measures	Ramping Rates Limitations	4.2.1.4	By applying ramping rate limitations, Fort Collins will seek to constrain existing and potential dramatic decreases and increases in the rate of discharge from Fort Collins' portion of the enlarged Halligan Reservoir to avoid and minimize impacts on aquatic species, particularly small-bodied native fish and rainbow trout. The ramping rate limitations will also help maintain a more natural descending limb of the North Fork hydrograph following peak flows by incorporating a more gradual decrease in outflow and establishing a lag time before returning the stream to a base flow level.	The ramping rate limitations are intended to protect aquatic life, as well as people recreating (for example, fishing) downstream, minimizing Fort Collins' impacts to aquatic ecosystems. Fort Collins will limit dramatic decreases and increases in the discharge rate resulting from Fort Collins' operation of its portion of the enlarged Halligan Reservoir. The details of ramping rate limitations to decreasing discharge rates and increasing discharge rates are described in Section 4.2.1.4 of the FWMEP.	\$625,000	\$625,000
Avoidance and Minimization Mitigation Measures	Peak-Flow Bypass Program	4.2.1.5	When the forecast peak flow has been estimated to within a few days, Fort Collins will forgo all diversions into its portion of the enlarged Halligan Reservoir for three days coinciding as closely as practicable, as detailed below, with the annual forecasted peak (runoff) flow event for the North Fork. The Peak Flow Bypass Program will allow 3 days (in addition to ramping rate limits Section 4.2.14) of peak flows during times when Fort Collins could be diverting water into storage in the enlarged Halligan Reservoir.	<p>The Peak Flow Bypass Program will avoid and minimize impacts on the aquatic ecosystem from the Halligan Project by maintaining some of the historical, pre-enlargement peak flows past the enlarged Halligan Reservoir. This Peak Flow Bypass Program is intended to mimic a natural, pre-enlargement stream flow for this 3-day period (in addition to ramping) to support riverine and ecological processes in the North Fork, such as the following:</p> <ul style="list-style-type: none"> ▪ Providing phenological cues to aquatic and riparian organisms for emergence of aquatic insects, spawning, the timing of flowering, and seed dispersal ▪ Facilitating natural seasonal sediment transport, channel shaping, and channel scour ▪ Recruiting and transporting woody debris and other organic materials ▪ Providing overbank flooding to maintain wetland and riparian habitat function, including seed transport and propagation of native cottonwood and willow species, sediment transport, formation and maintenance of aquatic habitat, and riparian area diversity and structure 	\$765,000	\$0

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Avoidance and Minimization Mitigation Measures	End of Summer Flushing Event	4.2.1.6	An end of summer flushing event (flushing event) will be conducted following fall turnover of Halligan Reservoir each year that a turnover event occurs (turnover is anticipated to occur in all years of normal Halligan Project operations) to address potential iron coatings on river materials. The intention of the flushing event would be to flush seasonal iron deposition (if it occurs) from sediment surfaces below the dam to minimize the potential adverse effects of such deposition, which is most likely to occur in late summer, if it were to occur.	The goal of the end of summer flushing event is to release a maximum of 30 acre-feet of water at the lowest discharge rate from the outlet of the enlarged Halligan Reservoir that is practicable to successfully mobilize the iron deposits. Targeting lower effective flow rates is desirable to avoid unintended adverse consequences on small-bodied fish and inadvertent sediment release. To avoid unintended adverse effects on small-bodied native fish and sediment, Fort Collins will seek CPW input regarding the planned rate, ramping, and timing of the release each year. Fort Collins would also monitor iron and habitat conditions immediately below the enlarged reservoir for 5 years to determine if this flushing event is effective and/or necessary. This monitoring will consist of visual checks for iron deposition on sediment in the vicinity of the NBH sampling station (and photographic records of any observed deposition) as well as continued sampling at NBH for dissolved and total iron. However, if it is determined at the end of the first 5 years following construction (in consultation with CPW) that this operation is no longer needed, then the releases and special monitoring (observations of iron deposition) will end.	\$7,650	\$0
Avoidance and Minimization Mitigation Measures	Legal Protection of Flows	4.2.1.1., 4.2.1.2, and 4.3.8	Through the Flow-related operational measures (Winter Release Plan, Summer Low-Flow Plan, Peak Flow Bypass) and Temporary Environmental Pool enhancement, Fort Collins will provide additional stream flow. NPIC cannot divert these flows into the North Poudre Canal pursuant to an existing agreement with Fort Collins. Additionally, Fort Collins will undertake a good faith effort to protect the Summer Releases from Halligan Reservoir to Seaman Reservoir using the “Protected Mitigation Release” statute (CRS 37-92-102[8]) in the same manner and subject to the same limitations as described for the Winter Release Plan.	Avoid/minimize impacts to aquatic species by protecting Halligan release from being removed between Halligan and the Mainstem of the Poudre. If Fort Collins fails to acquire a Water Court decree to protect Halligan Releases under the Protected Mitigation Release statute, or its agreement with NPIC changes such that Halligan Releases can be diverted into the North Poudre Canal, Fort Collins will consult with CPW in good faith to evaluate how Halligan Releases can be protected.	\$250,000	\$250,000
Avoidance and Minimization Mitigation Measures	Multi-Level Outlet Structure	4.2.2.1	A multilevel outlet works (MLOW) for Halligan Reservoir that would allow water to be released from one or more elevation higher than the bottom has been discussed since the CMP was put forth in the DEIS. An MLOW is a tool that can, in some cases, allow for beneficial additional management controls on the quality of water released from a reservoir, particularly at times of stratification. At this time, however, an MLOW is not expected to be necessary from the perspective of aquatic life mitigation efforts. Therefore, based on CPW comment, the MLOW is not a commitment in the FWMEP, but the need for an MLOW may be revisited through the 401 certification process.	During the 401 Certification process modeling and analysis findings will be reviewed to assess whether such a structure would provide effective and practical water-quality management options for mitigating anticipated project water-quality impacts. CWA Section 401 water quality certification model findings will be shared, and CPW and CDPHE will be consulted on this decision, as part of the CWA Section 401 water quality certification process.	\$0	\$0
Avoidance and Minimization Mitigation Measures	Outlet Conduit Sizing	4.2.2.2	To allow for the peak flow bypass mitigation measure (Section 4.2.1.5), Fort Collins incorporated an enlarged outlet conduit, which is larger than necessary to meet demand-based releases. The enlarged outlet will be constructed to release up to 800 cfs.	Minimize impacts to aquatic ecosystems by upsizing outlet size to allow peak flow bypass.	\$0	\$0

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Avoidance and Minimization Mitigation Measures	Big Game Interference Minimization	4.2.3.1	Fort Collins aims to avoid and minimize the Halligan Project’s potential impacts on wildlife within the Halligan Project Area when feasible. The Halligan Project includes many construction-related measures designed to avoid and minimize impacts on big game. Information specific to bighorn sheep is discussed in sections 4.2.3.17, 4.2.3.18, and 4.2.3.19.	Construction-related measures to avoid and minimize impacts on big game, including the following measures. Because these measures also benefit other resources, they are described elsewhere in the FWMEP: <ul style="list-style-type: none"> Construction scheduling to ensure efficient project delivery, to limit temporal impacts and number of seasons during which habitat is disturbed (4.2.3.13) Construction carpooling (Section 4.2.3.11) Management of fugitive dust during construction (Section 4.2.3.7) Minimizing construction disturbance areas Minimization of and the number and footprint of construction access roads and construction areas (Sections 4.2.3.9, 4.2.3.10, and 4.2.3.14) Reclamation and revegetation of temporarily disturbed areas (Section 4.2.3.9) Implementation of a noxious and invasive weed management plan for construction and reclamation activities (Section 4.2.3.15). Compensatory mitigation and enhancement measures specific to bighorn sheep are described in Sections 4.3.3 and 5.2.3.	\$0	\$0
Avoidance and Minimization Mitigation Measures	Preconstruction Botanical Surveys	4.2.3.2	Previous botanical surveys have not located Ute ladies’-tresses orchid in the area of Halligan Reservoir.	To further minimize the possibility of Project impacts on this federally threatened plant, botanical surveys will be conducted at a minimum of a year before construction. Surveys will focus on areas that will likely be disturbed by the Halligan Project and that could support the orchid, and be performed during the growing season (July and August). Results of preconstruction surveys will be submitted to USFWS as required by the ESA; CPW will be provided a courtesy copy of results.	\$10,200	\$0
Avoidance and Minimization Mitigation Measures	Preconstruction Bat Surveys	4.2.3.3	Visual and auditory detection surveys for bats were conducted in the area of Halligan Dam and up to 0.5 mile downstream of Halligan Dam in 2021. Several lone bats were detected during the surveys, but no large concentrations of bats were identified. The scattered occurrence of lone bat detections suggests that the area below Halligan Dam is used for foraging, but evidence of a bat colony or identification of roosting locations was not observed during this brief presence/absence survey.	To minimize the possibility of Project impacts on bats, additional surveys are warranted, including a survey for roosting sites near the dam. This additional bat survey work will be conducted in the year before construction commences for the Halligan Project. Surveys will focus on areas that will likely be disturbed by Halligan Project construction activities. If surveys indicate the presence of an active bat roost near the Halligan Dam, Fort Collins will consult with CPW on appropriate mitigation measures.	\$10,200	\$10,200
Avoidance and Minimization Mitigation Measures	Migrating Bird and Raptors Survey	4.2.3.4	Nest surveys were conducted in the area of Halligan Dam and along access roads in 2021.	Additional monitoring for migratory birds and raptors will be performed every other year before construction, the year before the start of construction, and annually during construction with a focus on areas of suitable habitat within planned or proposed disturbance areas in the immediate Halligan Project Area. Before and during construction activities, Fort Collins may use bird nesting deterrents during nesting season to reduce the risk of nesting activities during construction. Deterrent measures may include modifying or removing attractive nesting habitat (for example, trees, shrubs, tall grass) within potential disturbance areas during inactive periods to reduce the potential for construction-related impacts during active nesting periods. Before Project implementation, Fort Collins will provide CPW an opportunity to review and comment on Project specifications related to migratory bird and raptor nesting avoidance and minimization.	\$70,800	\$0

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Avoidance and Minimization Mitigation Measures	Raptor Nesting or Roosting Platforms	4.2.3.5	Fort Collins will include nesting or roosting platforms near Halligan Reservoir to encourage eagles and other raptors, such as osprey, to use the reservoir.	The platforms will also minimize any temporary loss of perching locations from the inundation of shoreline trees while new shoreline habitat becomes established. The final design and location of nesting or roosting platforms will be developed in coordination with CPW.	\$12,400	\$0
Avoidance and Minimization Mitigation Measures	Stormwater Management Plan	4.2.3.6	Targeted planning and successful execution of the stormwater management plan will reduce the potential for water quality degradation of the North Fork and its associated aquatic ecosystem.	Fort Collins will develop a stormwater management plan in compliance with local and state requirements and as required by the National Pollutant Discharge Elimination System (NPDES), Construction General Permit, COR400000 prior to construction, which will include all necessary stormwater management controls and best practices, temporary sediment and erosion control during construction, and medium-term sediment and erosion control during vegetation reestablishment. Additionally, a non-stormwater discharge permit and monitoring plan will be prepared, if required, before the start of construction.	\$14,800	\$0
Avoidance and Minimization Mitigation Measures	Best Management Practices	4.2.3.7	Fort Collins will employ standard construction best management practices (BMPs; also called control measures) typically included in federal, state, and local permit requirements to reduce potential construction-related impacts on upland and aquatic habitats, fish, and water quality. BMPs will be implemented at Project construction areas including dam construction and staging/stockpile areas, along access roads, the North Poudre Canal Diversion structure, and mitigation or enhancement sites that involve City-led construction. At a minimum, BMPs will include: <ul style="list-style-type: none"> ▪ Erosion control measures ▪ Sediment control measures ▪ Dust suppression measures ▪ Non-stormwater controls and waste and materials management ▪ Material management and waste management 	Avoid and minimize impacts to aquatic and terrestrial ecosystems. Refer to the FWMEP text for the complete list of best management practices. Additional measures may be incorporated if those described differ from permit conditions defined in the CWA Section 401 water quality certification and CWA Section 404 permit, or if site conditions warrant them.	\$1,171,250	\$48,750
Avoidance and Minimization Mitigation Measures	Existing Dam for Construction Sediment Control	4.2.3.8	Leaving the original dam in place during construction to act as a coffer dam provides strong control of sediment to allow for avoidance of an inadvertent major release of sediment during construction. The existing dam will continue to function normally during the entire time the replacement dam is being constructed; therefore, drawdown of the reservoir will not be necessary during construction. Once the replacement dam is complete, Fort Collins anticipates that a coffer dam will be put in place around the existing dam during the brief (a few months or less) demolition period.	Avoid and minimize impacts to aquatics by controlling existing reservoir sediments during construction.	\$0	\$0
Avoidance and Minimization Mitigation Measures	Construction Disturbance Minimization and Reclamation	4.2.3.9	Fort Collins will reclaim temporarily disturbed areas following construction completion. Materials stockpile and borrow areas created on Fort Collins' property may be left in place for long-term operations and maintenance of the enlarged Halligan Reservoir.	Reclaiming disturbed areas to their current condition will reduce the permanent footprint of the Halligan Project and reduce the potential for long-term ecological degradation. Revegetation and monitoring is described in Sections 4.2.3.7 and 4.2.3.15.	\$533,170	\$0

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Avoidance and Minimization Mitigation Measures	Access Road Minimization and Reclamation	4.2.3.10	To accommodate larger vehicles and equipment necessary to construct the Halligan Project and to implement some of the mitigation measures described herein existing roads will require some or all of the following: temporary widening to accommodate two-way truck traffic in some locations, placement of new culverts at drainage crossings, grade modifications, and road stabilization. In addition, use of the western access road will be limited as discussed in section 4.2.3.14	Fort Collins proposes using existing roads whenever possible and to reclaim access roads to their current condition following construction completion to reduce the permanent footprint of the Halligan Project and reduce the potential for long-term ecological degradation. Widened roads and turnouts created on Fort Collins property may be left in place for long-term operations and maintenance of the enlarged Halligan Reservoir; widened roads may be left in place on private property if requested by the landowner.	\$533,170	\$0
Avoidance and Minimization Mitigation Measures	Traffic Impact Minimization	4.2.3.11	Traffic impacts on residents will be limited to predominant ingress and egress from Highway 287, with less ingress and egress from Larimer County Road 80C (Cherokee Park Road). Given the complexity of construction activities associated with the Halligan Project, large amounts of staffing will be required to access the construction zone throughout Project construction.	To minimize impacts on traffic on Highway 287, Fort Collins will construct a temporary or permanent turn lane and/or an acceleration lane. This minimization measure will be designed and implemented in coordination with the Colorado Department of Transportation and Larimer County. Fort Collins will incorporate carpooling of staff to and from construction areas. Carpooling of staff will reduce traffic on access roads and minimize air quality impacts, greenhouse gas emissions, potential wildlife and vehicle collisions, and fugitive dust during construction. To minimize traffic impacts on wildlife as noted here, as well as Sections 4.2.3.1, 4.2.3.7, and 4.2.3.9, will minimize impacts on wildlife by using existing roads, reducing traffic-related equipment emissions and noise, reducing fugitive dust, reducing the potential for wildlife vehicle collisions, and reducing displacement and disturbance of habitats adjacent to construction activities and access roads. Construction of a temporary river crossing on the North Fork below the replacement dam will minimize traffic along County Road 80C by allowing direct access to the west side of Halligan Dam during construction (Section 4.2.3.14).	\$296,749	\$0
Avoidance and Minimization Mitigation Measures	Construction Impact Minimization that will Benefit Wildlife	4.2.3.12	Construction of certain elements of the Halligan Project are anticipated to occur throughout all hours of the day or night during certain construction milestones. Fort Collins proposes to minimize nighttime construction activities that have the potential to generate increased noise levels, such as blasting, and will proactively respond to noise complaints. Lighting impacts associated with Halligan Project nighttime construction activities will be minimized in consideration of both local residents and wildlife.	Lighting during construction will be limited to what is necessary for safety and security on the Project site during construction. Lighting will be angled and shielded to avoid light pollution and impacts on neighbors and wildlife. Noise will be minimized to the extent practicable during construction; Fort Collins plans to fit equipment with mufflers and apply construction standard practices for noise construction (the specific practices will depend on equipment used). Fort Collins' contractors will comply with Larimer County ordinances or approved variance requests through the county that may include noise shielding and reduction of after-hours activities.	\$0	\$0
Avoidance and Minimization Mitigation Measures	Construction Timing Restrictions at the North Poudre Canal and Calloway Diversions	4.2.3.13	To minimize potential construction-related disturbance to bighorn sheep spring and fall movements, Fort Collins and CPW have agreed to implement a 1-year construction window for both the North Poudre Canal and Calloway Diversions. To the extent reasonably possible, all work will be completed within one construction season beginning in November and ending the following end of March.	During the 1-year construction window, Fort Collins will perform work in two phases. During the first phase, work on the access road construction, and staging equipment and materials at the North Poudre Canal and Calloway Diversions will occur in July and August. Then during the second phase, both the North Poudre Canal and Calloway Diversions construction work will commence in November and conclude in March before spring movements by bighorn sheep through the mapped linkage area between the two diversion structures. To the extent reasonably possible, all work will be completed within one construction season beginning in November and ending the following end of March. In the unlikely event of an unforeseen occurrence such as extreme snow, Fort Collins will coordinate with CPW to develop a revised schedule.	\$109,500	\$109,500

