Harney Basin Surface Water Portion of Integrated Water Plan

Harney Community-Based Water Planning

A sustainably managed supply of quality water for people, the economy, and the environment

October 2024

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Abbreviations

CBWP	HARNEY COMMUNITY-BASED WATER PLANNING
CC	COORDINATING COMMITTEE
CREP	CONSERVATION RESERVE ENHANCEMENT PROGRAM
DEQ	OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
GHVGAC	GREATER HARNEY VALLEY AREA OF CONCERN
OAR	OREGON ADMINISTRATIVE RULES
ORS	OREGON REVISED STATUTES
OWRD	OREGON WATER RESOURCES DEPARTMENT
PBP	PLACE-BASED INTEGRATED WATER RESOURCES PLANNING
USGS	UNITED STATES GEOLOGICAL SURVEY

Plan at a Glance: Executive Summary

Our Goal: A sustainably managed supply of quality water for people, the economy and the environment.

The Harney Community-Based Water Planning (CBWP) Collaborative consists of diverse stakeholders working together to plan for future surface water management in the Harney Basin. The planning process followed Oregon Water Resources Department's (OWRD) place-based planning (PBP) steps. In general terms, those steps are: 1) Build a Collaborative, 2) Examine Existing Basin Conditions, 3) Characterize Future Water Needs, 4) Develop Solutions and 5) Implement. The planning process was conducted within the framework of existing statutes and rules.

Like much of the western United States, the Harney Basin faces increasing pressure on its water resources. Surface water in the Harney Basin has been over appropriated for more than a century. Surface water flood irrigation maintains wet meadow systems critical to ranching and migratory bird populations in the Pacific flyway. Surface water flows into the basin is driven by snowpack and is highly variable year to year and decade to decade. Currently, groundwater discharge, majorly used for irrigation purposes, exceeds the amount of natural recharge the Harney Basin receives. Both surface and groundwater are over appropriated leading to water shortages for some users in the basin. These factors, and other influences, prevent some instream and out-of-stream water needs from being met. Multiple stakeholder engagement and cross-agency coordination, in addition to sufficient funding, are critical to meet the challenges for managing water resources in the Harney Basin.

This report describes the Surface Water Section of the Harney Basin's Integrated Water Resource Plan. The CBWP Collaborative details 18 critical surface water issues identified that impede the Harney Basin's ability to meet both instream and out-of-stream water needs. Along with each critical issue is a set of strategies that will address or help to overcome the critical issue of concern and ultimately support the CBWP Collaborative's vision: *A sustainably managed supply of quality water for people, the economy, and the environment.*

The surface water in the Harney Basin is quite variable through the year and a visual summary (Figure 1) provides a view of the flow, wetland conditions of Malheur Marsh and wet meadows of the lower Silver Creek, Silvies River and Donner und Blitzen River.

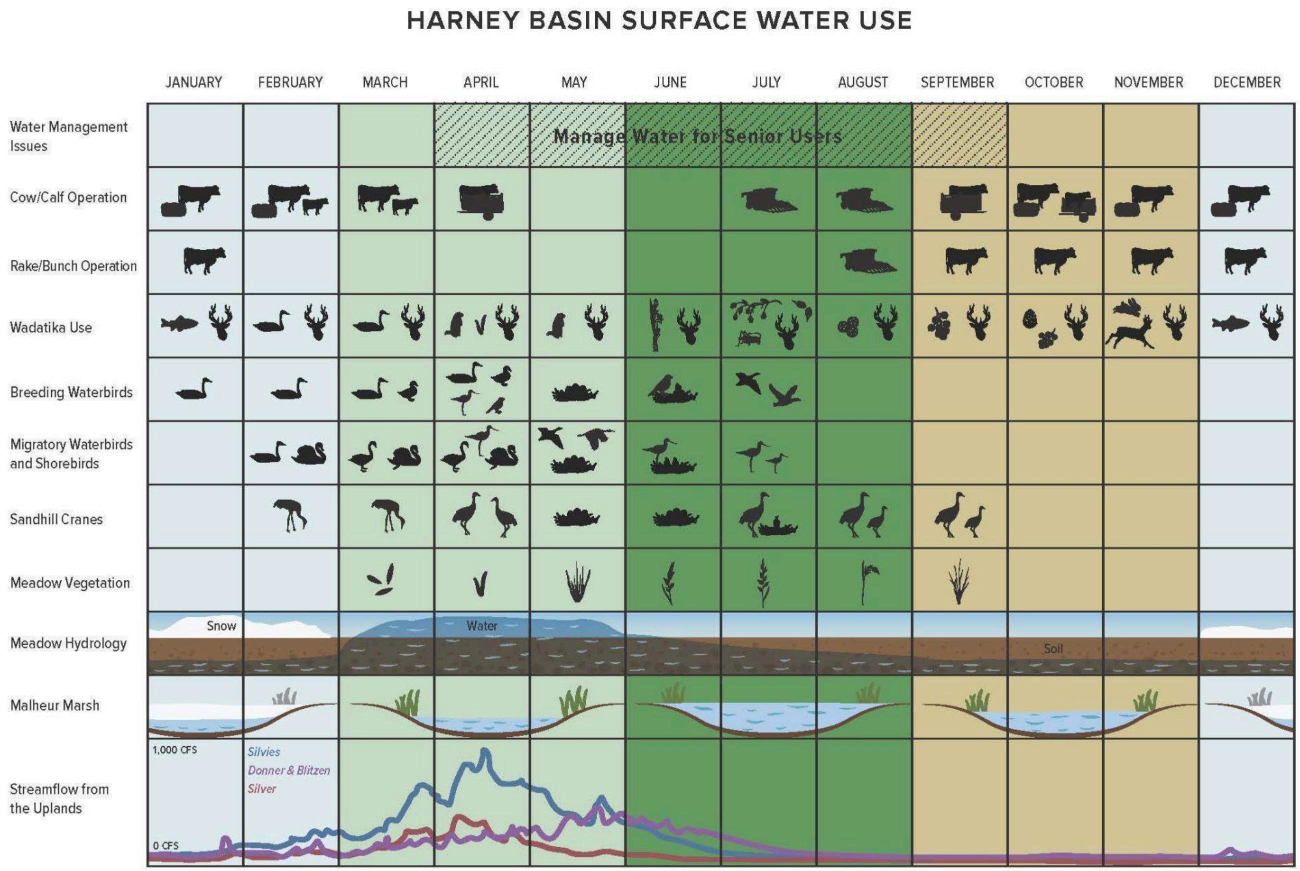

Figure 1. Harney Valley Surface water flows, wetland conditions and resource uses

HARNEY BASIN SURFACE WATER USE

The main elements of the figure are from the Wet Meadow Partners seasonal calendar for the Silvies wet meadows and Blitzen Valley. Tony Svejcar provided suggestions that will be used in another manner. The wet meadow vegetation and bird use has been simplified. The Wadatika Use is taken from the Harney Valley Seasonal Round from Couture, Marilyn D, Ricks, Mary F, and Housley, Lucile. 1986. Foraging Behavior of a Contemporary Northern Great Basin Population. Journal of California and Great Basin Anthropology Vol. 8, No. 2, pp. 150-160. Water management timing was from a conversation with Harney Basin Watermaster Donald (Dally) Swindlehurst. Additional information on cattle management was provided by Katie and Keith Baltzor. Malheur Marsh conditions were reviewed by Jess Weneck and suggestions from Casie Smith will also be used elsewhere. Zach Freed provided temperature information which will be used elsewhere and made significant suggestions on how to make the images understandable. All errors and oversimplifications are from Ken Bierly.

LEGEND

COW/CALF OPERATION
- Shipping calves
- Cows on meadows
- Calving on meadows
- Shipping cows to summer range
- Returning cows to meadow
- Cutting hay

RAKE/BUNCH OPERATION
- Cows on meadows
- Rake bunching meadow hay

WADATIKA USE
- Mule deer
- Redband fishing
- Waterfowl
- Groundhog
- Indian potato
- Camas
- Buckberry
- Crickets
- Huckleberries
- Chokecherries

BIRDS

Multiple species guilds use the basin

MEADOW VEGETATION
- Growth initiated
- Leaf growth
- Flowering
- Seed ripening
- Senescence
- Dormant

MEADOW HYDROLOGY

Winter – snow covered relatively low water table
Spring – flooded from spring freshets
Summer – declining water table drying of the meadows
Fall – dormant vegetation dry surface soil

MALHEUR MARSH

Winter – snow and ice covered relatively low water level
Spring – high water level from spring freshet
Summer – water level declines with increased evapotranspiration
Fall – water level at its lowest

Surface water in the Harney Basin is used to flood meadows in the spring adding to Malheur marsh, stimulating meadow vegetation and providing habitat annually for thousands of migratory and resident birds. These meadow systems have provided pasture and meadow hay production for ranches for nearly 150 years. The Wadatika people have used the resources of the basin for millenia to sustain their lives and culture. The surface water plan looks at ways to sustain the conditions that birds, people, cattle, and others depend on into a changing future.