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Avoidance and Minimization Mitigation Measures	Limited Use of Western Access Road	4.2.3.14	Following completion of the temporary construction access crossing of the North Fork below the Halligan Dam, which is planned in the first year of construction, use of the western access road intersecting Larimer County Road 80C (Cherokee Park Road) will be reduced to only occasional or as-needed access from April to July in the second and subsequent years of construction to reduce construction vehicle disturbance to wildlife in the area.	Minimization of potential animal and vehicular interference along Cherokee Park Road.	\$0	\$0
Avoidance and Minimization Mitigation Measures	Noxious and Invasive Weed Control and Revegetation	4.2.3.15	Restoration and revegetation will be completed for all temporarily disturbed areas using native plants. These disturbance areas will be monitored after construction to ensure successful re-establishment of vegetation in accordance with Construction General Permit requirement to stabilize all disturbed soil areas (Section 4.2.3.94.2.3.15) before completion of the Halligan Project. Specific revegetation/restoration details will be identified following final design.	Fort Collins will develop a noxious and invasive weed management plan for construction activities, in coordination with the Larimer County Weed District. No domestic sheep or goats will be used for weed control on City-owned property or easements Fort Collins grants to others in the vicinity of Halligan Reservoir. Noxious weed BMPs, including chemical, cultural, and mechanical measures, will be implemented during all construction phases for all Halligan Project disturbance areas, including access roads and buffers. Equipment will be cleaned so that it is free of accumulated soils that may carry noxious and invasive weed seeds to the Halligan Project Area	\$96,264	\$0
Avoidance and Minimization Mitigation Measures	Aquatic Nuisance Species	4.2.3.16	Fort Collins will take a proactive approach to preventing the introduction of aquatic nuisance species into Halligan Reservoir, the North Fork, and the Main Stem. Non-native species and invasive species pose a threat to ecosystems, and Fort Collins will minimize the risk of spreading aquatic nuisance species through implementation of BMPs to prevent the potential spread of these species in Halligan Reservoir and in the rivers.	Fort Collins will implement specific procedures to ensure that all equipment is cleaned of mud and debris (for example, tracks, turrets, buckets, drags, teeth), and inspected to confirm they are free of aquatic nuisance species. Specific decontamination measures for equipment or materials that were used in any stream, river, lake, pond, or wetland within 14 days of the start of the project to prevent the spread of New Zealand mudsnails, zebra and quagga mussels, invasive plant species, and other aquatic nuisance species will follow the most current guidance from CPW and are expected to include one or more of the following methods: <ol style="list-style-type: none"> 1. Remove all mud and debris from equipment (tracks, turrets, buckets, drags, and teeth) and spray/soak in a 1:15 solution of Quat 4 or Super HDQ Neutral institutional cleaners and water. Keep equipment moist with the solution for at least 10 minutes. 2. Remove all mud and debris from equipment (tracks, turrets, buckets, drags, and teeth) and continuously spray/soak equipment with water that is hotter than 140 degrees Fahrenheit for at least 10 minutes. Hand tools, boots, and any other equipment that will be used in the water will be cleaned, as well. 	\$30,000	\$0

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Avoidance and Minimization Mitigation Measures	Bighorn Sheep Habitat Improvements	4.2.3.18	<p>Fort Collins in consultation with CPW, has identified several areas within the Cherokee SWA that would provide the largest benefit to bighorn sheep habitat and foraging through cheatgrass mitigation. The habitat treatment targets cheatgrass seed germination, allowing for higher quality native forage to grow, which, in turn, may keep the Lone Pine herd within the boundaries of Cherokee SWA longer and away from domestic sheep during the April to July grazing period. The treatment should not alter normal migration routes, habitat range use, or lambing areas.</p> <p>Funding will be provided to CPW will install either two water guzzlers for precipitation capture or one water guzzler and one stock-tank type structure that uses water from a spring that CPW holds rights to develop. These features will passively (that is, external power source not needed) provide water sources away from Halligan Project disturbances and are expected to provide benefit before, during, and after construction. The water features will be used to enhance bighorn sheep habitat in areas that may be underused due to lack of water resources and within a reasonable distance of the priority habitat restoration area noted previously.</p>	<p>To improve bighorn sheep habitat opportunities and water access on the Cherokee SWA, Fort Collins will provide to CPW \$250,000 for chemical treatment to abate invasive cheatgrass over at least 500 acres, along with installation of two remote passive water sources. Funding is to complete a minimum of one round of cheatgrass treatment over 500 acres and the installation of two water features at least 2 years before the start of project construction in an effort to entice bighorn sheep away from construction areas and areas at times used for the grazing of domestic sheep. Any remaining monies up to the \$250,000 earmarked for vegetation and habitat restoration could be used by CPW for habitat treatment on additional acreages within the Cherokee SWA.</p> <p>The water features will be used to enhance bighorn sheep habitat in areas that may be underused due to lack of water resources and within a reasonable distance of the priority habitat restoration area noted previously.</p>	\$250,000	\$250,000
Avoidance and Minimization Mitigation Measures	Bighorn Sheep Collaring Study	4.2.3.19	<p>Support CPW in collaring bighorn sheep from the Lone Pine her to track their movements before, during, and immediately after Halligan Project construction. Collaring study results will support evaluation of whether construction may influence herd habits, in particular with respect to interactions with domestic sheep and/or other bighorn herds. CPW will implement the collaring study. GPS collar monitoring studies are needed to assess disease risk and habitat restoration needs for the Lone Pine Herd by gathering data on herd landscape use (habitat, spatial and temporal), recruitment, and overall health. Depending upon the Lone Pine Herd size, up to a maximum of 15 collars may be deployed.</p>	<p>Fort Collins will provide CPW additional funding of up to \$120,000 to support global positioning system (GPS) collaring of up to a maximum of 15 bighorn sheep from the Lone Pine herd. The preconstruction portion of the GPS collaring study will begin no less than 2 years before the anticipated start of the Halligan Project construction. GPS collars are expected to have a 2-year life and collect data approximately every 4 hours. Preconstruction collaring data will be considered viable for 5 years. Should construction be pushed beyond that initial 5-year window, a second GPS collar study would start 1 year from the start of construction. The intent of the second preconstruction GPS collar study is to have accurate and recent data on the Lone Pine herd's movements before construction. The Lone Pine herd will be fitted with GPS collars during all of the construction with collars having an anticipated 2-year battery life. The final phase will be a 2-year postconstruction GPS collaring event to evaluate postconstruction movement and habitat use.</p>	\$120,000	\$120,000
Avoidance and Minimization Mitigation Measures	Halligan Reservoir Sediment Management Plan	4.2.4	<p>Operating the reservoir, particularly at low water levels, in accordance with a plan developed by sediment experts is intended to avoid adverse sediment release events.</p>	<p>A sediment management plan will be developed for Halligan Reservoir that will provide guidelines for post-construction reservoir operations (including low water level operations). CPW will be given an opportunity to comment on the draft sediment management plan.</p>	\$75,000	\$0

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Compensatory Mitigation Measures	Preservation as Early Compensatory Mitigation Measure	4.3.1	In 2003 to 2004, as an act of early mitigation in anticipation of the Halligan Project, Fort Collins led the purchase and preservation of a permanent conservation easement of a 4,557-acre property known as Roberts Ranch, which comprises several disconnected parcels (Figure 4 8) in the Livermore Valley. The easement covers 4,557 acres of high-quality wildlife habitat and rangelands near Halligan Reservoir and is also adjacent to 14,000 acres of other state and locally protected lands.	<p>This early conservation effort provides the following benefits:</p> <ul style="list-style-type: none"> ▪ Direct and indirect ecological benefit to wildlife resources affected by the Halligan Project, including long-term preservation of suitable habitat for big game ungulates, as well as the federally and state threatened Preble’s meadow jumping mouse and the federally threatened Ute ladies’-tresses orchid ▪ Land preservation and conservation in perpetuity of habitat for wildlife and rare and native plants, and conservation of the diverse forest, shrubland, meadow, and riparian vegetative communities ▪ Approximately 2 decades of land preservation before disturbance from the Halligan Project construction activities ▪ Preservation of areas within the linkage area for the Lone Pine bighorn sheep herd where individual rams have been observed annually by local residents from approximately March to October on parcels of Roberts Ranch east of Highway 287 (Thode, pers. comm. 2021), and limitations on grazing such that species other than cattle or horses cannot be grazed on the property unless approved by The Nature Conservancy in areas where use of cattle or horses is impractical ▪ Conservation of more than 8.8 miles of perennial streams ▪ Direct connectivity to 14,000 acres of adjacent state and locally protected lands 	\$1,800,000	\$0
Compensatory Mitigation Measures	Fish Passage at the Fort Collins Intake at Gateway Park	4.3.2	The majority of diversions related to the Halligan Project will take place at the Fort Collins’ Intake at Gateway Park on the Main Stem. This diversion structure is located approximately 0.5 mile upstream of the confluence with the North Fork. The diversion structure currently acts as a barrier to fish movement, preventing the migration of fish past the structure. With this action, Fort Collins will compensate for reduction of flows on the Main Stem in the Exchange Reach between the Fort Collins Intake(s) and the North Fork confluence.	Fort Collins will construct fish passage around the Fort Collins Intake diversion structure at Gateway Park to increase connectivity for trout and other large-bodied fish species on the Main Stem and to compensate for impacts on Main Stem fisheries associated with flow changes as a result of the Halligan Project. The fish passage will be designed, in consultation with CPW, and to CPW’s Research and Design Guidelines, <i>Fish Passage and River Structures</i> to provide reliable upstream fish passage and will help to provide additional connectivity upstream of the Fort Collins Intake.	\$1,210,200	\$1,210,200
Compensatory Mitigation Measures	Bighorn Sheep Mortality Compensation	4.3.3	Fort Collins will avoid and minimize potential Project effects on bighorn sheep through the habitat improvements and movement tracking collaring study described in Sections 4.2.3.17, 4.2.3.18, 4.2.3.19 and through construction timing restrictions described in Section 4.2.3.13. Additional construction-related measures to avoid and minimize impacts on terrestrial wildlife, including bighorn sheep, are described in Section 4.2.3.7. If, despite these efforts, construction of the Halligan Project causes mortality to bighorn sheep in the Lone Pine herd, Fort Collins will offset this unavoidable impact through monetary compensation to CPW.	Fort Collins will provide monetary compensation of \$7,300 per sheep to CPW for any Lone Pine herd bighorn sheep that experience mortality during project construction and 2 years postconstruction. Although not all mortality experience during the construction period is anticipated to be caused by the Project, as a conservative approach Fort Collins is willing to assume that mortalities during the construction period and 2 years postconstruction will be compensated. Additionally, if Lone Pine herd mortalities are observed in the 2 years following the end of construction, Fort Collins will compensate CPW \$7,300 per sheep. CPW has concerns that the Halligan Project construction may cause Lone Pine herd sheep to change movement patterns such that they act as a vector for disease transmission from domestic sheep to the Lower Poudre herd. Fort Collins will work with CPW to develop an adaptive management approach to monitoring bighorn sheep movements to assess disease transmission, and will compensate CPW for Lower Poudre herd bighorn sheep that were exposed to respiratory disease because of the Halligan Project during and 2 years after construction.	\$0	\$0

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Compensatory Mitigation Measures	Compensatory Mitigation for Halligan Project Impacts on Stream Temperature	4.3.4	The restoration will be focused on either enhancing aquatic life habitat or funding a fish passage project, or both. This money is committed as a compensatory mitigation for unavoidable temperature impacts on the Main Stem.	Fort Collins will commit \$200,000 of funding for stream restoration efforts along the Main Stem to compensate for potential project-related temperature increases. Note: This commitment is separate from the \$200,000 enhancement commitment for the North Fork described in Section 5.1.1.6; however these funding commitments may be combined or used independently.	\$200,000	\$200,000
Compensatory Mitigation Measures	Compensatory Mitigation for Halligan Project Impacts on Wetlands	4.3.5	Wetland mitigation for Halligan Project impacts may include restoration, mitigation banking, or other measures that benefit fish and wildlife.	Compensatory mitigation and monitoring for wetlands will be described in a separate mitigation plan yet to be developed for approval by the Corps.	\$2,490,400	\$0
Compensatory Mitigation Measures	Special Status Species	4.3.6	Fort Collins seeks to avoid and minimize any adverse impacts on any special-status species. Halligan Project mitigation measures, such as the preservation of Roberts Ranch (Section 4.3.1), and the numerous avoidance and minimization measures (Section 4.2) will adequately mitigate potential Halligan Project effects on state-listed species. This applies for all of Section 4.3.6 except for Section 4.3.6.1 discussed in the next row.	No additional species-specific compensatory mitigation measures have been proposed. Although Fort Collins' mitigation actions directed towards special status species (e.g., Preble's meadow jumping mouse) will benefit other fish and wildlife, no costs are included here since they are considered in the Preservation as Early Compensatory Mitigation Measure.	\$0	\$0
Compensatory Mitigation Measures	Preble's Meadow Jumping Mouse Habitat Improvements/Monitoring Contribution	4.3.6.1	Mitigation and monitoring of Halligan Project impacts on Preble's are being developed in consultation with USFWS.	Mitigation and monitoring of Halligan Project impacts on Preble's are described in the <i>Halligan Water Supply Project Preble's Meadow Jumping Mouse Mitigation Plan</i> .	\$218,900	\$0
Compensatory Mitigation Measures	Recreational Resources	4.3.7	The surface of Halligan Reservoir is not open to the public for recreational use, the Halligan Project will not change the public's ability to recreate on the reservoir. The enlarged Halligan Project Reservoir will inundate approximately a 0.75-mile reach of the North Fork upstream of the existing Halligan Reservoir, resulting in the loss of approximately 20 acres of potential hunting lands and river fishing along a 0.4-mile stretch of this reach.	The proposed mitigation measure are discussed in detail in the next three rows relating to Sections 4.3.7.1, 4.3.7.2, and 4.3.7.3. If, separate from the current processes to enlarge Halligan Reservoir, the reservoir is opened to public recreation at a point in the future, any recreation plan proposed by Fort Collins that will affect the Cherokee SWA will be developed in conjunction with CPW and will consider impacts on fish and wildlife habitat, including impacts on any access through the Cherokee SWA. The recreation plan will also consider and compensate for the resource needs for CPW to stock and manage Halligan Reservoir for public angling access, if CPW determines it will maintain a public fishery.		
Compensatory Mitigation Measures	Reconciliation of Title Chain Confusion	4.3.7.1	Fort Collins discovered that approximately 39 acres of land in the eastern half of Section 29 and in the northeastern quarter of Section 32 that were thought to be owned by CPW are owned by Fort Collins and a private party. Upper portions of the enlarged Halligan Reservoir will be located on portions of these lands. For the most part, these lands are surrounded by the Cherokee SWA–Middle Unit and according to CPW, these lands have been accessed by the public for over 50 years ²⁰ . Fort Collins intends to acquire these lands for the enlarged Halligan Reservoir.	After acquiring these lands, Fort Collins will seek an agreement with CPW to convey an easement to CPW across these lands for public use, provided that the surface of the enlarged reservoir will not be opened to public access at this time. Any such agreement and conveyance will be subject to applicable laws, including statutes applicable to CPW, and the Fort Collins Municipal Code Chapter 23 (Public Property), Article IV (Disposition of Property), Division 2 (Real Property).	\$0	\$0

²⁰ Fort Collins is evaluating if and the extent to which the public has accessed this part of the inundation area and makes no representations on this issue.