The CBWP Collaborative identified the following themes in their list of 18 critical surface water issues and 18 strategies to help address those issues. Those themes are:

- Watershed Management
- Conifer and RiparianWatershed Conditions
- Historic Overallocation of Surface Water
- Impacts to Instream Uses and Ecology
- Out-of-Stream Uses
- Climate Change Impacts
- Limited Information

Key findings of the CBWP Collaborative include:

- Water rights in the Harney Basin exceed available water, creating ongoing challenges for balancing agricultural, ecological, and community needs.
- Predominantly used for agriculture, flood irrigation faces efficiency challenges due to outdated infrastructure, leading to water losses and allocation conflicts.
- Reduced streamflows and barriers to fish passage jeopardize aquatic species and wetland ecosystems, which are critical for migratory birds and local wildlife.
- Warmer air temperatures and altered runoff patterns increase drought frequency, strain water resources, and impact agriculture, streams and wetlands.
- Managing riparian zones, upland vegetation, and reintroducing beavers are key to improving watershed health and supporting ecosystem resilience.

The issues and proposed strategies as well as additional components found in this plan are based on a multi-year, multi-stakeholder effort committed to community input, engagement and a balanced approach. Agricultural stakeholders, landowners, Tribal representatives, rural and municipal residents, conservation groups, and local, state, and federal government agencies participated in identifying the critical issues and in developing strategies or actions that will help improve conditions. Evidence to support the critical issues and strategy development was gathered from peer-reviewed science, local knowledge, and data, and is documented throughout the plan. Support was provided from state and federal agency experts and scientists from regional conservation organizations. Collectively, the CBWP Collaborative's information and findings from Steps 2 to 4 support the strategies and recommendations in this Plan.

Introduction

Planning Purpose

Place-based integrated water resources planning (PBP) is a voluntary, locally initiated and led effort in which a balanced representation of water interests works in partnership with the state to understand and meet their instream and out-of-stream water supply needs. The program was established by Senate Bill 266 (2015) which provides broad requirements. The Integrated Water Resource Strategy was developed to "...carry out two goals: to improve our understanding of Oregon's water resources and to meet our state's instream and out-of-stream water resource needs." Place-based planning was developed to apply those principles to specific areas in Oregon. By collaboratively developing a shared vision for the future and anticipating and addressing specific water-related challenges, PBP gives those who live, work, and play in a community and care about it deeply a stronger voice in their water future, which in turn will provide a pathway for building the political and public support needed for water resource projects. Furthermore, communities that undertake a PBP approach can help inform statewide efforts. In summary, PBP allows communities and groups interested in water resources of an area to identify the water resource needs and then partner with the state and others to develop solutions and tools that will help meet those needs now and into the future.

The Harney Basin PBP process began in 2016 to address the water resource issues in the watershed. While PBP is meant to be integrated, because of the current crisis of overallocation and over-use of groundwater in the basin, the Harney Community-Based Water Planning Collaborative decided to focus their efforts on groundwater first. That effort led to the completion of "Harney Basin Groundwater Portion of Integrated Water Plan" completed in April 2023. This plan is the companion effort to document the findings, analysis and recommendations for managing surface water. Planning for surface water and surface-groundwater interactions commenced in August 2023.

Geographic Scope

The Harney Basin is in southeastern Oregon in the northern Great Basin. This cold desert region is characterized by flat basins surrounded by block faulted and other mountains. Being on the northern edge of the Great Basin, the northern and northwestern boundary of the basin is composed of volcanic mountain ranges of the High Lava Plains and Blue Mountains. The Harney Valley makes up a significant portion of the Harney Basin. This relatively flat area is the focus of agriculture and is the population center for the basin. The basin lies between the Blue and Ochoco Mountains to the north and northwest with Steens Mountain at the Southeastern edge. The Harney Basin is dominantly within Harney County but includes small portions of Lake, Malheur, and Grant Counties.

The basin climate is semiarid with long, cold winters and short, dry summers. The growing season, based on temperature, for most of the county is quite short, generally only from June to September (Gomm, 1979). Gingerich and others (2022) report; "The monthly mean temperature for 1981–2010 varied little by location and elevation, ranging from 27 degrees Fahrenheit (°F) in December to 67 °F in July at the Malheur Refuge Headquarters near Malheur Lake (Malheur Refuge Headquarters, Oregon [355162]; elevation 4,100 ft) and from 25 °F in December to 65 °F in July at the Fish Creek SNOTEL station on Steens Mountain (elevation 7,660 ft)" (U.S. Department of Agriculture Natural Resources Conservation Service, 2020; Western Regional Climate Center, 2020)" The basin has a very wide diurnal temperature range, particularly during the summer months. Easterly flows of dry air in the summer result in high temperatures and low humidity.

Much of the precipitation falls in the form of snow. Precipitation in the form of rainfall is quite variable both in timing and location and occasional, localized intense storms can bring as much as an inch of rain in an hour. Regional studies of predicted snowpack change in the future (Klos et al., 2014) estimate a significant reduction in snowpack and increased incidence of rain in the basin. The Oregon Water Resources Department (OWRD)/United States Geological Survey (USGS) Groundwater Study (Gingerich et al., 2022) compared the study period (1982-2016) precipitation to the longer record (1900-2016) to determine if the range of values was comparable to the long-term record. The analysis showed that the 1980's and 1990's generally were wetter than the 2000's.

The Harney Basin is an internal drainage basin with four surface subbasins; Silvies River, Silver Creek, Donner und Blitzen River and the immediate drainages to Malheur and Harney Lakes (Figure 2).