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Compensatory Mitigation Measures	Funding of Public Access Lease with Roberts Ranch	4.3.7.2	The Krause Field parcel was conserved as a part of the Roberts Ranch conservation easement secured by Fort Collins and partners in 2003 and 2004 (refer to Section 4.3.1). CPW has been pursuing a lease allowing primitive foot access for hunting and fishing on the Krause Field parcel. Fort Collins understands that this lease will provide public access to over 2,200 acres of hunting and approximately 1 mile of river access and fishing, which includes the North Fork and potentially stretches of its tributaries, Dale Creek and Bull Creek.	Fort Collins will contribute funding to CPW to support a lease of the Krause Field parcel of Roberts Ranch. Fort Collins agrees to a one-time reimbursement in the amount of \$135,000 for CPW to pursue a long-term lease (in process) of the Krause Field parcel.	\$135,000	\$135,000
Compensatory Mitigation Measures	Parking Area Establishment at State Wildlife Area	4.3.7.3	An existing primitive parking area near the southwest portion of Halligan Reservoir is located on Fort Collins' property in the northeast quarter of Section 32. The parking area falls within an area previously thought to be owned by CPW. This parking area will be inundated by the enlarged Halligan Reservoir.	Fort Collins will provide \$30,000 in funds to create a new parking area on CPW land outside of the inundation area, to provide comparable access to this general location. The new parking area will be primitive and similar in form to the existing parking area.	\$30,000	\$0
Compensatory Mitigation Measures	Instream Water Rights	4.3.8	The enlarged Halligan Reservoir will inundate approximately 0.75 mile of the North Fork upstream of the current reservoir where the CWCB holds an instream flow water right.	Because of the additional stream flow that will be provided downstream, Fort Collins' commitment to protect those associated releases from Halligan Reservoir for approximately 22 miles downstream using the Protected Mitigation Release statute (CRS 37-92-102[8]), and the aquatic resource enhancements described in Section 5, no additional compensatory mitigation is proposed for impacts on the CWCB's instream flow water rights as part of this FWMEP.	\$0	\$0
Monitoring and Adaptive Management for Mitigation	Streamflow Monitoring	5.3.1	Streamflow monitoring data will enhance the existing dataset that is available for public use and will also be used by Fort Collins to help inform operational decisions for the enlarged Halligan Reservoir.	Fort Collins has already installed one of two new North Fork streamflow gages associated with the Halligan Project. The first gage, located above the future inlet of the enlarged Halligan Reservoir, was installed by Fort Collins in fall 2020 in coordination with the United States Geological Survey. An existing stream gage is located below the Halligan Dam that will remain in the future. The second gage will be installed by Fort Collins at or below the bypass channel to be constructed on the North Poudre Canal Diversion to monitor streamflow and inform North Poudre Canal Diversion and Halligan Reservoir operations. In addition, Fort Collins will also rely on the existing Livermore gage located where the North Fork crosses West County Road 74E.	\$2,487,200	\$0
Monitoring and Adaptive Management for Mitigation	Sediment, Macroinvertebrate, and Water Quality Monitoring	5.3.2	Sampling for sediment and macroinvertebrates, downstream of Halligan Reservoir will help monitor sediment relative to standards and identify any new impairment or worsening conditions. This information can be used to determine appropriate response actions per the sediment management plan, as needed. Fort Collins will also monitor iron immediately below the enlarged reservoir for 5 years to determine if the flushing event (described in Section 4.2.1.6) is effective and/or necessary. If a MLOW is installed (described in Section 4.2.2.1), real-time oxygen and temperature data from multiple elevations in Halligan Reservoir during summer months will be needed to support operational decision-making for the MLOW.	This sediment sampling will continue for a period of 5 years following the build out of Halligan Project operations, after which time the need to continue sampling will be reconsidered in coordination with CPW and WQCD. Iron monitoring will consist of visual checks for iron deposition on sediment in the vicinity of the NBH sampling station (and photographic records of any observed deposition) as well as continued sampling at NBH for dissolved and total iron. However, if it is determined at the end of the first 5 years following construction (in consultation with CPW) that this operation is no longer needed, then the releases and special monitoring (observations of iron deposition) will end. If a MLOW is installed (described in Section 4.2.2.1), real-time oxygen and temperature data from multiple elevations in Halligan Reservoir during summer months would be used to help manage water quality of releases to the North Fork with an MLOW. As such, this monitoring will be conducted as a critical component of the MLOW mitigation element.	\$120,000	\$120,000

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Monitoring and Adaptive Management for Mitigation	Adaptive Management Costs	Various Measures	Adaptive management in response to environmental monitoring is indirectly incorporated into some mitigation and enhancement measures in the FWMEP, including the MLOW, bighorn sheep collaring and mortality compensation, sediment management, and temporary environmental pool measures.	This measure will help with aquatic and terrestrial species and ecosystems by monitoring and adapting plans accordingly. The FWMEP capitalization cost of \$37,500 is for adaptive management related to bighorn sheep.	\$225,000	\$37,500
Monitoring and Adaptive Management for Mitigation	Bighorn Sheep Collaring Study	5.3.3	Collaring and tracking of the Lone Pine herd will be conducted before, during, and after the Halligan Project construction.	The commitments are captured in the avoidance and minimization mitigation measures described in Section 4.2.3.18 and the compensatory mitigation measure described in Section 4.3.3.	\$0	\$0
Enhancement Measures	Temporary Environmental Pool	5.1.1.1	Between the time that Halligan Reservoir is enlarged and the time when Fort Collins grows into its future demand levels associated with the Halligan Project, Fort Collins will dedicate an annually variable storage volume in the enlarged Halligan Reservoir to release for environmental benefits downstream. This annually variable volume of water dedicated for environmental benefits is referred to as the temporary environmental pool (TEP). The purpose of the TEP is to enhance the environmental benefit, or functional lift, of the flow-related operational measures described in Section 4.2.1. The primary objective of the TEP is to positively affect stream health in the North Fork from the replacement Halligan Dam to Seaman Reservoir. In general, the TEP will be used to benefit whole stream health, with the ability to focus on specific river functions, or single-species management in select years. Use of the TEP will be informed by first principles of river ecology.	Fort Collins will determine the volume of water available for the TEP each year. Volumes in the range of 500 to 1,000 acre-feet are expected to be available; however, the actual volume available could increase or decrease after information is gained from the first several years of operation of the enlarged Halligan Reservoir. Decisions regarding the volume of water allocated each year will be made by Fort Collins. The volume and targeted window for releases will be determined before July 1 each year. The window for releases will typically be from July 1 to the following April 30. Fort Collins will not re-divert the TEP releases until after they have reached the confluence with the Main stem of the Poudre River. The primary stakeholders for the TEP will be Fort Collins and CPW. The best use of this water will be determined based on decreed beneficial uses of the water rights and current conditions at that point in time and the greatest ecological concerns or issues, with one of the priorities being management of small bodied native fish species downstream of Halligan Reservoir. Operational targets for use of the TEP could be set for several years at a time to address multiple ecological priorities. NPIC cannot divert the TEP releases into the North Poudre Canal pursuant to an existing agreement with Fort Collins.	\$150,000	\$0
Enhancement Measures	Joint Operations	5.1.1.2	Fort Collins will continue to entertain opportunities for operational synergies with other managed water deliveries in the Poudre River watershed in order to potentially provide targeted benefits to the watershed.	Potential enhancement to environmental benefits related to stream flows.	\$0	\$0
Enhancement Measures	Fish Passage at the Reconstructed North Poudre Canal Diversion	5.1.1.3	North Poudre Canal Diversion is approximately 6 miles downstream of Halligan Reservoir on the North Fork. The structure currently acts as a barrier to upstream fish passage, preventing the migration of fish past the structure.	Fort Collins will reconstruct the North Poudre Canal Diversion so that Fort Collins' releases can be bypassed by that structure and remain in the North Fork. To provide increased connectivity for small-bodied native species and trout in the North Fork, Fort Collins will incorporate fish passage into or around the reconstructed North Poudre Canal Diversion, in the form of a fish ladder, bypass channel, or other infrastructure. Fish passage will be designed, in consultation with CPW, and to CPW's Fish Passage and River Structures Research and Design Guidelines to provide reliable fish passage at the North Poudre Canal Diversion and connect an extensive reach of the North Fork.	\$1,759,750	\$0

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Enhancement Measures	Channel Improvements and Modifications of the Calloway Diversion	5.1.1.4	The Calloway Diversion is located on the North Fork approximately 7.5 river miles downstream of Halligan Reservoir. The diversion is no longer used. Although water passes the structure, it acts as a barrier to fish passage, preventing the migration of fish past the structure.	Fort Collins will pursue an agreement in good faith with the landowners and other stakeholders to complete this project. A preliminary concept was developed in collaboration with landowners, CPW, and other stakeholders, includes removal of the center portion of the structure, while leaving the sidewalls of the structure in place.	\$1,120,645	\$0
Enhancement Measures	Ramping Rate Limitations for NPIC's Pool in an Enlarged Halligan Reservoir	5.1.1.5	The ramping rate limitations described in Section 4.2.1.2 apply only to Fort Collins' operation of its portion of the enlarged Halligan Reservoir; they do not apply to operation of NPIC's portion of the reservoir.	Fort Collins will commit to making a good faith effort to reach an agreement with NPIC to adhere to the same ramping rate limitations. Previous discussions with NPIC indicate that it would prefer to explore any such commitments after the enlarged reservoir is operational for several years.	\$0	\$0
Enhancement Measures	North Fork Stream Restoration	5.1.1.6	Fort Collins will commit to provide funding for stream restoration efforts along the North Fork. The restoration will be focused on either enhancing habitat for small-bodied native fish or salmonids.	Fort Collins will commit \$200,000 of funding for stream restoration efforts along the North Fork. This commitment is separate from the \$200,000 mitigation commitment for the Main Stem described in Section 4.3.4; these funds may be combined or used independently. Fort Collins and CPW will have final approval authority on any use of funds.	\$200,000	\$200,000
Enhancement Measures	Bottom Release from Halligan when Spilling	5.2.1.1	Water will be released from Halligan Reservoir through the bottom outlets at times when the reservoir is spilling over the dam. Avoiding buildup of sediment behind the dam should, in part, help avoid an adverse sediment release event like the one that occurred because of operations in 1996. Thermal shock can occur below the Halligan Reservoir dam under current Halligan Reservoir dam operations. The Halligan Project has an inherent benefit of reducing the current frequency of thermal shock below Halligan Reservoir dam because no spilling is anticipated (per DEIS flow modeling) to occur in summer or fall months (that is, at times when the reservoir is thermally stratified).	Bottom release should allow for reduced retention of sediment in Halligan Reservoir, allowing for appropriate sediment transport downstream to the North Fork. This measure is also considered a voluntary enhancement in terms of river temperature for its parallel benefits in reducing the risk of thermal shock below the Halligan Reservoir dam. Bottom releases during spilling would provide further enhancement in terms of further reducing the risk of thermal shock because such releases would serve to blend top and bottom temperatures, minimizing the sharp temperature change in releases, in the unanticipated event that the reservoir does spill at a time of thermal stratification with the Halligan Project.	\$0	\$0
Enhancement Measures	Passive Aeration in Outlet Structure	5.2.2	Fort Collins will incorporate design measures for the replacement Halligan Dam that passive physical aeration. This will increase dissolved oxygen concentrations in water released to the North Fork, enhancing conditions for aquatic life immediately below the reservoir. This aeration will be applied to releases from both Fort Collins' and NPIC's portion of the enlarged Halligan Reservoir.	Because adverse impacts on aquatic life are not anticipated in terms of oxygen below Halligan Reservoir, inclusion of passive aeration in the outlet structure is considered to be a voluntary enhancement, as opposed to mitigation. Design measures being evaluated that would increase DO include an updated stilling basin, a stepped spillway, and a turbulent discharge area with energy dissipation. This aeration will be applied to releases from both Fort Collins' and NPIC's portion of the enlarged Halligan Reservoir.	\$0	\$0
Enhancement Measures	Prohibition of Domestic Sheep and Goat Grazing on City-owned Lands Near Halligan Reservoir	5.2.3.1	Several land managers within the Lone Pine herd-occupied range along or near key components of the Halligan Project use domestic sheep to control larkspur (Delphinium species), which are toxic to cattle. Although domestic sheep can be an effective vegetation management tool, this practice increases the chances of commingling between the Lone Pine herd and domestic sheep. The greatest concern of such commingling is the transmission of deadly pathogens between domestic sheep and goat populations and populations and the Lone Pine herd.	As a measure to help reduce the long-term risk of disease transmission, Fort Collins will not allow during construction of the Halligan Project domestic sheep and goat grazing on all Fort Collins-owned lands around Halligan Reservoir and on any easements Fort Collins may grant on their lands around Halligan Reservoir. Fort Collins may explore making such prohibitions permanent.	\$0	\$0

Measurement Type	Mitigation, Monitoring, and Enhancement Measure	FWMEP Section	Purpose for Measure	Description of the Commitment ^[a]	Fort Collins Total Capitalized Cost ^[b]	FWMEP Capitalized Cost ^[b]
Enhancement Measures	Advocate for Cessation of Domestic Sheep and Goat Grazing on Private Lands Near Halligan Reservoir	5.2.3.2	Landowners near the Halligan Project Area periodically allow domestic sheep and goat grazing on their property to control larkspur, which are toxic to cattle and horses. Comingling of domestic sheep and goats with bighorn sheep is linked to disease transmission to bighorn sheep, which can result in bighorn sheep mortality.	Fort Collins will engage with local landowners to advocate for both the temporary cessation of domestic sheep and goat grazing during construction, as well as for the permanent cessation of domestic sheep and goat grazing near the Halligan Project Area. Ceasing domestic sheep and goat grazing on private property around the Halligan Project Area will avoid the potential for disease transmission from domestic sheep and goats to bighorn sheep.	\$0	\$0
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Mitigation	\$15,345,903	\$2,958,650
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Monitoring and Adaptive Management	\$2,832,200	\$157,500
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Total Mitigation, Monitoring and Adaptive Management Cost	\$18,178,103	\$3,116,150
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Enhancement	\$3,230,395	\$200,000
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Total Mitigation and Enhancement Costs for Project	\$21,408,498	\$3,316,150
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Total Design and Construction Costs (Per 30% Design)	\$144,584,000	Not Applicable

^[a] The description of mitigation commitments is at a summary level - see text for details of the commitment. The text shall take precedent over any discrepancies between this table and the text.

^[b] Capitalized cost is the sum of the capital cost plus any annual operations and maintenance costs capitalized over the life of the commitment, or 50 years for those commitments that are perpetual.

Appendix C

Surface Water Quality Supplemental Information

Appendix C. Surface Water Quality Supplemental Information

This appendix presents an overview of surface water quality current conditions for Halligan Reservoir, Seaman Reservoir, the North Fork, and the Main Stem. This appendix is intended to be a high-level summary and is not intended to fully recreate documentation of the studies/communications referenced (Hydros 2020, 2021a, 2021b, 2021c, and 2021d, 2022a, 2022b, and 2022c). Instead, highlights of the key findings regarding current surface water-quality conditions are presented, by area. The referenced studies rigorously document the conceptualization of existing major drivers of spatial and temporal variability in temperature and water quality in Halligan Reservoir, Seaman Reservoir, the North Fork, and the Main Stem. The conceptual understanding in those documents is based on evaluation of observed water-quality data, flow data, diversion patterns, reservoir operations, geology, point sources, land use, and spatially varying meteorological conditions. Observed data were also compared in these studies to applicable aquatic life water-quality standards to identify existing concerns relative to standards. Sampling stations considered in those analyses and referenced in this appendix are presented in Appendix D, Water Quality Sampling Location Maps. Additionally, Appendix D is supported by two memoranda (Hydros 2022a and Hydros 2022c).

C.1 Halligan Reservoir

Current conditions in Halligan Reservoir are discussed in Hydros (2020, 2022a, and 2022c) and summarized briefly here. Halligan Reservoir is currently an approximately 6,400 acre-feet, on-channel, water supply reservoir on the North Fork. The reservoir is relatively shallow except near the dam (Figure C-1). The annual residence time is relatively short, averaging roughly 26 days (based on observed data from 2010 to 2018). Monthly residence times tend to be relatively low (fewer than 30 days) from April through October and higher in winter months of November through March (Figure C-2). This reflects the typical seasonal inflow and release patterns. Inflows into the reservoir follow a typical pattern of high flows during spring snowmelt runoff and declining flows through the summer. The reservoir fills in the winter and the timing of full pool can vary by year, sometimes filling as early as the end of December and sometimes not filling until the end of May. The reservoir stratifies each year, generally from May to August, with the duration of stratification being limited by strong winds and reservoir operations that draw down water levels during summer. Water can be released via outlet works at the bottom of the reservoir and/or at the spillway (when the reservoir is full).

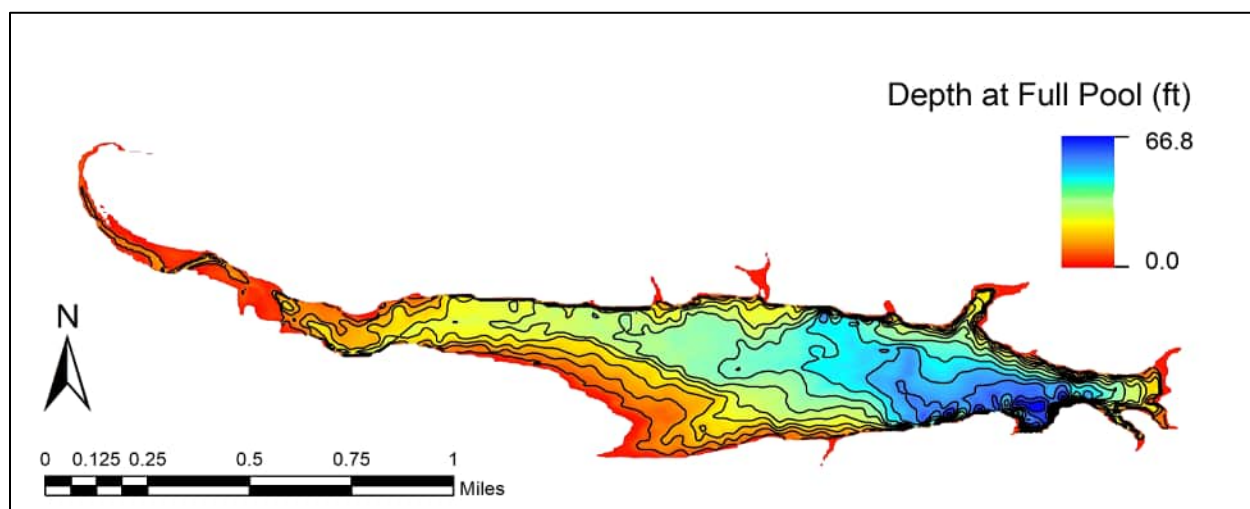


Figure C-1. Bathymetric Map of Halligan Reservoir (Based on 2003 Survey) at Existing Full Pool

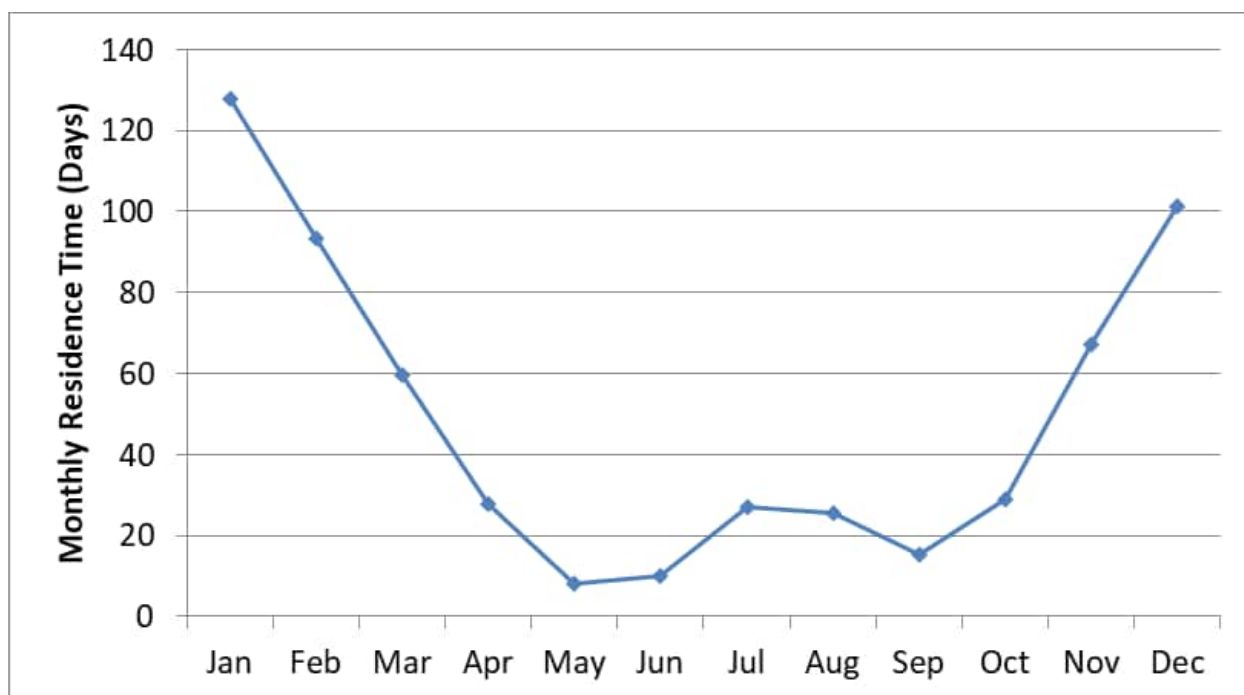


Figure C-2. Average Monthly Residence Time in Halligan Reservoir (Based on Observed Release Rates and Storage Volumes from 2010 to 2018)

For most constituents, inflow concentrations to Halligan Reservoir peak during spring runoff and then decline. While the reservoir is stratified during summer, the hypolimnion can become hypoxic (≤ 2 milligrams per liter [mg/L] dissolved oxygen [DO]; Figure C-3) and internal loading of redox-sensitive constituents from the sediments is observed. Chlorophyll *a* concentrations tend to be relatively low, averaging 6 micrograms per liter [$\mu\text{g/L}$] for July through September (2016 to 2019). The maximum observed chlorophyll *a* concentration in Halligan Reservoir (2016 to 2019) is 13.3 $\mu\text{g/L}$ (November 8, 2016; Figure C-4).²¹ The reservoir is not on the current CWA Section 303(d) list or the

²¹ Note that the sampling stations considered in the development of the understanding of current conditions for surface water quality are mapped in Appendix D.

Monitoring and Evaluation list for any constituents (WQCC 2021b) because the data were not previously shared with WQCD; however, a comparison of observed data to applicable aquatic life water-quality standards and interim nutrient criteria (WQCC 2020) indicates possible current in-reservoir concerns for dissolved silver, water temperature, and total phosphorus.

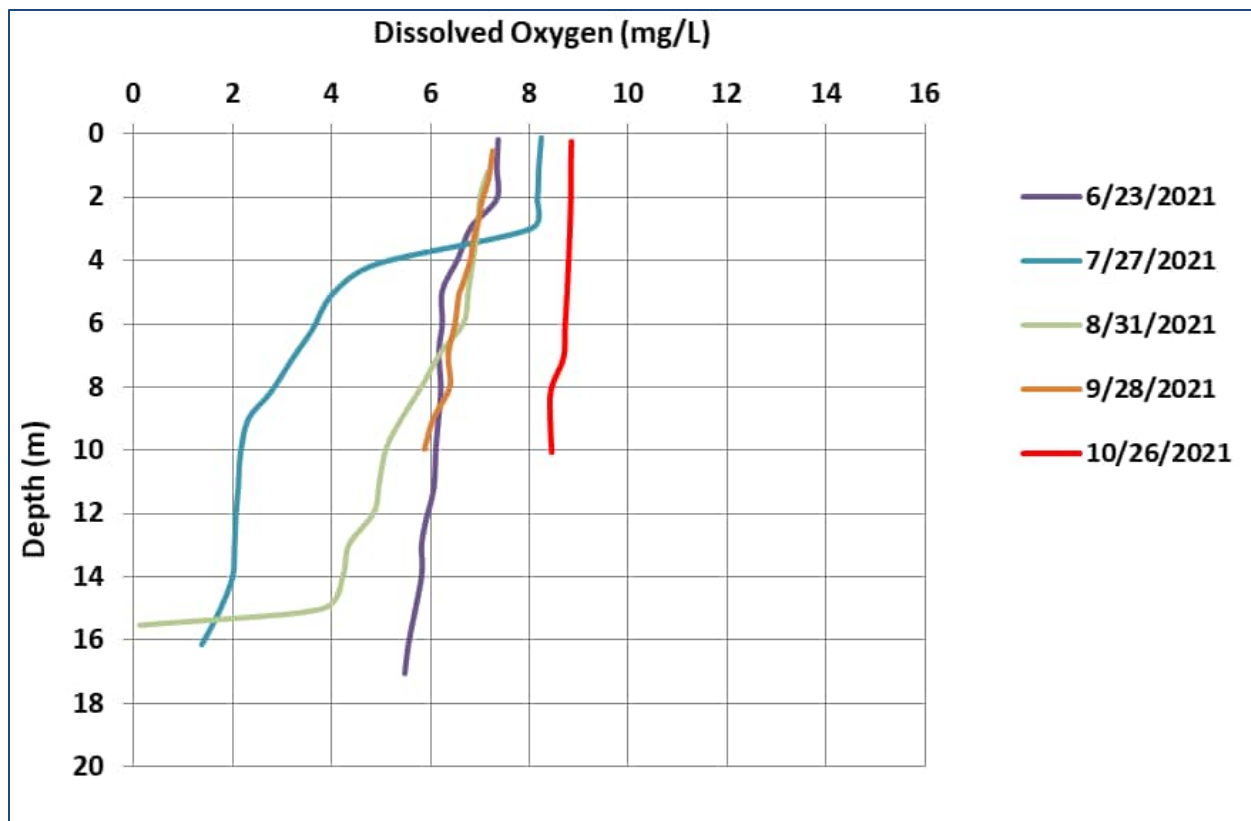


Figure C-3. Dissolved Oxygen Profiles in Halligan Reservoir (2021)

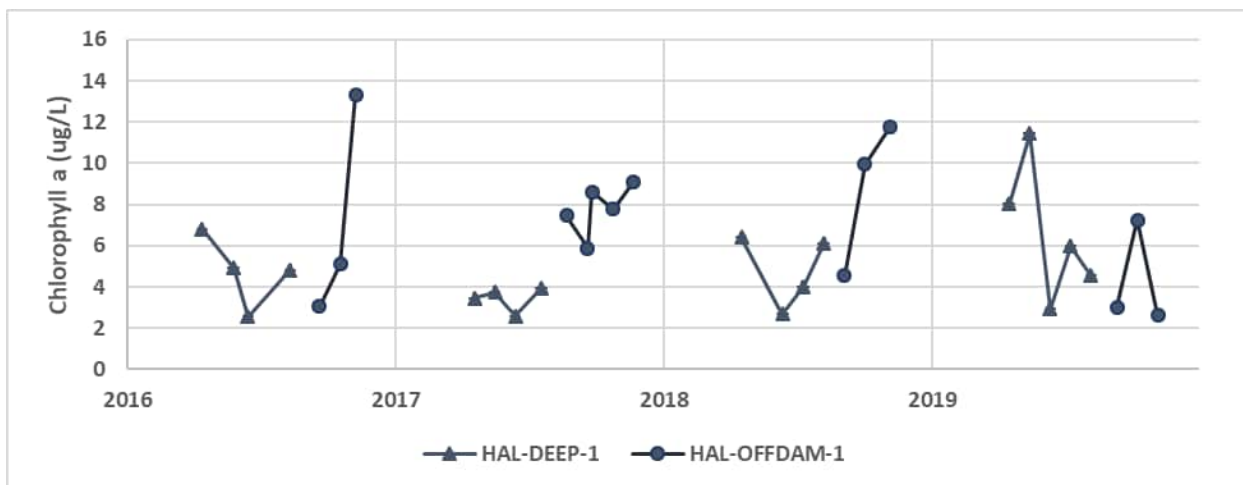


Figure C-4. Observed Chlorophyll a Concentrations in Halligan Reservoir (2016 to 2019)

C.2 Seaman Reservoir

Current conditions in Seaman Reservoir are described in detail in Hydros (2011b) and briefly summarized in this section. Seaman Reservoir is a 4,150 acre-feet,²² on-channel water supply reservoir on the North Fork operated by the City of Greeley located 22 miles downstream of Halligan Reservoir. The average annual residence time (2008 to 2019) is 45 days. Inflows to the reservoir primarily occur during spring runoff and enter the reservoir via the North Fork. Because the reservoir is often full during spring runoff, much of the spring runoff flow is passed through the reservoir and released to the North Fork downstream. The reservoir is often drawn down during late summer and fall, and typically refills by December. Water is released from outlet works at the bottom of the reservoir dam when pool levels are below the spillway. Seaman Reservoir stratifies in the summer each year, with stratification typically beginning early April or May and lasting until fall turnover in September or October. At times, water quality below Seaman Reservoir has negatively impacted aquatic life, including a fish kill in August 2018 (Battige 2018).

Anoxia (0 mg/L DO) is routinely observed in the hypolimnion of Seaman Reservoir during summer stratification (for example, Figure C-5), and the reservoir also periodically exhibits metalimnetic DO minima (caused by the decay of settling organic matter; for example, the profile on June 25, 2019 on Figure C-5). The seasonal reducing conditions in the hypolimnion cause internal release of nutrients and metals from the reservoir sediment. Summer chlorophyll *a* concentrations are typically below 20 µg/L, but major blooms have also occurred. For example, a cyanobacteria bloom occurred in 2012 exhibiting a peak observed chlorophyll *a* concentration of 183 µg/L, and another bloom occurred in 2017, with a peak observed chlorophyll *a* concentration of 100 µg/L.