Harney Basin and Sub-Basins

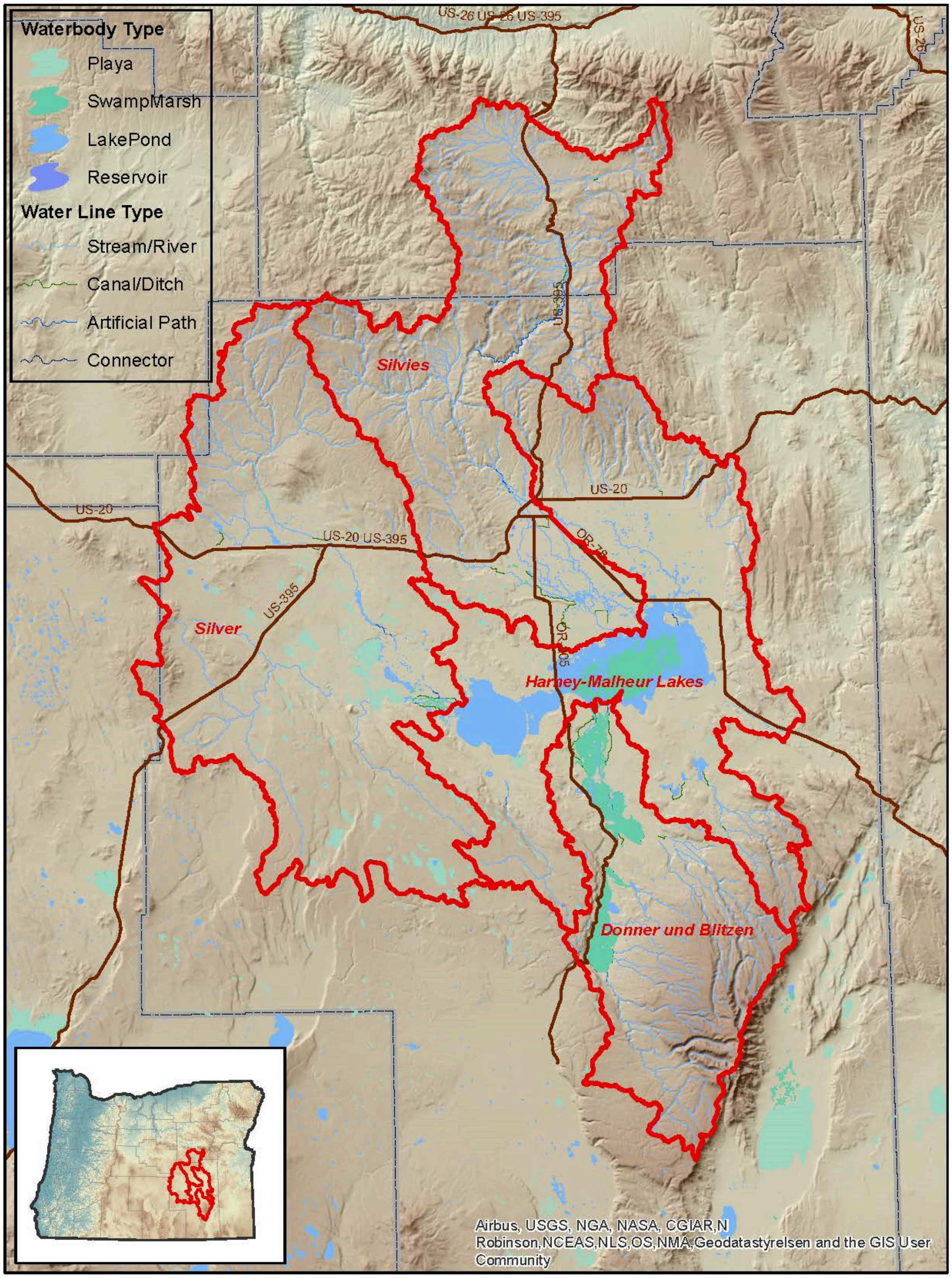

Figure 2 Harney Basin Study Area with Hydrologic Subbasins (USGS HUC 8 boundaries)

Plan Organization

The Surface Water Portion of the Integrated Water Resource Plan (Step 5) is a summary of the Harney Basin's background and findings from the Collaborative's Step 1 through Step 4 process.

- Chapter 1 provides an overview of the Harney Basin, including its geographic, ecological, and hydrological context, and outlines the Collaborative's initial groundwork (Step 1).
- Chapter 2 explains the Collaborative's planning process, detailing the development and engagement efforts undertaken in Step 1.
- Chapter 3 presents current surface water conditions and trends, offering insights into the basin's hydrological dynamics (Step 2).
- Chapter 4 describes surface water uses in the Harney Basin, covering both instream and out-of-stream needs (Step 2).
- Chapter 5 identifies the critical surface water issues uncovered throughout the planning process, such as over-allocation, watershed conditions, and climate impacts (Step 3).
- Chapter 6 defines the desired surface water conditions for the Harney Basin, outlining the goals for sustainable and balanced water use (Step 3).
- Chapter 7 details the strategies developed to address these critical issues, supporting the Collaborative's goals and vision (Step 4).
- Chapter 8 highlights the data needs essential for effective water management and continued assessment (Step 4).
- Chapter 9 describes the Collaborative's implementation approach, including an action plan and timelines for each strategy (Step 5).
- Chapter 10 emphasizes the importance of adaptive management principles, ensuring flexibility and responsiveness throughout implementation (Step 5).
- Chapter 11 concludes the plan by summarizing the key findings, reflecting on the Collaborative's journey, and outlining the path forward.

Chapter 1: Background and Context

Compliment to Groundwater Plan

The Harney Basin is dominantly rural and agricultural, and attracts visitors to the natural resource assets of the basin for recreation. The 3,280,100 acres (5,125 square miles) basin is composed of four major subbasins; Silver Creek, Silvies River, Donner und Blitzen River, and the immediate drainages to Harney and Malheur Lakes. Irrigation from surface water is dominantly flood irrigation from spring freshets.

The Harney Basin groundwater decline and overallocation is the subject of the “Harney Basin Groundwater Portion of Integrated Water Plan " completed in April 2023 by the Collaborative, reviewed by the OWRD interagency review team and presented to the Oregon Water Resources Commission. The over appropriation of surface water occurred significantly earlier than groundwater. By the time major adjudication was completed in the basin, there were more claims and permits than typically available water. This required management by curtailing junior right holders on a regular basis. Most surface water is used for irrigation or wildlife habitat in the lower Silvies River floodplain and at the Malheur National Wildlife Refuge in the Blitzen River Valley.

The 1967 Malheur Lake Basin report for the State Water Resources Board identified that each of the major tributaries to Malheur and Harney Lakes were over appropriated at that time (Table 1).

Table 1 Over-appropriation of Surface Water in the Harney Basin (from Oregon Water Resources Board, 1967)

Stream	Legal Rights	Natural Yield
Silvies River	385,000 acre-feet/year	225,000 acre-feet/year
Silver Creek	84,000 acre-feet/year	58,000 acre-feet/year
Donner und Blitzen River	329,000 acre-feet/year	154,000 acre-feet/year

Much of the surface water irrigation in the Harney Basin is dependent on spring freshet flows. The high water flows during spring are spread to satisfy senior users and flood wet meadow pastures across the floodplains. Modest storage is provided by Moon Reservoir on Silver Creek. Chickahominy Reservoir is managed as a recreational fishery reservoir also on Silver Creek. While there have been several explorations of water storage sites in the Harney basin (Whistler and Lewis, 1916; U.S. Army Corps of Engineers, 1957) none have proven cost effective and/or implemented.

The prior appropriation doctrine used in Oregon for administering water rights will continue to provide a mechanism for allocating surface water by priority date. The strategies recommended in this Plan are focused on mitigating human-made effects of over appropriation, and other impacts to surface water, while taking efforts to maintain beneficial uses of appropriations, protect in-stream resources, and provide adequate recharge to the aquifer. The purpose of place-based planning is to balance out of stream uses with in stream uses.

Surface-Groundwater Interaction

The USGS groundwater study (Garcia et al., 2023) identified different flow paths of groundwater to surface water in the uplands than the lowlands. Melting snow and rainfall in the uplands have short groundwater flow paths leading to many springs and significant contributions to nearby streams. Significant recharge is at the boundary between uplands and lowlands where larger, more porous materials settle from stream discharge into the valley.

The shallow groundwater in the lowlands is partially recharged by spring floods and subsequently less rapidly discharged to the streams. A significant portion (varying by sub-basin) of streamflow originating in the uplands and discharged to the lowlands is diverted for irrigation use, primarily by flood irrigation of low gradient areas that support wet meadows for grass hay production.

Harney Basin Surface Water Quantity/Quality Studies

The surface water conditions of the Harney basin are incompletely documented. Early documentation of surface water conditions (Waring, 1909) provides estimates of flow for the early years of the 20th century. Waring also describes springs in the Harney Valley. The Harney County Watershed Council prepared several sub-basin assessments with funding from OWEB in the last few decades. Hubbard (1975) evaluated two contrasting years of the contributions of surface water flow to Malheur Lake. Studies of hydrology and water quality as it affects management of the Malheur National Wildlife Refuge were conducted for the preparation of the Comprehensive Conservation Plan for the Refuge (USFWS, 2013). More recent studies have focused on stream flow and temperature in the Blitzen River as it affects redband trout (Benjamin and others, 2023). However, many aspects of the surface water resource conditions of the Harney basin are not well documented or studied.The primary data gaps identified include more detailed information on water quality and flow measurement.

The Silvies River has the greatest total magnitude of streamflow and more variability compared to the Silver Creek and Donner und Blitzen basins. However, flow from the Silvies is diverted for flood irrigation and during most years rarely reaches Malheur Lake. The Donner und Blitzen River maintains the most consistent late-season flow among the three basins due to its reliance on snowpack and groundwater, and discharges into Malheur Lake under most conditions. Silver Creek has the largest watershed and lowest flow with the earliest annual maximum flows. All three streams exhibit substantial interannual variability for flood events, and evidence suggests that all three watersheds have been affected by recent changes to precipitation and temperature compared to historical conditions.The primary method used in the Rivers and Streams Step 3 report to quantify instream flow conditions and demands applied a presumptive standard for environmental flow protection based on Richter (2011) using OWRD's Surface Water Availability Reporting System (SWARS) estimates of natural and expected streamflow for each "Water Availability Basin" (WAB). This work is described below in Chapter 4.