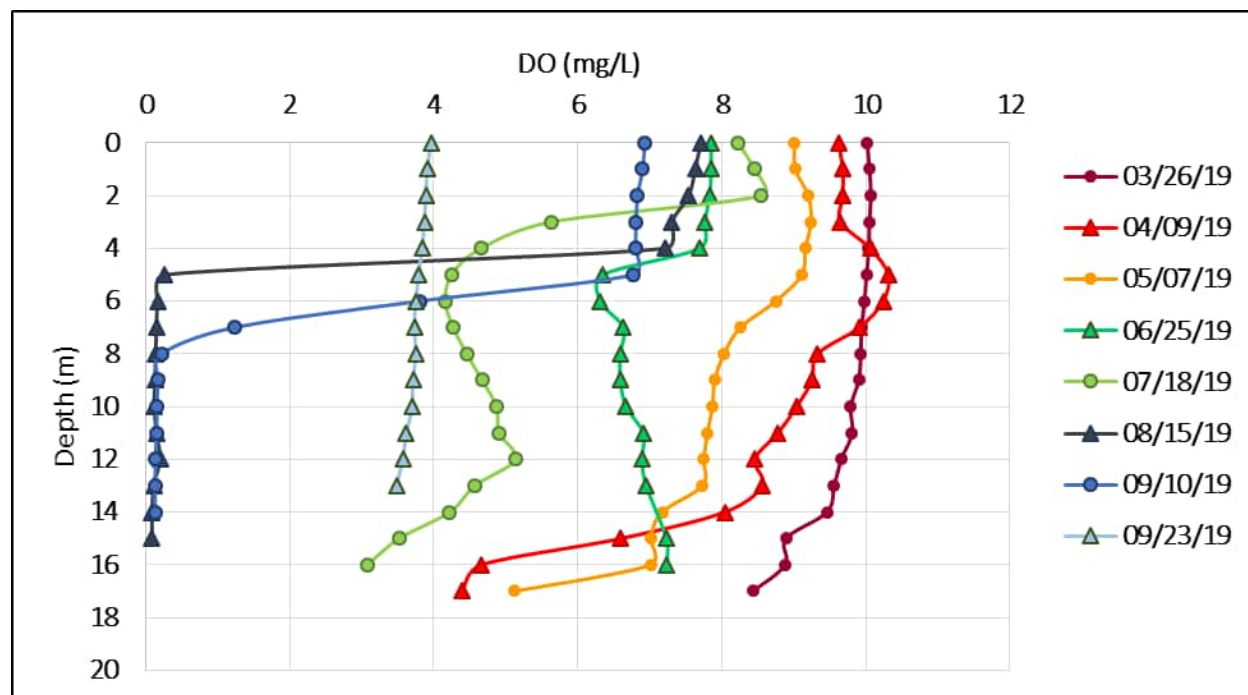


Figure C-5. Example Dissolved Oxygen Profiles from Seaman Reservoir, 2019

²² Recent (2016) bathymetric surveys performed by TetraTech indicate the reservoir capacity is approximately 4,150 acre-feet, suggesting the reservoir has lost approximately 850 acre-feet of storage to sedimentation since reservoir construction in 1941 (TetraTech 2018).

Comparison of observed data from Seaman Reservoir to applicable aquatic life water-quality standards (WQCC 2021a) indicates concerns with DO and temperature. In 5 of 11 years from 2008 to 2019, DO concentrations were observed below the standard in the mixed layer following fall turnover (for example, the profile on September 23, 2019 on Figure C-5). Seaman Reservoir is currently on the CWA Section 303(d) list for DO (WQCC 2021b). There are also two years in the recent record (2017 and 2018) that show temperatures in the mixed layer exceeding the applicable standard at a time when no adequate refuge for fish existed at greater depth (e.g., 7/10/18 in Figure C-6).²³ Given the anoxic conditions in the hypolimnion during stratification and the bottom releases during summer, there may also be issues relative to the aquatic life sulfide standard in and immediately below the reservoir, though there are no sulfide data²⁴ to verify this concern.

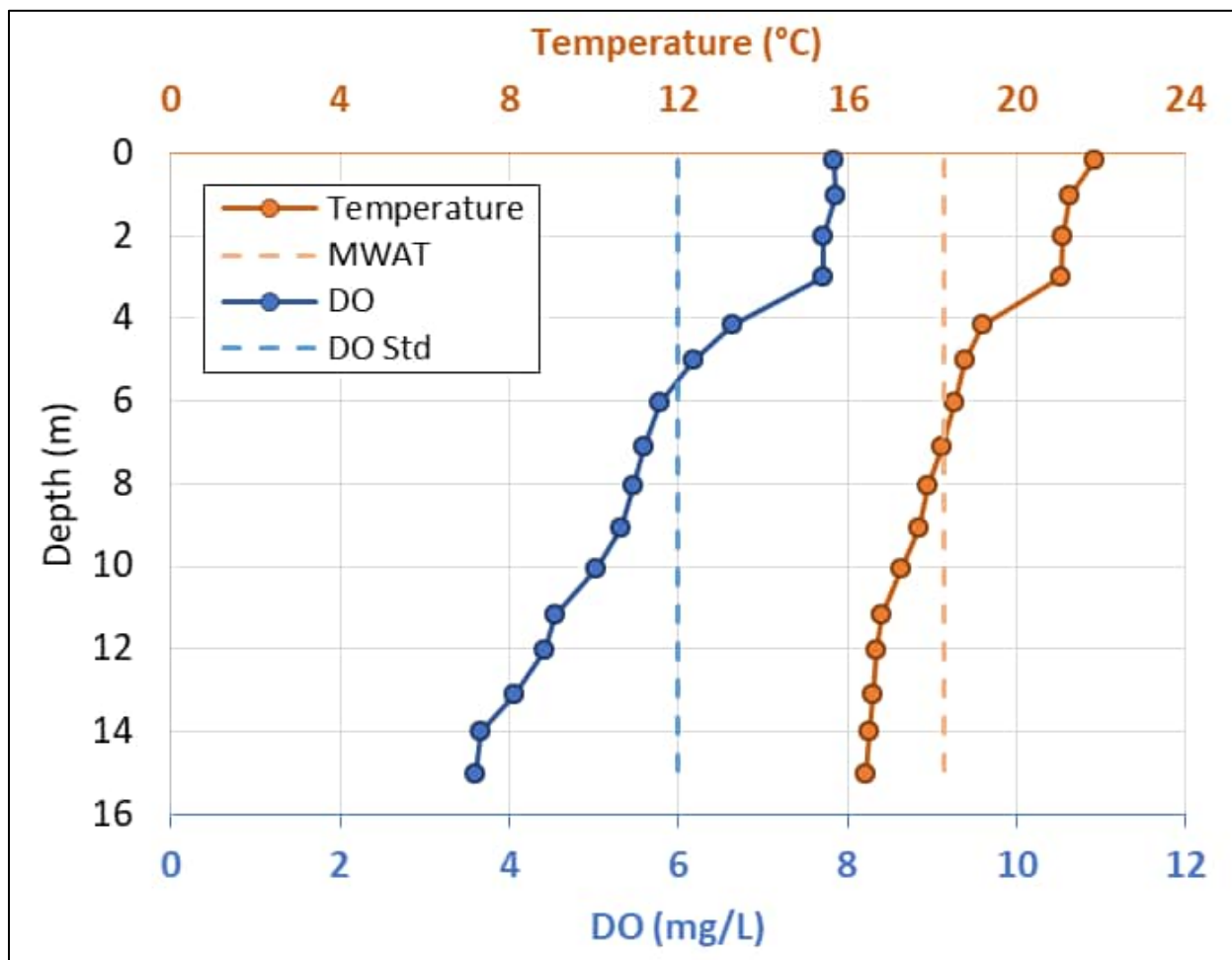


Figure C-6. Example Profile Pair from Halligan Reservoir Showing Temperature Exceedance and No Adequate Refuge; July 10, 2018

Finally, observed data from Seaman Reservoir suggest concerns relative to the interim nutrient criteria values (WQCC 2020) for chlorophyll *a*, total nitrogen, and total phosphorus. While the interim criteria values have not been adopted as standards for the reservoir, concentrations in excess of the interim values are observed in more than half of the years of record from 2008 through 2019.

²³ Adequate refuge refers to layers in the water column where both temperature and dissolved oxygen are within their respective standards.

²⁴ Note that the standard applies to undissociated sulfide, and there are no undissociated sulfide data.

C.3 North Fork

Current conditions for surface water quality on the North Fork are discussed in detail in Hydros (2021b, 2022a, and 2022c) and summarized in this section. Water quality on the North Fork from Halligan Reservoir to the confluence with the Main Stem is influenced by releases from Halligan and Seaman Reservoirs, as well as seasonally by inflow water quality of tributaries and groundwater in the Livermore Valley. Concentrations of many constituents tend to peak during spring runoff. There is notable attenuation for some constituents, including nutrients and some metals, along the approximately 22 river miles from Halligan Reservoir to Seaman Reservoir, particularly in summer and winter months (outside of the high-flow spring runoff period).

Current aquatic life water-quality concerns on the North Fork relative to standards are limited to dissolved silver and water temperature. Additionally, CPW has expressed concern regarding total iron concentrations, specifically below Halligan Reservoir, indicating that CPW believes the existing standard is not adequately protective of aquatic life. Note that this iron aquatic life standard concern is specific to CPW, and WQCD intends to focus on the existing aquatic life iron standard for the purposes of CWA Section 401 water quality certification. Finally, there is an existing total maximum daily load (TMDL) for sediment on the North Fork. The following paragraphs provide additional discussion regarding current conditions on the North Fork for dissolved silver, water temperature, total iron, and sediment.

C.3.1 Dissolved Silver

Dissolved silver in the North Fork is on the current CWA Section 303(d) list (WQCC 2021b) because it exceeds the hardness-based standard in some years (during spring runoff when hardness tends to be low). Observations above standards are most frequent in the reaches above and below Halligan Reservoir, though exceedances also occur farther downstream (Figure C-7). The timing and spatial distribution in the silver data indicate that it is mobilized from the watershed by runoff. There are no known metals mining or industrial activities in the watershed that could serve as an anthropogenic source of the observed silver. Further, the extensive Halligan Reservoir dataset indicates that there is no evidence suggesting the occurrence of internal loading of silver within the reservoir (Hydros 2022c).

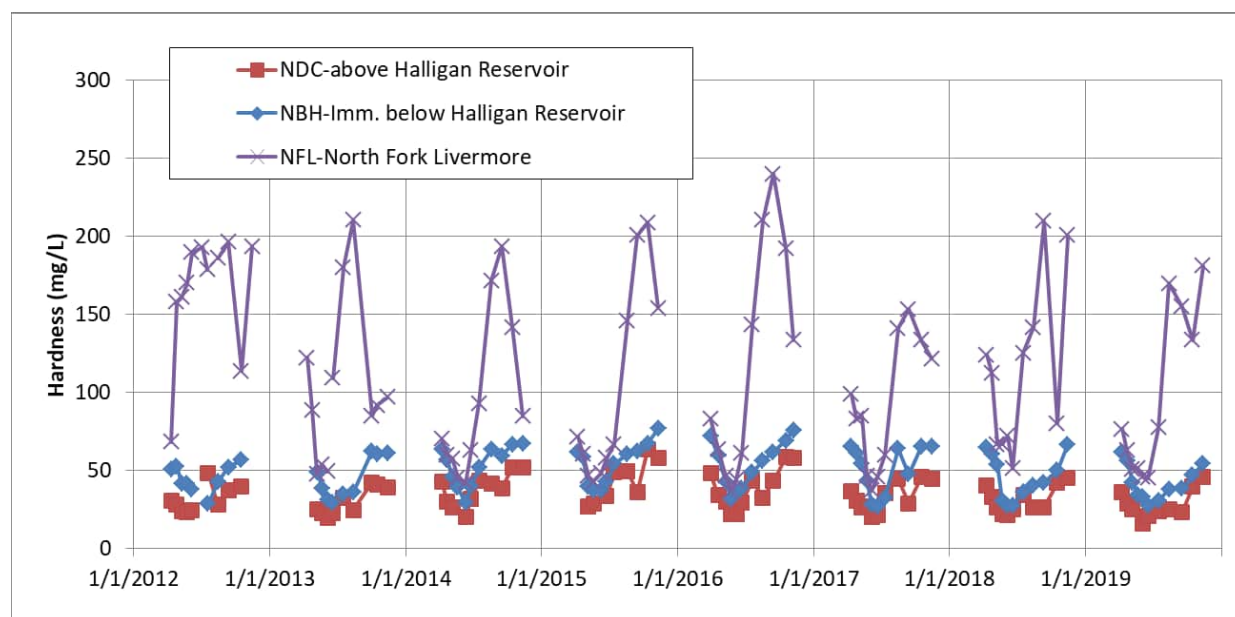


Figure C-7. Hardness across the North Fork, 2016-2019

C.3.2 Water Temperature

Current conditions for river temperature on the North Fork are discussed in detail in Hydros (2021d) and summarized in this section. The reach of the North Fork below Seaman Reservoir is currently on the CWA Section 303(d) list for temperature (WQCC 2021b); however, observed data indicate that there are consistent issues relative to both the acute and chronic temperature standards across most of the North Fork in summer months, typically July through September. There are no issues on the North Fork relative to temperature standards outside of summer months with two exceptions. First, there are occasional fall shoulder season issues below Seaman Reservoir, with conditions exceeding the acute and chronic temperature standards in early November in some years. Second, sharp changes in water temperature can occur downstream of the Halligan Reservoir dam (that is, thermal shock) at times when the reservoir is thermally stratified and reservoir outflows switch from spilling of warmer water over the dam to bottom releases of cooler water (for example, July 2017; Figure C-8). Such cases of unnatural thermal shock can adversely affect aquatic life.



Figure C-8. Example of Thermal Shock below Halligan Dam (NBH), 2017

Red circle indicates observed sharp drop in river temperature due to switch from spilling over dam to bottom releases.

Issues relative to temperature standards generally increase from upstream to downstream on the North Fork in the summer months, as illustrated in the example dataset from July 2019 on Figure C-9 and Figure C-10. Summer temperatures tend to be coolest immediately below Halligan Reservoir (NBH), reflecting bottom release temperatures, though the chronic temperature standard is still exceeded in all years of record at NBH, with typical months of concern being July, August, and/or September. The rate of warming along the North Fork is strongly influenced by meteorological conditions and flow rate, including the effects of the North Poudre Canal Diversion, a major diversion located 6 river miles downstream of Halligan Reservoir. Summer warming of river water is tempered somewhat through the Livermore Valley by inflows from tributaries and groundwater gains (refer to NBP), which can comprise the majority of flow in the North Fork below Lone Pine Creek from July through September (Hydros 2021a). Below Seaman Reservoir on the North Fork (refer to NF-PRU) water temperatures can be lower than those immediately upstream of Seaman Reservoir (refer to NSR) in early summer (for example, July), but the opposite pattern is observed in later summer and early fall. On the North Fork

below Seaman Reservoir, there are exceedances of both the acute and chronic summer standards in all years of the observed record.