Water quality data in the basin is limited. The Oregon Department of Environmental Quality has three sampling stations in the basin to monitor and characterize surface water quality conditions. Early studies of the potential contamination of Malheur Lake by agricultural runoff were conducted by Rinella and Schuler in 1992. The limited water quality data available is dominantly water temperature taken on public lands. The Oregon Department of Environmental Quality has reported that stream reaches on the East Fork of Silvies River, Silver Creek, and tributaries to the Donner und Blitzen River do not meet water quality criteria for temperature .

Harney Basin Aquatic Resources

The forested portions of the watersheds that drain towards the Harney Valley support cold water fish, particularly redband trout.The fish fauna has changed only slightly over the last 50 years with the greatest change in lowland river areas (Harney Valley)(Laramie et al., 2023). The authors conclude "Overall, our results show that native fish are still relatively widespread across the Harney Basin, but also face increasing threats despite the basin having experienced less development than many other areas in the Pacific Northwest." Redband trout are found in Silver Creek, Silvies River, Poison Creek, Prater Creek, Rattlesnake Creek, Coffeepot Creek, Cow Creek, Riddle Creek and The Donner und Blitzen River. The 2018 evaluation by ODFW is that only the Blitzen River population is at low risk of extinction in 100 years. Prater and Cow Creek populations are at high risk of failure while the remaining populations are at moderate risk of failure.

The streams of the Harney Basin also support plants, birds, freshwater mussels, amphibians and other species. The Columbia Spotted frog, a candidate species, is found in the Blitzen River and Silver Creek drainages. The Western Ridged mussel, a candidate species for listing under the Endangered Species Act, is also found in the Blitzen River.

The wetlands of Bear Valley, Silvies Valley, and Harney Valley (including the Silvies River floodplain, Blitzen River floodplain and lower Silver Creek floodplain) are important habitat for resident and migratory birds. The Harney Valley has the largest population of bobolink and supports tens of thousands of migratory waterbirds each year, including about 40% of the Pacific Flyway's population of Ross's Geese. Malheur marsh (formerly called Malheur Lake) and the wetlands of the Malheur National Wildlife Refuge appear to be recovering the habitat characteristics (emergent vegetation, submergent vegetation and clear water) that support both migratory and resident waterbirds. The lower Blitzen river floodplain is managed for wetland bird use.

Applicable Law and Policy

Oregon Water Law

Under Oregon Law, all water belongs to the public. With few exceptions, any person wishing to use surface water or groundwater must first obtain a permit from OWRD. The water right, once developed, is attached to the land where it was established. The place of use of a water right can be moved through a permit amendment process (ORS 537.211 and OAR 690-380-2110) or transfer following the procedures of Oregon Water Law (ORS 540.505 to 540.580 and OAR Chapter 690, Divisions 380 and 382). In Oregon, landowners with water flowing past, through, or below their property do not automatically have a right to use that water.

Oregon's water laws are based on the principle of "prior appropriation." This means that the first person to obtain a water right to a water source is the last to be regulated off in times of low water availability. In water-short times, water users with the oldest water right have a right to the amount specified in their right regardless of the needs of junior users. If regulation occurs, water rights are regulated off in order of priority, with the most junior regulated off first. If there is a surplus beyond the specified amount of the senior right holder, the right with the next oldest priority date can take their specified amount as necessary to satisfy their appropriation under their right and so on down the line until there is no further water available. State law has required issuance of a water permit for surface water use since 1909; groundwater has been subject to statewide permitting requirements since 1955. Apart from water uses established prior to permit requirements, the date of application for a permit is the priority date of a right issued for that application. Five important provisions of Oregon's water code are:

1. Except for certain exempt uses, surface or groundwater may be legally diverted only if it is used under the terms of a valid water right for a beneficial purpose.
2. The more senior the water right, the more likely water is available to appropriate under that right in a time of shortage.
3. Water permits and water right certificates for irrigation and most other consumptive uses specify, among other conditions, the land to which the permitted water may be applied. The permit or certificate is attached to that land but may move through an approved amendment (for permits) or transfer (for certificates) if certain standards are met.
4. To avoid forfeiture, subject to certain exceptions, a water right must be used at least once every five years for its intended purpose. If the right is unused for five consecutive years, subject to certain exceptions, it is presumed forfeited and is subject to cancellation.
5. Instream water rights are water rights held in trust by the Water Resources Department for the benefit of the people of the State of Oregon to maintain water instream for public use such as recreation; conservation, maintenance and enhancement of aquatic and fish life, wildlife, fish and wildlife habitat and any other ecological values; and pollution abatement.

Oregon’s Integrated Water Resources Strategy (IWRS)

Oregon’s Integrated Water Resources Strategy (IWRS) provides a statewide inter-agency framework for better understanding and meeting Oregon’s instream and out-of-stream water needs. The IWRS program was established by the legislature in 2009 (*see* ORS 536.220), which set forth several sideboards and requirements. Although OWRD is the lead agency for developing and updating the IWRS, it works in close cooperation with other agencies, stakeholders, and the public.

Oregon’s Integrated Water Resources Strategy is updated every five years, providing a statewide framework for water management. The IWRS includes a provision for collaborative place-based planning, authorized by separate legislation in 2015, recognizing that water challenges vary across different regions. The IWRS highlights the importance of balancing instream and out-of-stream water uses to support both ecological functions and economic activities. Consistent with statute, it supports the establishment of instream water rights, which help to ensure minimum flow levels are maintained for aquatic and riparian ecosystems, recreational opportunities, and water quality. Additionally, the strategy recognizes the value of community involvement and engagement among stakeholders, Tribes, and state agencies. By seeking to balance instream and out-of-stream demands and including place-based planning, the IWRS plays a crucial role in addressing water scarcity, maintaining ecosystem health, and fostering sustainable water management across Oregon.

Summary

This chapter has provided a foundational understanding of the Harney Basin’s unique geography, historical water usage, and the legal and policy frameworks that shape water management in the region. By exploring the interaction between surface and groundwater, as well as the implications of over-appropriation and the challenges of balancing ecological and agricultural needs, we’ve set the stage for a deeper exploration of the basin's water resources. With this context, we can now examine the planning process that seeks to address these intricate challenges through a collaborative and adaptive approach. The next chapter will detail the structured planning process undertaken by the Harney Basin Collaborative to create a plan that responds to the region’s specific water needs.

Chapter 2: The Planning Process (Step 1)

The Harney Basin's complex water dynamics, marked by long standing over-appropriation and a delicate balance between surface and groundwater, have underscored the need for comprehensive water management strategies. With the groundwork laid in Chapter 1, detailing the region's hydrological challenges, ecological significance, and legislative framework, the focus now shifts to the planning process that seeks to address these multifaceted issues. Chapter 2 delves into the structured approach adopted under Oregon's Place-Based Planning initiative. This process, driven by the Integrated Water Resources Strategy, involves collaborative efforts from local, state, and federal stakeholders, and emphasizes the importance of integrating surface water and groundwater planning. The subsequent sections outline the steps taken by the Harney Basin Collaborative to engage the community, gather and analyze data, and develop a holistic plan aimed at achieving sustainable water use for both ecological health and economic stability in the basin.

Drivers for Planning

In December 2017, the Oregon Water Resources Commission adopted an updated Integrated Water Resources Strategy, a framework for better understanding and meeting instream and out-of-stream water needs, including water quantity, water quality, and ecosystem needs. The IWRS recommended that OWRD help communities undertake a Place-Based approach to integrated water planning. Place-Based integrated water resources planning is a voluntary, locally initiated and led effort in which a balanced representation of water interests focus on a Basin, watershed, or groundwater area to work in partnership with the state to:

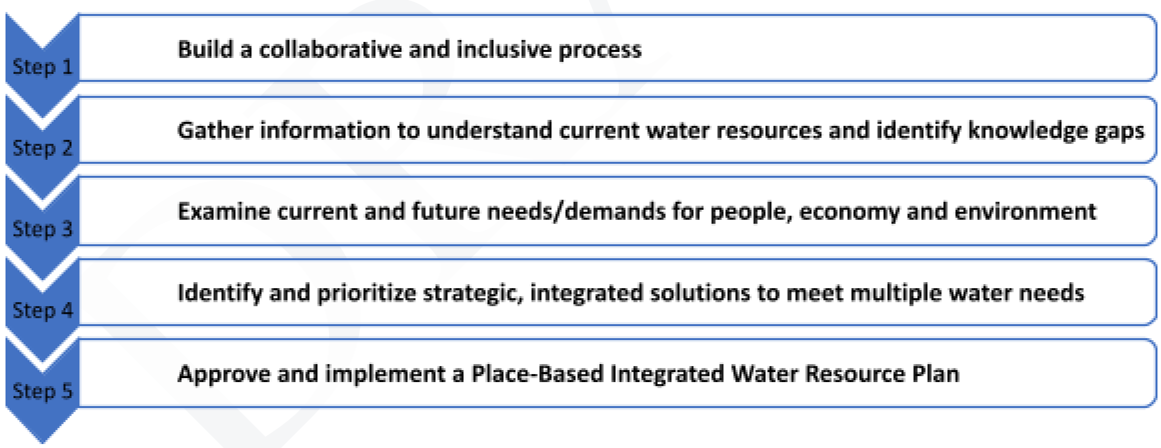

Figure 3. Place-Based Planning Steps

OWRD developed draft Place-Based Planning Guidelines that lay out the five-step process for pursuing Place-Based planning efforts. In 2016, OWRD awarded grants to four communities to pilot the Place-Based process. The Harney County Watershed Council and Harney County Court applied for and were awarded partial funding on February 25, 2016.