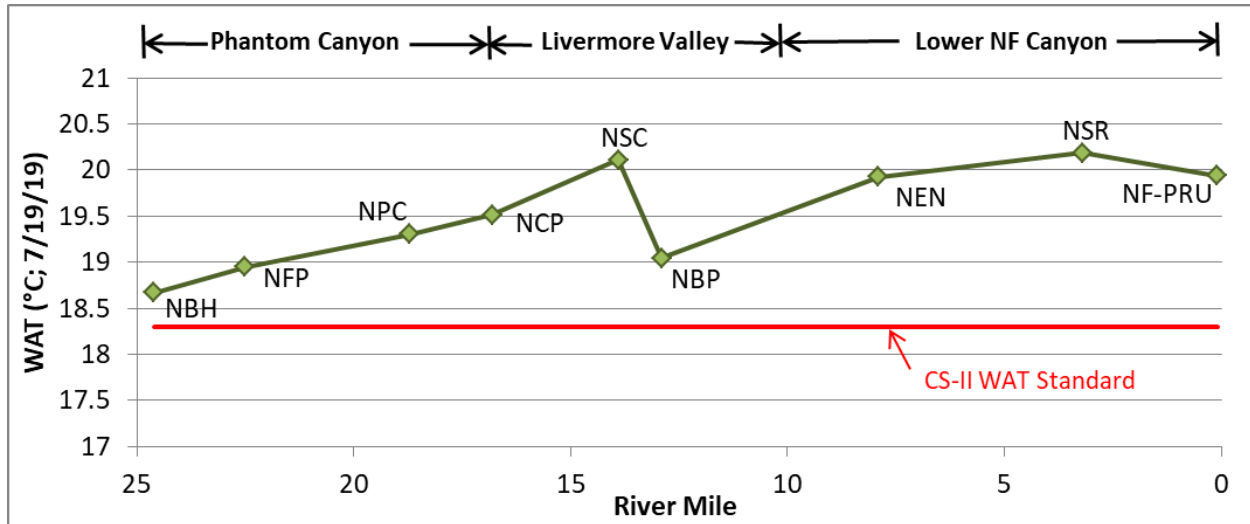


Figure C-9. Observed Weekly Average Temperatures across the North Fork on a Typical Summer Day with Bottom Releases from Halligan Reservoir, 7/19/2019

°C = degree(s) Celsius

NBH, NFP, NPC, NCP, NSC, NBP, NEN, NSR, and NF-PRU are temperature sensor locations, and CS-II is the applicable summertime temperature standard.

Weekly average temperature is a chronic temperature standard metric

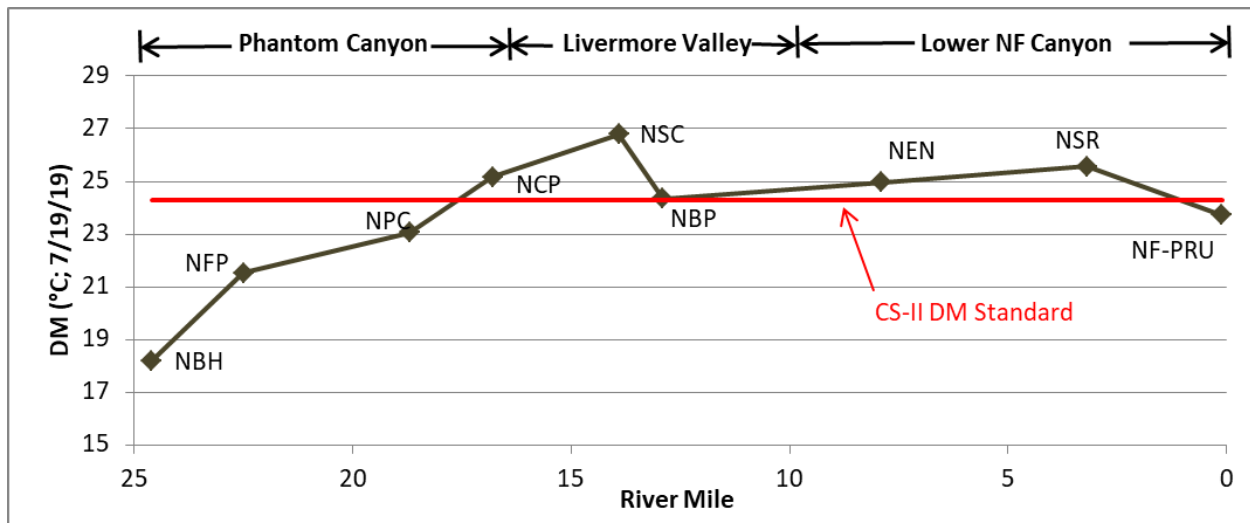


Figure C-10. Observed Daily Maximum Temperatures across the North Fork on a Typical Summer Day with Bottom Releases from Halligan Reservoir, 7/19/2019

Daily maximum is an acute temperature standard metric

C.3.2.1 Total Iron

Observed data indicate that there are no issues on the North Fork relative to the current aquatic life standard for total iron (1,000 µg/L, assessed as an annual median); however, CPW has expressed

concerns that the existing standard is not adequately protective.²⁵ CPW cites Cadmus et al. (2018), indicating that the chronic iron standard should be on the order of 251 µg/L, based on mesocosm tests. While Fort Collins acknowledges that revision of the aquatic life iron standard may be appropriate, the 251 µg/L value from Cadmus et al. (2018) is not directly comparable to field measurements of total iron. Assertion of a disconnect between field measurements of total iron and the 251 µg/L value is based on the following: Cadmus et al. (2018) arrived at the 251 µg/L value through mesocosm studies applying ferric chloride, which results in colloidal iron in solution. This form of iron is not directly comparable (in terms of effect on aquatic life) to iron bound in suspended sediments, which would be included in total iron lab analyses from field samples.

Net loading calculations indicate that Halligan Reservoir is a sink for iron. Inflow concentrations of both total and dissolved iron peak during runoff. Data indicate that internal loading of iron from sediments occurs in Halligan Reservoir during summer stratification due to reducing conditions in the hypolimnion. Further, observed data indicate that a chronic standard value of 251 µg/L would not currently be met upstream or downstream of the reservoir, or within Halligan Reservoir. This is the case for chronic total or dissolved iron at 251 µg/L at any depth level in Halligan Reservoir (Table C-2).

Table C-2. Median and 85th Percentiles of Total Iron and Dissolved Iron Data

Site	Years of Record	Total Iron Median ^[a] (µg/L)	Dissolved Iron 85th Percentile ^[a] (µg/L)
NDC (North Fork above Dale Creek)	2016–2021	799	487
NAH (Halligan Reservoir inflow)	2020–2021	660	341
Halligan, top	2016–2021	377	318
Halligan, bottom	2016–2021	778	412
NBH (below Halligan Reservoir)	2016–2021	622	357

^[a] These metrics are shown because water quality standards are typically assessed by comparing the median (for total metals) or the 85th percentile (for dissolved metals) of the data to the standard value.

While chronic concentrations of total iron below Halligan Reservoir are currently greater than 251 µg/L, there is currently no site-specific indication of aquatic life impairment on the North Fork because of iron, though observations to date are not definitive. There have been no observations of iron coating of sediments below the reservoir,²⁶ which is an expressed concern of CPW regarding inhibition of periphyton growth, benthic macroinvertebrates, and early life stage development of fish eggs. Unfortunately, because of confounding factors, there is no direct approach to definitively determine on a site-specific basis whether there is current impairment below Halligan Reservoir because of iron. Multiple known aquatic life stressors on the system, including temperature and low flow rates, could confound interpretation of the cause of any observed impairment.

²⁵ While CPW has expressed concerns with the existing aquatic life standard for total iron, WQCD has made it clear that the existing standards will be the basis for analysis in the HWSP 401 Certification Application, and 251 µg/L will not be considered in that analysis as an aquatic life standard for total iron.

²⁶ Sampler observations are limited to the reach between the dam and NBH (the sampling location approximately 600 feet below the dam). While NBH is relatively close to the dam, it is expected to be far enough downstream to observed iron coating issues because dissolved oxygen concentrations at this location are consistently at saturation.

C.3.3 Sediment Total Maximum Daily Load

Currently, there is a sediment TMDL on the North Fork that extends from Halligan Reservoir dam to a point 3.2 miles downstream. The TMDL was developed in 2002 (WQCC 2002) in response to a CWA Section 303(d) listing of sediment for the reach because of a major sediment release event in 1996. The sediment release event occurred at the time of a drawdown of the reservoir to allow for a safety inspection of the dam and outlet structure. The 1996 sediment release resulted in severe adverse impacts on fish and benthic macroinvertebrates in the North Fork in the 3.2 miles of river immediately downstream of Halligan Reservoir.

There have been no observed damaging sediment releases from Halligan Reservoir since the 1996 event, and recent data suggest sediment and aquatic life standards are currently being attained. Specifically, pebble counts from 2020 indicate that percent fines are below the applicable threshold, and macroinvertebrate data from 2019 and 2020 indicate that multimetric index values are above the applicable attainment threshold. Macroinvertebrate data from 2020 also indicate that sediment threshold indicator values (TIV_{SED}) are below the applicable impairment threshold.

C.4 Main Stem

Water quality on the Main Stem over the approximately 60 river mile reach from the Munroe Canal Diversion to the confluence with the South Platte River is influenced by many factors, including seasonal snowmelt runoff, major tributary inflows, groundwater inflows, major diversions, treated wastewater effluent, subsurface geology, and stormwater runoff. Current water-quality concerns on the Main Stem, in terms of exceeding or approaching aquatic life standards, are limited to water temperature. Additionally, observed concentrations of Total Nitrogen and Total Phosphorus are routinely above interim nutrient criteria (WQCC 2020) in Segments 12a and 12b (from Prospect Road in Fort Collins to the confluence with the South Platte River), though those criteria are not currently applicable standards. Brief overviews of major temperature and non-temperature water-quality dynamics on the Main Stem are provided in the following subsections. These discussions present major drivers of water-quality response from upstream to downstream and provide information relevant to subsequent discussions of anticipated Halligan Project impacts. Additional detail on spatial and temporal patterns and drivers of water-quality in the Poudre River can be found in Hydros (2015, 2021a, 2021c, and 2021d).

C.4.1 Poudre River Temperature Dynamics

The Poudre River from the Munroe Canal Diversion to the Larimer County Canal (Segment 10a) is currently on the CWA Section 303(d) list for temperature (WQCC 2021b) because of exceedances of the chronic temperature standard. There are observations in excess of the chronic temperature standard in summer months (July, August, and/or September) from the top of Segment 10a to just above the Hansen Supply Canal inflow near the bottom of the segment. The frequency and magnitude of exceedances of the chronic temperature standard increase from upstream to downstream across this sub-reach of Segment 10a.

The rate of warming over Segment 10a above Hansen Supply Canal is exacerbated by major diversions, the largest of which is the Munroe Canal Diversion. Inflows from the North Fork in this reach tend to be notably warmer than the Main Stem during runoff months, summer months, and early fall. However, the warming effect of the North Fork inflows on the Main Stem in summer months is limited, due to relatively small flow rates from the North Fork. Finally, there is a dramatic shift in river temperature below the inflow from Hansen Supply Canal near the bottom of Segment 10a (for example, Figure C-11 and Figure C-12). Hansen Supply Canal provides cooling water to the Main Stem, typically from May to

October, in volumes significant enough to sharply reduce river temperatures (Bartholow 1991 and Hawley et al. 2014), averaging 42 percent of the flow in the river below its point of entry from July through September (Hydros 2021a). The cooling effect often reduces temperature from above the chronic standard to well below the chronic standard. As a result, stream temperatures on the Main Stem are less sensitive to small changes in flow rates downstream of Hansen Supply Canal on Segment 10a and through Segment 10b.

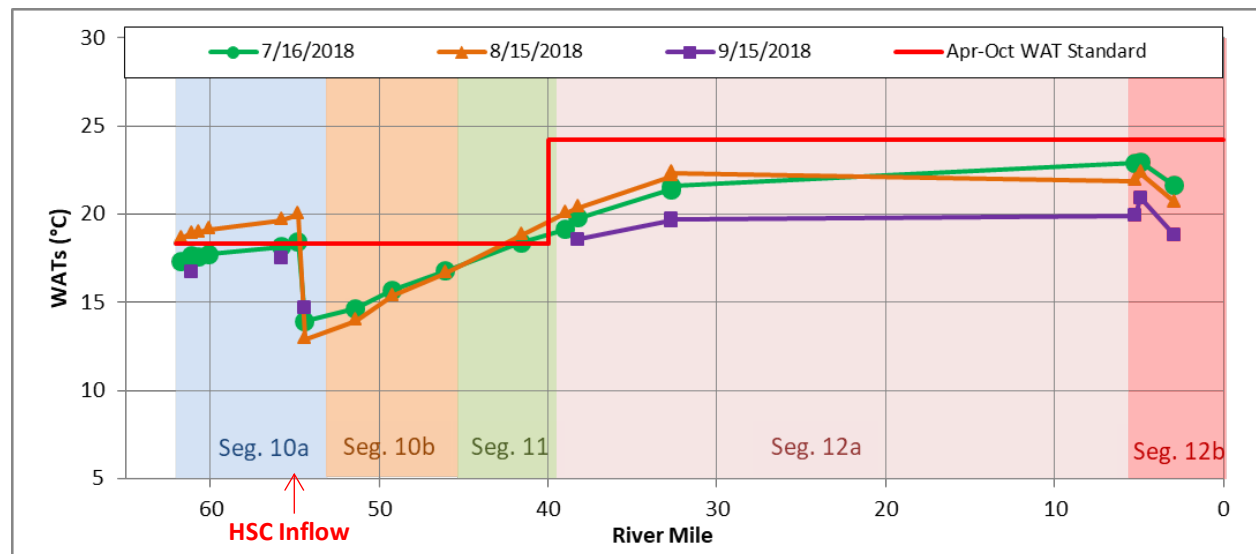


Figure C-11. Weekly Average Temperatures on Select Summer Days in 2018 across the Main Stem Focus Reach

Location of Hansen Supply Canal (HSC) inflow noted

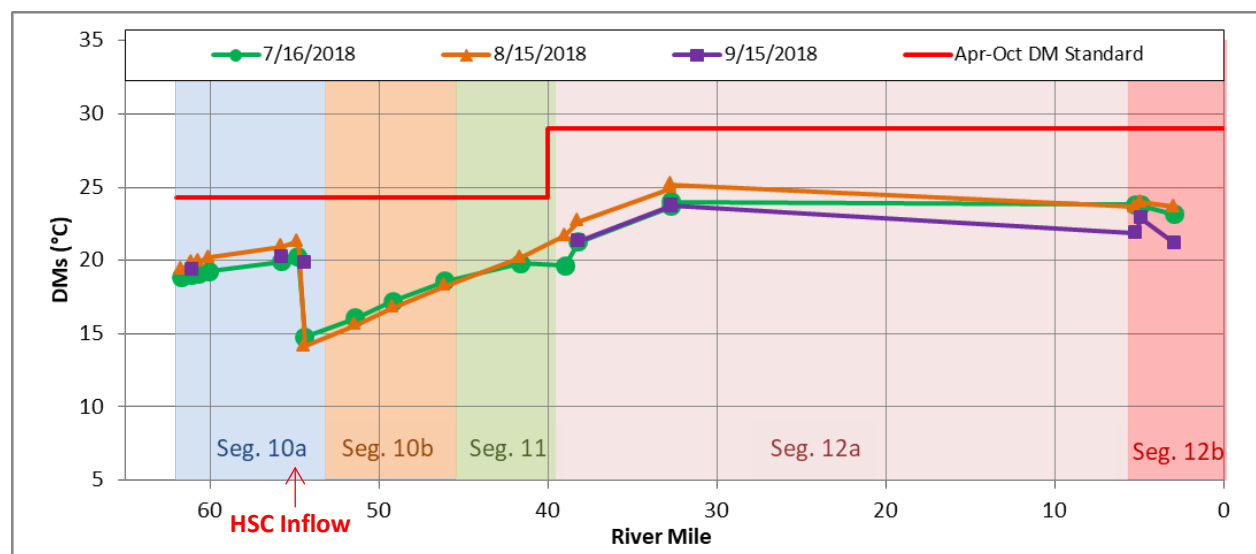


Figure C-12. Daily Maxima on Select Summer Days in 2018 across the Main Stem Focus Reach

Location of HSC inflow noted

Below Hansen Supply Canal, summer river temperatures tend to increase moving downstream through Segments 10b and 11. The rate of warming is increased primarily by major diversions in Segment 10b. While temperature standards tend to be met in Segment 10b, the chronic temperature standard in

Segment 11 (which was made more stringent in 2020) is routinely exceeded in summer months (July, August, and/or September).