While the Guidance from OWRD anticipated compiling information and developing issues and strategies for both surface and groundwater at the same time, the Harney Basin Collaborative chose to focus on groundwater during their early stage of planning and work on surface water later. Additionally the Harney Basin Collaborative gathered information using Work Groups that focused on different aspects of and expressions of the hydrological cycle. The early result was development of a Groundwater Plan in April 2023 shortly following the completion and publication of the USGS/OWRD groundwater studies of the Harney Basin.

The Harney Basin Groundwater Plan

After extensive deliberation and review the Harney Basin Collaborative adopted a Groundwater Plan that included 31 strategies to help address the over appropriation of groundwater in the Harney Basin. The annual deficit of 110,000 acre-feet/year of groundwater and the majority of pumping from ancient groundwater are major drivers to reduce groundwater pumping in the basin. Evaluation of surface water use and surface-groundwater relations are the subjects of this plan.

Surface Water Planning Process Participants

Harney County is a community of less than 7,500 people; however, the resources of the basin attract people and parties throughout the state and beyond that care and have concerns about the ecological and economic integrity of the community. During Step 1 (Build a Collaborative) of the CBWP's Surface Water PBP process, the conveners, project manager, and Harney County Watershed Council Coordinator invited people that represent a full suite of interests to participate in the effort. The same Working Agreement (Appendix A) created and utilized during the groundwater portion of planning was used for the surface water planning portion. The Working Agreement provided that only those parties who attended at least 2 of the last 4 Collaborative meetings AND signed onto the Working Agreement could participate in consensus decisions.

The Parties that participated and signed onto the Collaborative's Working Agreement include representatives from the following groups:

- Harney County Court (County Government) – co-convener (different convener during the groundwater phase of planning)
- Harney County Watershed Council (Conservation) – co-convener (different convener during the groundwater phase of planning)
- Burns-Paiute Tribe (Tribal Government)
- High Desert Partnership
- Audubon Society of Portland (Conservation)
- The Nature Conservancy (Conservation)
- WaterWatch of Oregon (Conservation)
- Oregon Department of Environmental Quality (State Government)
- Oregon Department of Fish and Wildlife (State Government)

- Oregon Water Resources Department (State Government)
- Oregon State University Extension Service (State Government)
- Harney County Soil Water Conservation District (State Government)
- Malheur National Wildlife Refuge (Federal Government)
- Landowners (Resident)
- Ducks Unlimited (Recreation)
- Water Rights Services, LLC (Business)

Other groups and individuals were invited and some of those participated periodically but did not formally sign the Collaborative's Working Agreement. These parties include:

Outreach

The Collaborative used a variety of communication methods to engage the public and maintain an open and transparent process. The project manager compiled and regularly updated an email list of all CBWP meeting attendees. At the end of the CBWP's surface water planning phase, that email list included over 160 contacts. Meeting announcements and materials were sent to all contacts on that email list and advertised on the radio, and on the Harney County Watershed Council's website and Facebook page. During CBWP meetings, attendees, both new and regular, were always welcomed to the process.

After each meeting, summaries, recordings, presentation slides, and decision outcomes were available to Collaborative members and were posted on the Harney County Watershed Council's website. The project manager kept open availability for Collaborative members to call and/or email with any questions or concerns.

Process and Timeline

The general Collaborative planning process is illustrated below (Figure 4). Because groundwater issues were acute, the Collaborative chose to separate the place-based planning process into two phases and focus the early efforts on groundwater. The timeline was initially driven by the potential of the groundwater study being completed in 2020 which would trigger a revisitation of the basin rule that established the Greater Harney Valley Groundwater Area of Concern (GHVGAC). Unforeseen delays (COVID 19, etc.) led to timeline slippage; however, the intention is to complete the integrated plan in 2024.

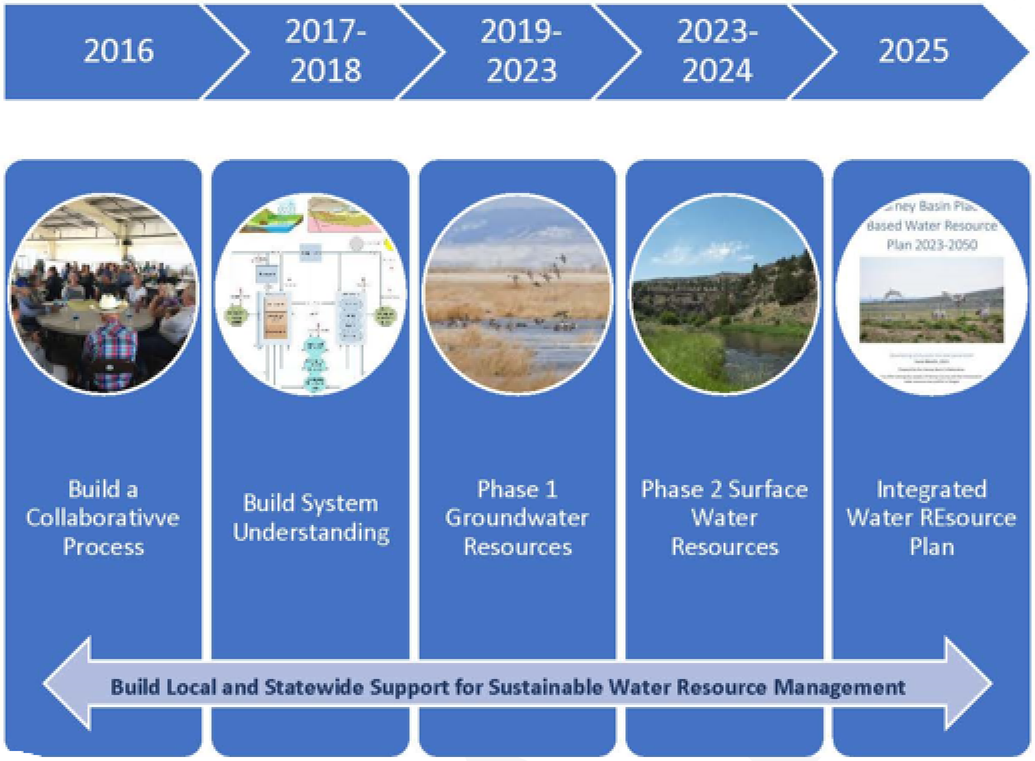

Figure 4. Harney Basin Community-Based Integrated Water Planning Program

Like Phase 1, during Phase 2 the Collaborative had a Coordinating Committee (CC) to take care of process details. The CC, composed of Collaborative members, provided input on meeting agendas, shaped discussions, and reviewed meeting materials to ensure productive Collaborative meetings and clear processes. The CC met on a biweekly basis throughout the planning process. Outcomes from CC meetings were regularly communicated with the Collaborative.

Questions, comments, or concerns from Collaborative members on meeting materials, reports, presentations, summaries, etc. were first organized by the project manager according to the document. The project manager then developed a plan for working through those questions, comments, or concerns. In some cases, the project manager alone could address all questions, comments, or concerns to the commenter's satisfaction. In other cases, the project manager would bring those questions, comments, or concerns to the CC for guidance on how to best address them. Sometimes a Working Group, composed of Collaborative members, would form to work through questions, comments, or concerns. In all cases, comments and any changes made to documents were shared with the Collaborative to ensure transparency.