Farther downstream in Segments 12a and 12b, observed data exhibit no issues relative to acute or chronic temperature standards. There is apparent warming in the Main Stem during summer months (July, August, and September) near the upstream end of Segment 12a because of inflows from the Fossil Creek Reservoir Outlet, which comprises a notable fraction of flow in the Main Stem immediately below the outlet's confluence with the river in summer months, averaging 15 percent of the flow from July through September (Hydros 2021a).

Moving downstream of the Fossil Creek Reservoir Outlet, warming tends to be somewhat limited over the remainder of Segments 12a and 12b (for example, Figure C-6 and Figure C-8). This is attributed to the competing effects of warming from flow reductions by major diversions and cooling because of groundwater return flows over the reach. Return flows include significant groundwater gains through Segments 12a and 12b (Hydros 2021a). In these segments, groundwater tends to be cooler than the river in summer months by 5°C to more than 10°C, providing a notable cooling effect on the river. There is also a dampening of the diurnal temperature range across Segment 12a that is indicative of the temperatures and magnitude of the groundwater inflows to the river (Hydros 2021a). There is an apparent warming effect from Greeley wastewater treatment plant effluent (near the upstream end of Segment 12b), typically observed in August and September; although temperature standards tend to be met in the Main Stem below the effluent discharge location, temperatures routinely approach the chronic standard. Downstream of the Greeley wastewater treatment plant, river temperatures exhibit some cooling before entering the South Platte (for example, Figure C-6 and Figure C-8), reflecting additional inflow of cooler groundwater.

C.4.2 Poudre River Non-temperature Water-quality Dynamics

There are currently no CWA Section 303(d) listings for aquatic life standards on the Main Stem from Munroe Canal Diversion to the South Platte River, based on the most recent assessment of the Poudre River in 2017 (WQCC 2021b). Still, to support consideration of potential effects of the Halligan Project, it is important to understand several key drivers of water-quality in the Main Stem. A detailed conceptual understanding of current water-quality dynamics on the Main Stem was developed based on observed data and consideration of natural and anthropogenic flow patterns, geology, land use, point sources, and non-point sources. Water-quality responses in the Main Stem follow many general patterns expected for most river systems. For example, water quality in the Main Stem generally tends to deteriorate from upstream to downstream, reflecting both natural and anthropogenic influences. Additionally, as expected, nutrient and metals concentrations are observed to increase downstream of treated wastewater effluent locations, particularly at times of lower flow in the Main Stem. This section summarizes the observed influences of other current Main Stem water-quality drivers specific to the Poudre River, including spring runoff, the North Fork, subsurface geology, and groundwater/agricultural return flows. Additional information is available on patterns and drivers of the current water-quality response across the Main Stem in Hydros (2015, 2021a, and 2021c).

Concentrations of some constituents on the Main Stem increase with seasonal spring runoff, including iron (total and dissolved), aluminum (total), manganese (dissolved and total), suspended solids, and mercury (total). This pattern reflects the mobilization of these constituents from the watershed and riverbeds as a result of seasonal snowmelt. Many of these constituents also show elevated concentrations in the Poudre River after wildfires and flooding. During spring runoff, the influence of point sources and groundwater recharge are minimized because of the typically high flow volumes associated with snow melt. While this water-quality pattern is notable in the observed record for many

constituents, there are no associated water-quality concerns relative to aquatic life standards that are driven by this natural phenomenon.

The North Fork is a critical tributary for consideration of potential effects of the Halligan Project on the Main Stem. While there are no CWA Section 303(d) listings at the mouth of the North Fork or on the Main Stem below the North Fork for aquatic life standards (except temperature), water entering the Main Stem from the North Fork tends to have higher concentrations of many constituents as compared to water in the Main Stem upstream of the North Fork. These include dissolved solids, hardness, arsenic, and sulfate. Additionally, the North Fork exhibits higher concentrations of ammonia, phosphorus, nitrogen manganese, and iron on a seasonal basis, corresponding to the timing of stratification and internal loading from sediments within Seaman Reservoir. These seasonally elevated concentrations on the North Fork are typically observed from July through September/October, depending on the timing of turnover in Seaman Reservoir. Currently, the North Fork comprises a seasonally variable fraction of flow in the Main Stem below its confluence (Figure C-13), with relatively low percent contributions in summer and early fall (7 percent to 25 percent) and higher percent contributions through the winter months (30 percent to about 45 percent).

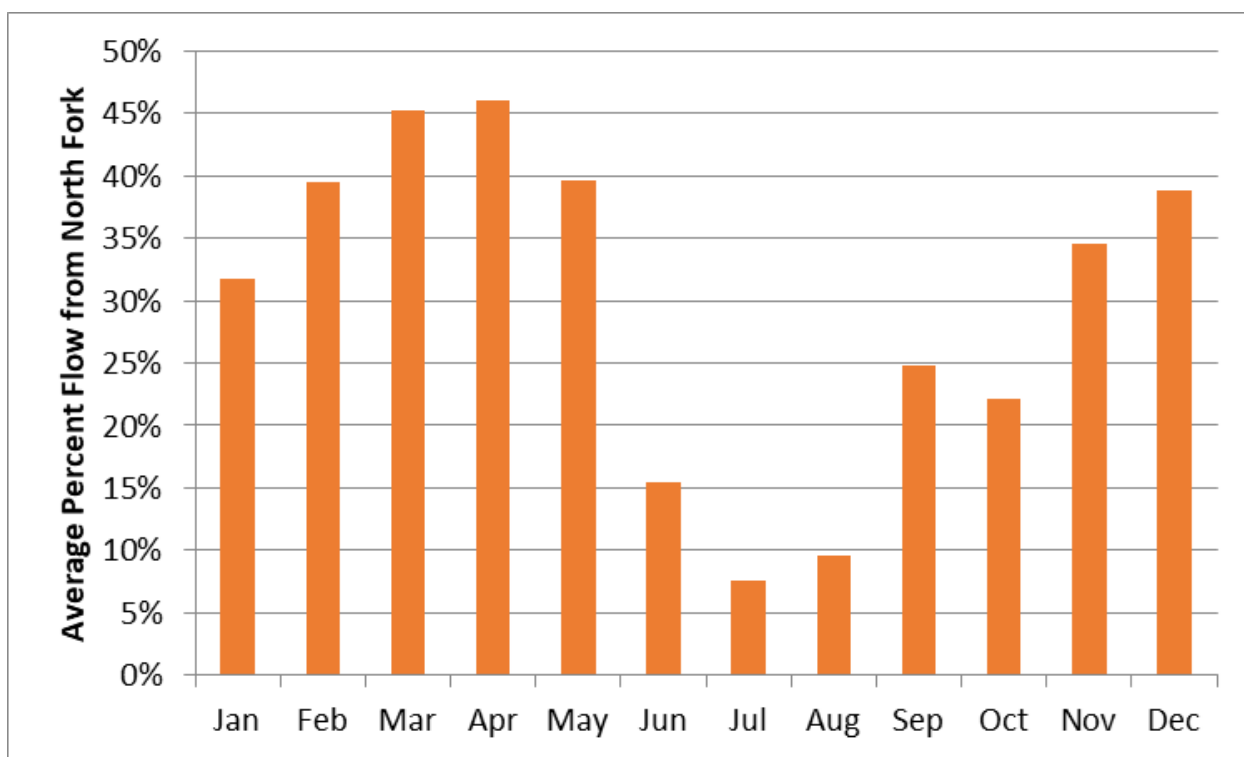


Figure C-13. Average Monthly Percentage of Flow from the North Fork on the Main Stem below the North Fork Confluence (based on observed flows 2009–2018)

Varying subsurface geology across the Main Stem also plays a role in observed water-quality response. From upstream to downstream over the focus reach of the Main Stem, the Poudre River passes through several geologic zones that affect water quality in the river (Figure C-14). The most critical zones are the Pierre Shale and Fox Hill Sandstone/Laramie Formation. From the lower half of Segment 10b through Segment 11 and the upper half of Segment 12a (through both Fort Collins and Windsor), the bedrock below the alluvium is comprised of low-permeability Pierre Shale, which can be a source of selenium to the river. Farther downstream in the plains (downstream of Windsor in Segment 12a), the bedrock

changes to the overlying Fox Hills Sandstone and the Laramie Formations. These sedimentary formations are less resistant to weathering and are notable sources of dissolved and particulate material to the river. The effects of these geologic features are apparent in the observed water-quality data, particularly outside of the snowmelt runoff season.

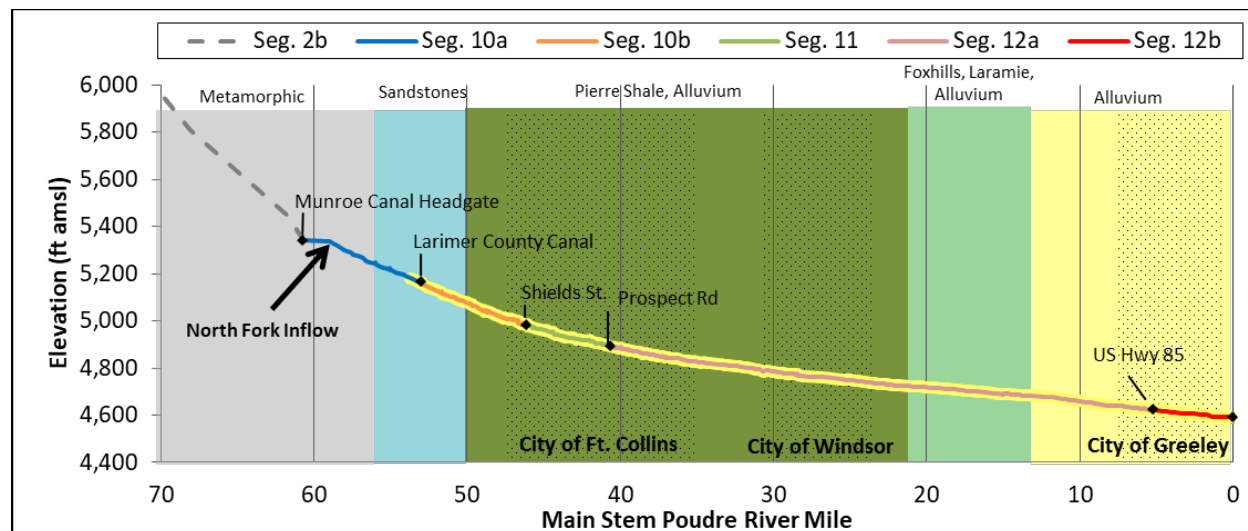


Figure C-14. Diagram of Geologic Zones of the Poudre River Main Stem Focus Reach

Finally, groundwater recharge and agricultural return flows are important drivers of water quality in the Main Stem. Groundwater recharge typically comprises the majority of the flow in Segment 12a and Segment 12b in all months outside of peak snowmelt runoff (Figure C-15). This reflects the stepwise pattern across Segments 12a and 12b of major diversions reducing flow and groundwater recharge replacing those flows. Agricultural return flows also make up a notable fraction of flow in the lower portion of Segment 12a and in Segment 12b in the latter months of the irrigation season (typically August through October; for example, Figure C-15). This pattern reflects both the increased extent of shallow alluvium as well as the increased agricultural land use in the Lower Poudre River. Groundwater recharge sources tend to increase total dissolved solids, nitrate, nitrite, arsenic, iron, and manganese concentrations in the river. Agricultural return flows tend to increase organic carbon and nutrient concentrations. The dominance of groundwater recharge and agricultural return flows in these reaches effectively minimizes the influence of small changes to water quality in Segments 10a, 10b, and 11 on water quality in Segments 12a and 12b.

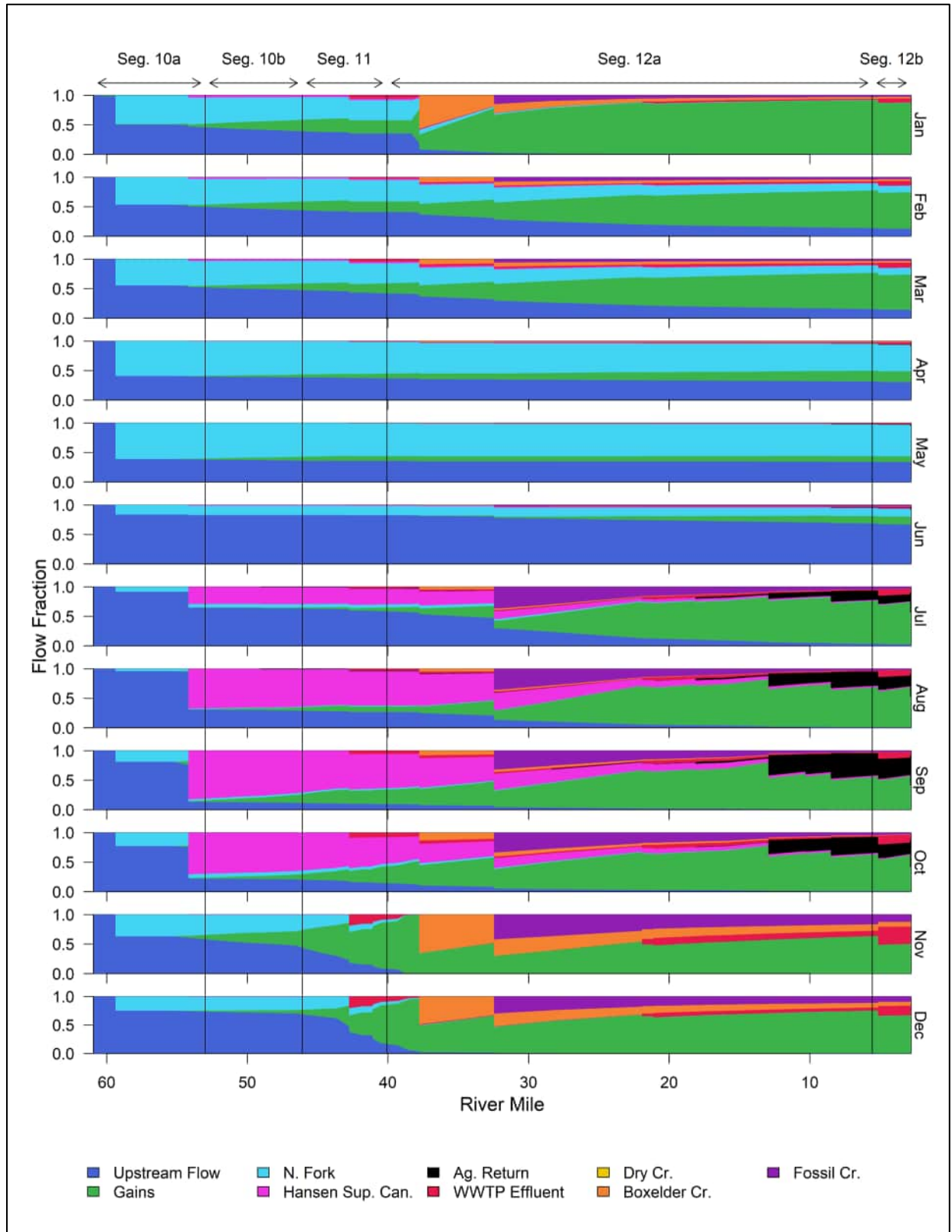


Figure C-15. Poudre River Fraction of Flow by Source, 2016 Monthly Averages

Source: Hydros 2021

Appendix D

Water Quality Sampling Location Maps

Appendix D. Water Quality Sampling Location Maps

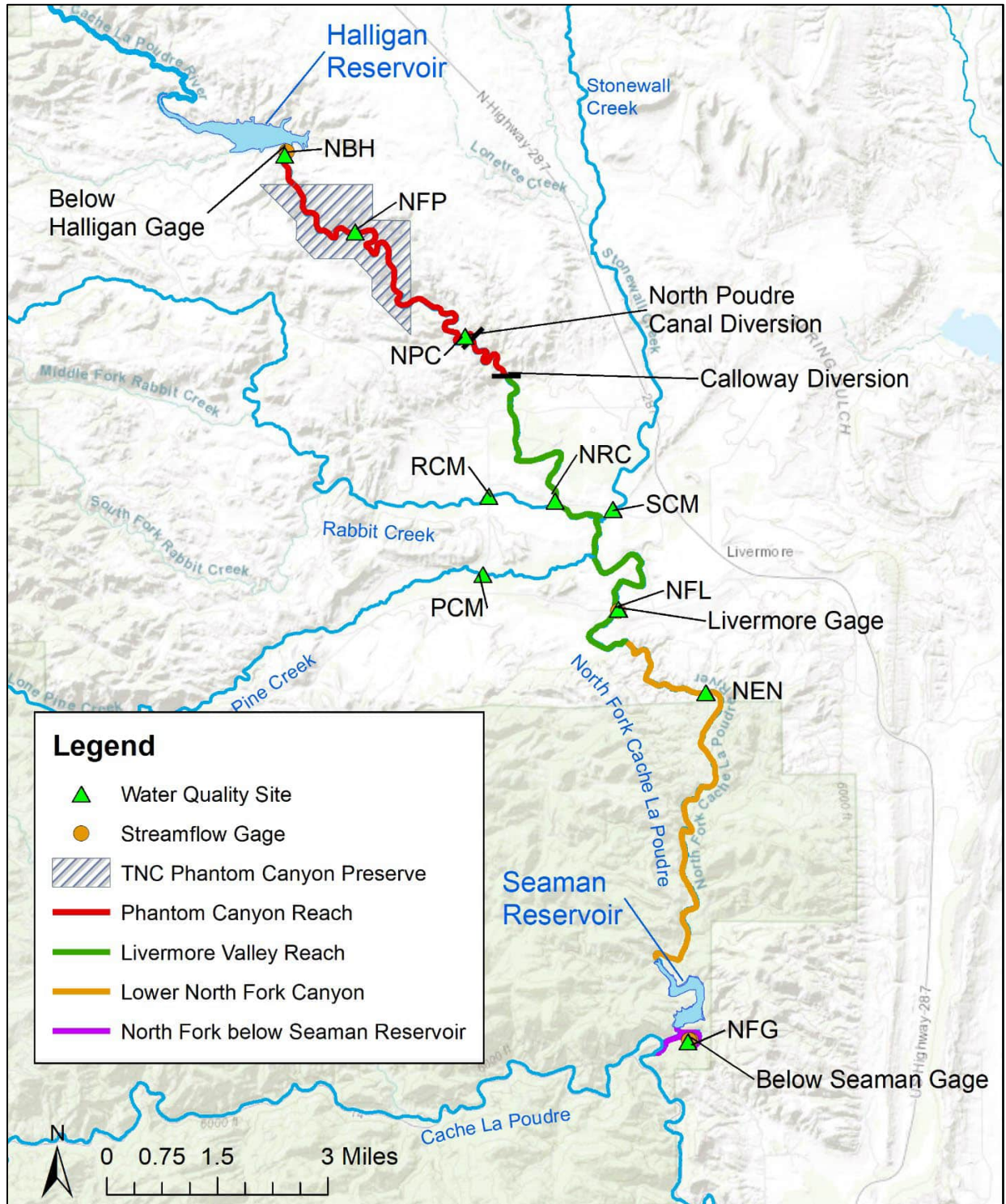


Figure D-1. Water-Quality Sampling Locations on the North Fork below Halligan Reservoir and its Tributaries

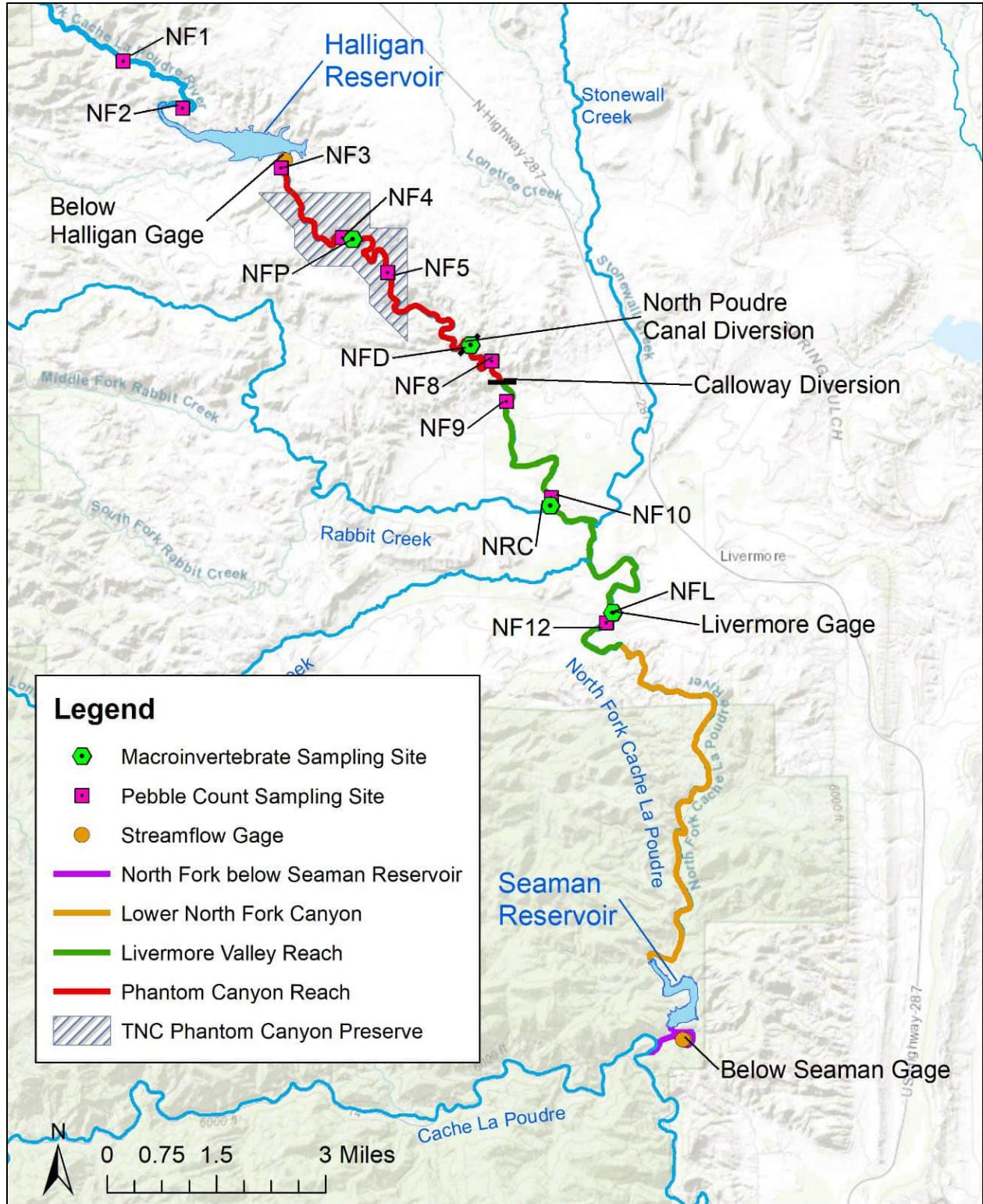


Figure D-2. Macroinvertebrate and Pebble Count Sampling Sites on the North Fork

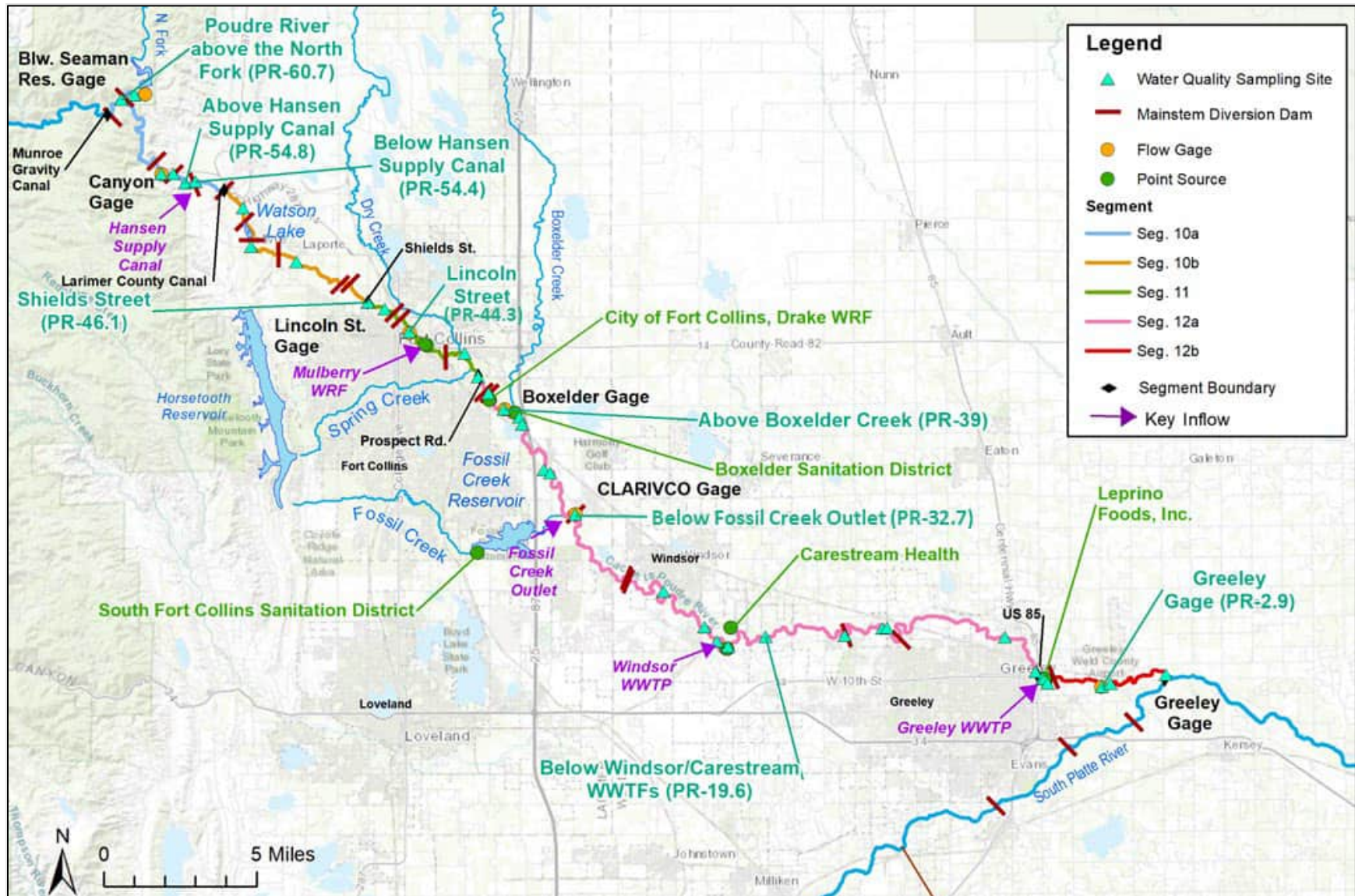


Figure D-3. Water Quality Sampling Locations along the Poudre River

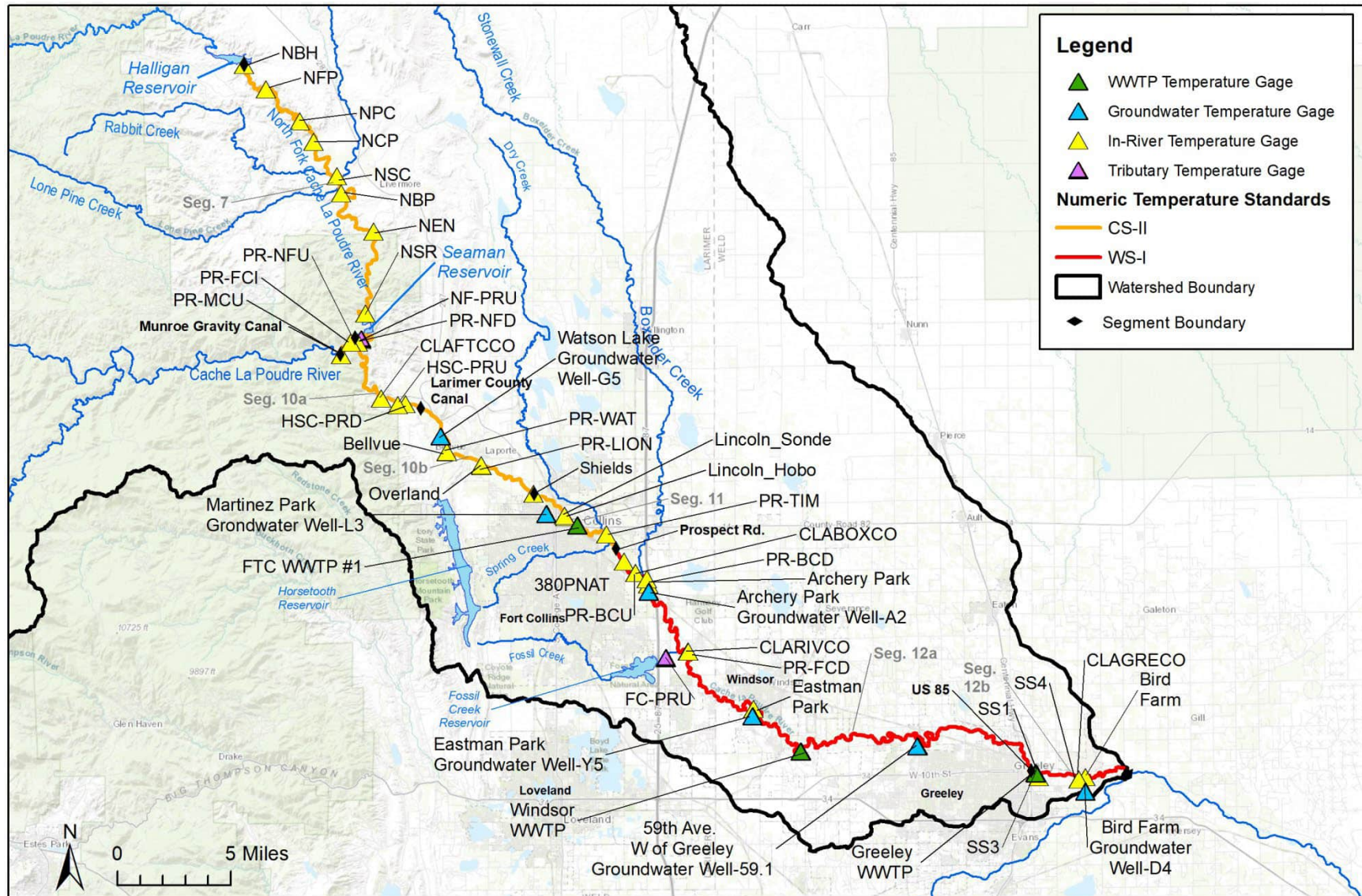


Figure D-4. Temperature Gages along the North Fork and Poudre River