From First Draft to Final Draft: CBWP Process, Public Comment, and Integration with Groundwater Plan

Building on lessons learned from the groundwater phase, the team streamlined the surface water planning process to enhance efficiency and collaboration. Staff developed a detailed timeline and assigned responsibilities for drafting plan chapters and conducting peer reviews. The Coordinating Committee established a review process in which three chapters were evaluated at a time. Feedback was collected from committee members, and staff made revisions, documenting the changes and the rationale behind them. After completing the first draft, staff circulated it to the entire Collaborative, allowing for a four-week review period. Staff then spent two weeks incorporating the Collaborative's input. The final draft was shared with the Collaborative and reviewed at a consensus event on __________. Following the consensus event, the plan was released for public comment and prepared for integration with the existing Groundwater Plan.

Summary

In this chapter, we outlined the collaborative planning process that serves as the backbone for addressing the Harney Basin’s surface water resource challenges. By leveraging the insights and contributions of diverse stakeholders, the Harney CBWP Collaborative has established a. process that not only emphasizes transparency and inclusivity but also recognizes the need for balancing instream and out-of-stream surface water needs. As we proceed to examine current surface water conditions in the following chapter, the groundwork laid here will guide our exploration of the specific issues and opportunities that influence surface water in this unique region.

Chapter 3: Current Surface Water Conditions (Step 2)

With a process in place and a comprehensive groundwater plan established, the Harney Basin Collaborative now turns its focus to surface water resources. In Chapter 3, we explore the current surface water conditions in the Harney Basin, exploring the intricate connections between surface water flows, groundwater recharge, and ecosystem health. This chapter presents a detailed examination of the basin's hydrological cycle, highlighting the seasonal dynamics, key water sources, and the vital role of surface water in supporting agricultural practices, aquatic habitats, and wetland ecosystems. By understanding these current conditions, the Collaborative aims to identify strategies that balance the needs of both the community and the environment, setting the stage for informed decisions.

The Hydrological Cycle Model

A model of the hydrology of the Harney Basin (Figure 5) was developed to guide planning. The model identifies the major elements and pathways of water flow throughout the basin. This model is being used to identify and keep track of the different factors to consider when managing water in the basin.

Surface water in the basin is only a portion of the hydrological cycle (Figure 5). It includes streams, springs, lakes, and wetlands, storage, and natural recharge to groundwater. The surface water portion, like the groundwater portion, of the hydrological cycle depends on precipitation in all forms but is dominated by snow melt. Consumptive use of surface water is dominated by use for flood irrigated agriculture. Only minor amounts of surface water is used for municipal and industrial uses, domestic and stock water uses. Surface water flows support stream, lake and wetland ecosystems. Surface flooding, both natural and flood irrigation, contribute to shallow groundwater recharge. There is very limited constructed surface water storage in the Harney Basin. Consumptive demand for surface water is dominated by flood irrigated wet meadows in the Harney Valley, Silvies Valley and Bear Valley.

Surface-groundwater interactions

The rivers and streams of the Harney Basin are connected to groundwater. In parts of the basin, groundwater provides important base flow to streams, while in other parts surface water provides water that recharges the groundwater aquifer. The Harney Basin is a closed surface water basin. Surface water and groundwater generally flow toward the marshes and lakes on the Malheur National Wildlife Refuge.

Surface water recharges groundwater in the Harney Valley along the edge of the valley where the uplands meet the lowlands. The lowlands of the Silvies floodplain, Silver Creek floodplain, and Donner und Blitzen floodplain are regularly flooded by spring freshets which vary from year to year. Flood irrigation provides a significant amount of shallow groundwater recharge (Figure 6). In the lowlands, recharge from flood irrigated hay/pasture (estimated at 57,000 acre-feet/year) is nearly as great as recharge from streams. The recharge is ultimately from stream flow but diverted for flood irrigation in a manner similar to historic floodplain inundation. Most recharge occurs in the uplands.

In the northern region of the basin, composed primarily of the Silvies River Sub-basin, "some larger spring complexes do occur in the northern uplands [that] are important sources of base flow to major upland streams, such as those in the headwaters of Emigrant Creek . . . ." (Garcia et al., 2022). In the western region, composed primarily of the Silver Creek Sub-basin, "there are important complexes that provide base flow to upper reaches and tributaries of Silver Creek." (Garcia et al., 2022).

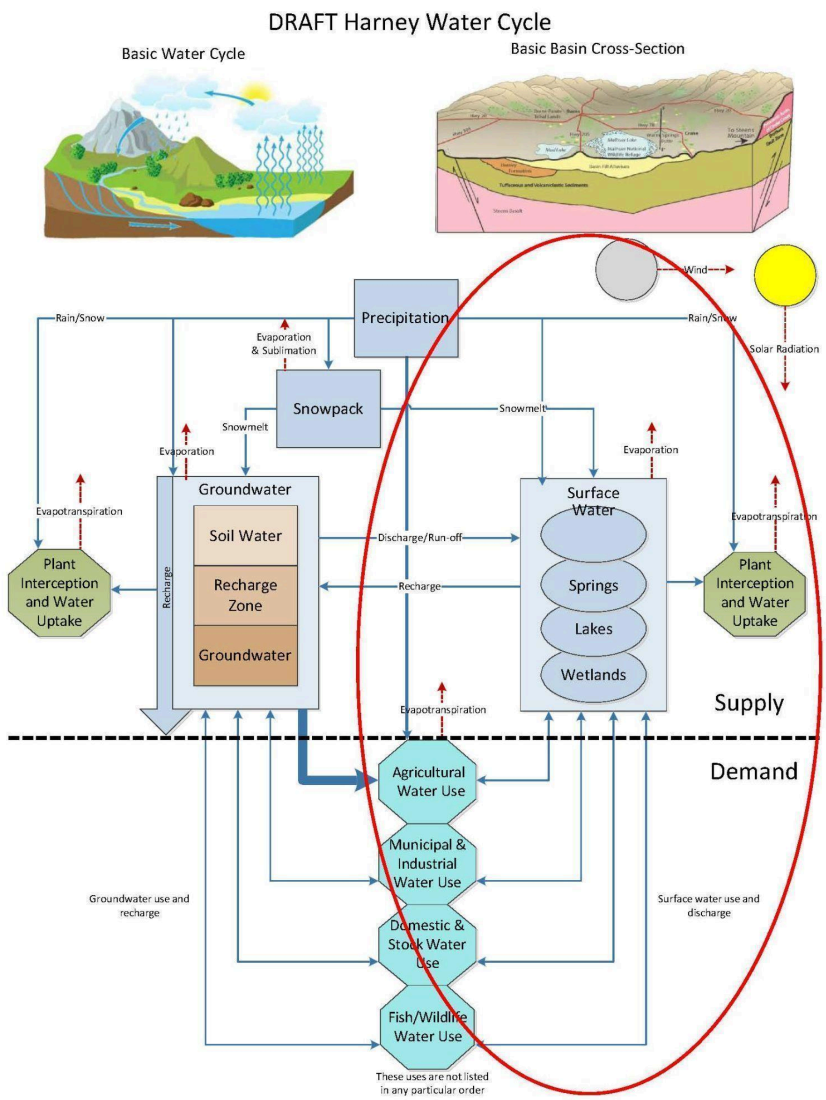

Figure 5. Surface Water portion of the hydrological cycle

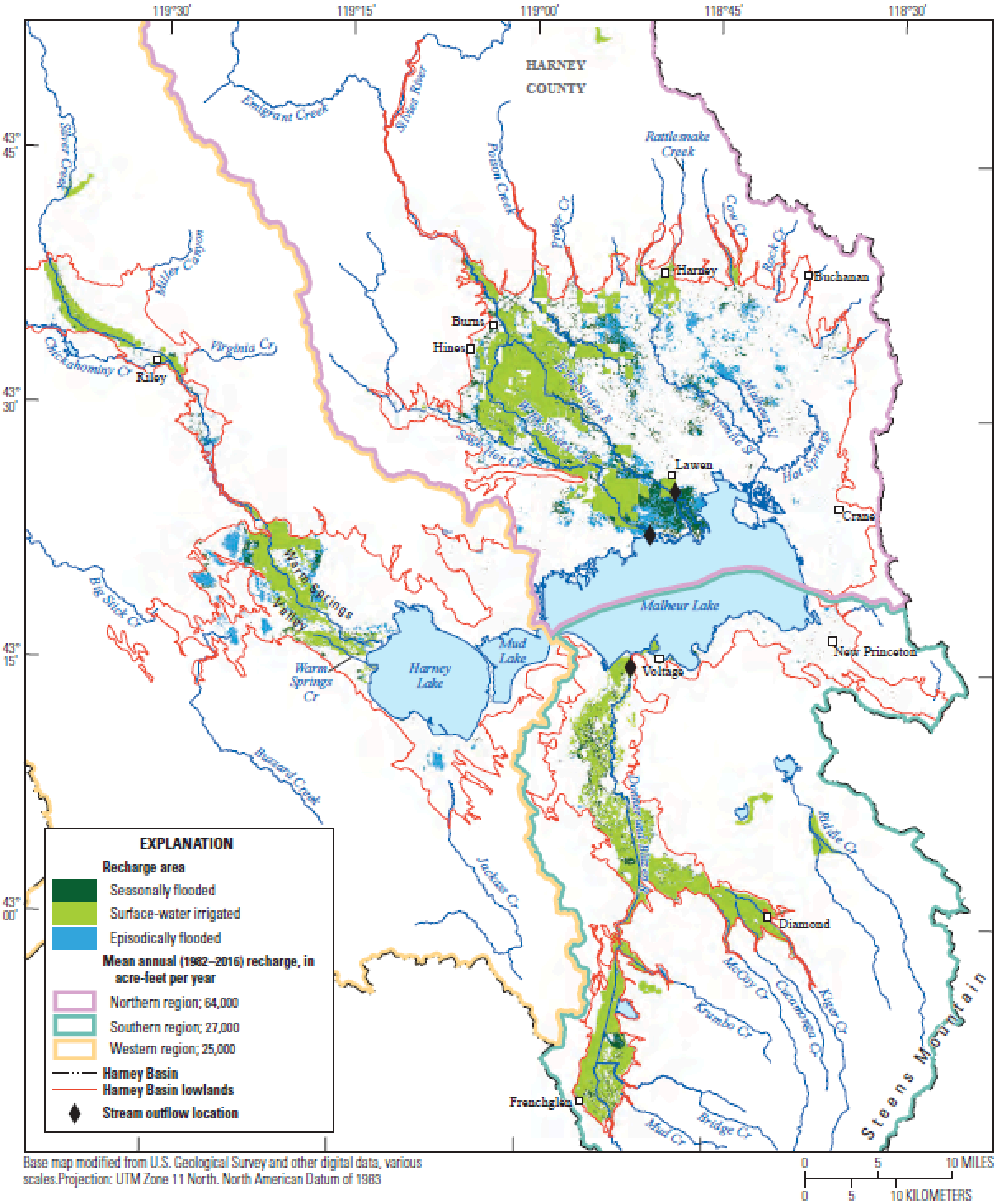

Figure 6 Location and volume of recharge from infiltration of surface water (Garcia et al., 2022)

Compared to the other rivers systems in the basin, “springs and base flow provide a larger portion of the total annual streamflow in the Donner und Blitzen River, and it discharges perennially to Malheur Lake without any reaches going dry.” (Garcia et al., 2022). Springs are also the headwaters of and contribute to smaller streams in the basin, such as Rattlesnake, Poison, and Sagehen Creeks.

Spring freshets from Silvies River, Donner und Blitzen River and Silver Creek provides water that recharges the groundwater aquifer. Natural stream flooding and lakes is estimated at 59,000 acre-feet/year (Garcia et al., 2023). The beneficial “inefficiencies” of flood irrigated hay production has been recognized in recent studies of the importance of these sites to migratory birds (Donnelly et al., 2024a, Essaid and Caldwell, 2017, Donnelly et al., 2024b, Moulton et al., 2022). Surface water accounts for more than 87% of the recharge to the lowlands of the Harney basin (59,000 ac.ft natural flooding, 57,000 ac.ft. flood irrigation and 8,200 ac.ft. groundwater irrigation).

Watershed Yield

Vegetation cover of the catchments that drain to the closed basin lakes in the Harney basin affects the water yield seen as stream flow (Figure 7). The vegetation of each watershed is quite different from the others (Table 2). The upper portions of Silver Creek, Silvies River, and the tributaries on the east are dominated by forest vegetation.

Table 2 Land Cover and Land Use by Subbasin (NRCS, 2005)

Land Cover (from NRCS, 2005)*						
Subbasin	**Forest**	**Agriculture***	**Pasture/Hay**	**Shrub/Range**	**Water/Wetland/Barren**	**Percent Land Area**
Silvies River	383,800	0	118,400	282,600	27,500	**21.3%**
Silver Creek	138,100	0	69,000	834,100	44,200	**28.4%**
Malheur-Harney Lakes	78,900	19,800	142,200	578,500	130,300	**24.9%**
Donner und Blitzen	62,800	0	37,900	360,900	44,000	**25.4%**
Total	**663,600**	**19,800**	**467,500**	**1,996,100**	**5,060,300**	**3,927,300**
Percent Cover	**17%**	**.05%**	**10%**	**54%**	**19%**	

*Area in acres
** Includes grains, orchard, row crops and CRP

Forest cover dominates the highlands of the Blue Mountains to the north, northwest and northeast of the Basin. Shrublands dominate the Harney Basin floor, while a significant area of

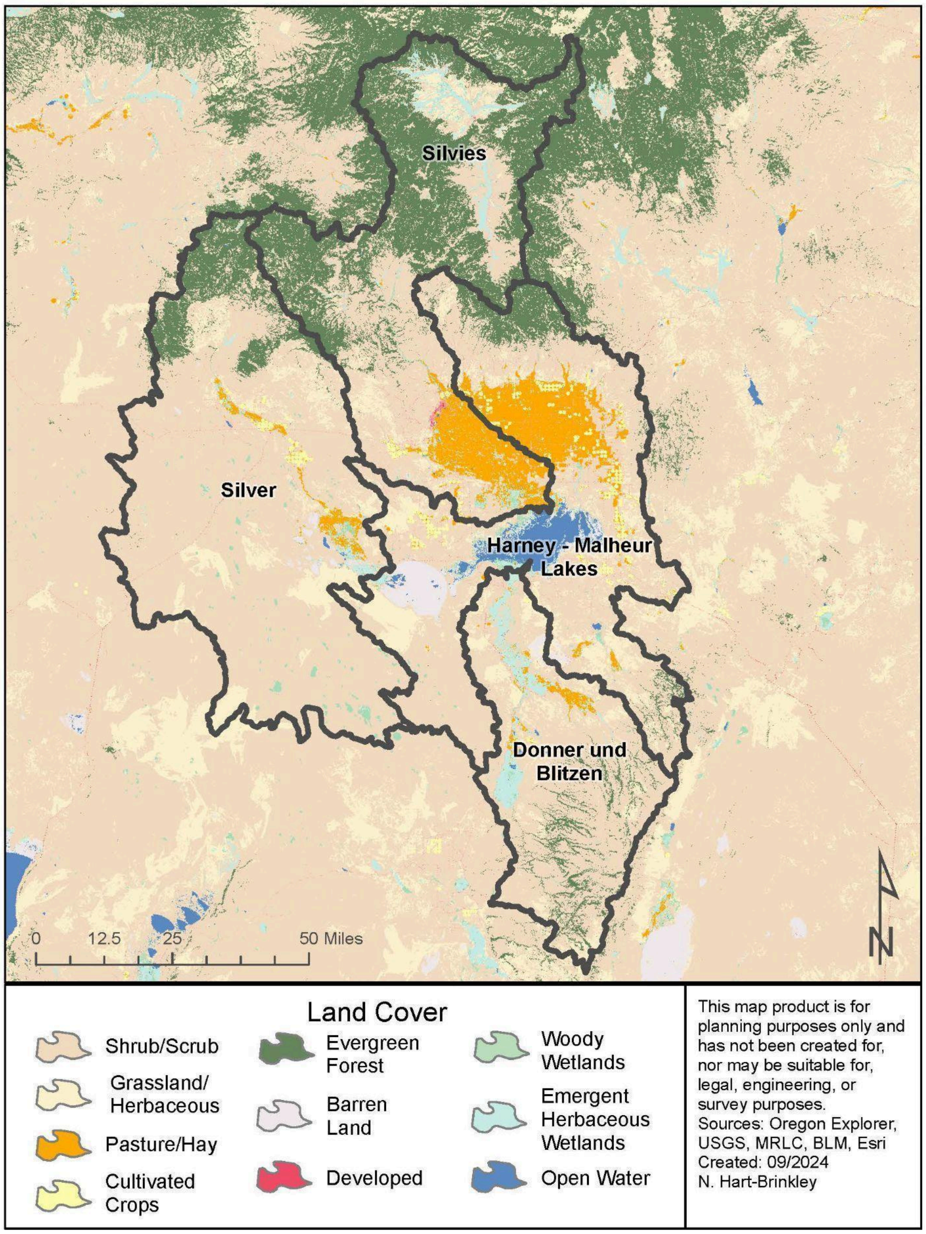

Figure 7. Land Cover in the Harney Basin (data from Multi-Resolution Land Characteristics Consortium)

wetlands and water occupy the terminal lakes and surrounding wetlands of Malheur and Harney Lakes. These gross land cover types give an idea of the relative effect of cover type within each sub-basin. The Silvies sub-basin has a greater proportion of forest than all other basins. The Donner und Blitzen has less forest similar to the Malheur-Harney sub-basin. There is a relatively equal area of the total catchment in each sub-basin. The gross land cover information suggests forest conditions will have the greatest effect on the Silvies River and less effect on the Donner und Blitzen and the small tributaries to the lakes.

Conifer forests of the Blue Mountains were historically dominated by large, widely-spaced ponderosa pine forests with grass and shrub understory. With extensive logging, older Ponderosa has been replaced by mixed stands of significantly greater density. Coarse scale modeling of forest cover indicates that more than half the forest stands in the Silvies River and Silver Creek headwaters have some 50% cover which is significantly greater than historic conditions and results in greater evapotranspiration and thus loss of water yield from the catchments.

There has also been a recent (last 100 years) expansion of Western juniper in the lower elevations of the catchments that drain to Harney Lake. Silvies and Silver Creek have the greatest area of juniper encroached sagebrush and ponderosa habitats (140-150,000 acres) (Vegetation Management Working Group Report). There is also substantial acreage of juniper encroached sage habitats in the Donner und Blitzen and Malheur-Harney Lakes sub-basins as well (some 98,000 and 77,000 acres respectively). There is limited understanding of the effects of juniper clearing to increase water yield.

The Vegetation Management Work Group identified both information gaps and management approaches to reduce the effects of overstocked conifer sites and questions surrounding the cumulative effect of Western juniper clearing.

Streams and Streamflow

Rivers, streams and their associated riparian areas in the Harney Basin support a diversity of fish, freshwater mussels, wildlife and plants. The Harney Basin represents the surface-water drainage area of three adjacent terminal lakes, Malheur Lake, Harney Lake, and Mud Lake (Garcia et al., 2022). It is composed of four sub-basins containing rivers and streams that flow towards these lakes: Silvies River, Silver Creek, Donner und Blitzen River, and a fourth, the Harney-Malheur Lakes sub-basin, that includes several smaller streams that flow towards the lakes from the north (Poison Creek, Prater Creek, Rattlesnake Creek, Coffeepot Creek and Cow Creek)) and from the south (Smyth Creek and Riddle Creek). (Figure 8). Ephemeral streams like Buzzard Creek, Jackass Creek, and Big Stick Creek occur on the arid western edge of the basin.

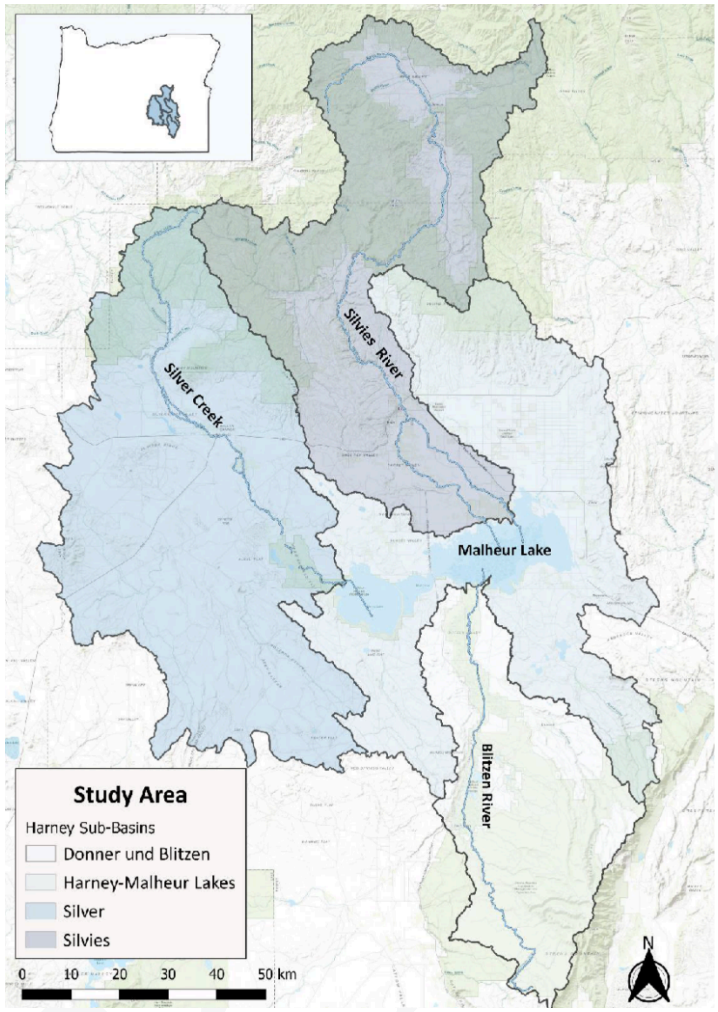

Figure 8 Subbasins of the Harney Basin (Esquivel, 2018)

The four subbasins of the Harney basin have different characteristics and resulting stream conditions. The size of the subbasin is not directly related to streamflow. The Silvies River has the greatest total magnitude of streamflow and more variability compared to the Silver Creek and Donner und Blitzen basins (Table 3). Hubbard (1975) documented the stream flow contributions to Malheur Lake (Marsh) in 1972 and 1973 representing a very high flow year (1972 at 200,000 ac. ft.) and a very low flow year (1973 at 75,000 ac.ft.). Contributions from the Blitzen River were 55% in 1972 and 62% in 1973. The Silvies contributed 28% in 1972 and 1% in 1973.This variability appears to be seen today with flow from the Silvies not regularly reaching Malheur Marsh.. The Donner und Blitzen River maintains the most consistent late-season flow among the three basins due to its reliance on snowpack and groundwater, and discharges into Malheur Lake under most conditions. All three streams exhibit substantial interannual variability for flood events, and evidence suggests that all three watersheds have been affected by recent changes to precipitation and temperature compared to historical conditions. The three systems are achieving peak flows earlier in the season on average, although the Donner und Blitzen appears to be changing at a slower rate.

Table 3. Area and stream kilometers of Harney Basin sub-basins. Stream length calculations only incorporate perennial or intermittent streams. Source for areas: https://water.usgs.gov/GIS/huc_name.txt (visited 7-14-2023); source for stream miles: U.S. Geological

HUC 8	Sub-Basin Name	Acres	Square Miles	Stream kilometers (miles)	Annual Average Discharge (ac.-ft.)[1]
17120001	Harney-Malheur Lakes	908,800	1,420	1,737 (1,079)	N/A
17120002	Silvies	838,400	1,310	2,281 (1,417)	131,000
17120003	Donner und Blitzen	489,600	765	1,612 (1,002)	91,000
17120004	Silver	1,068,800	1,670	2,877 (1,788)	31,010

A comparison of the mean-daily streamflows from Donner und Blitzen River, Silver Creek, and Silvies River from 2011-2019 provides insights into hydrologic differences between the three basins (Figure 8). The Silvies gage has a greater magnitude of streamflow than the other two basins. It also has a larger upstream drainage area (934 square miles). Silver Creek and Silvies River (as measured at existing gages) both peak in early April. However, the Donner und Blitzen River basin has higher mean elevation with greater mean-annual precipitation and more snowfall and snowpack than the headwaters of the other two basins. Because high flows from the Steens Mountain are snowmelt dominated, maximum annual streamflow in the Blitzen River typically occur in the spring, later than the other basins.

Water withdrawals upstream of the Donner und Blitzen gage are generally negligible. Gage data from the Silvies River and Silver Creek reflect varying levels of consumptive use upstream of the gages. It is estimated that diversions remove more than 40 percent of July–September streamflow upstream of the Silvies River stream gage near Burns (USGS ID: 10393500) and more than 10 percent of streamflow upstream of the Silver Creek stream gage (Cooper, 2002; Oregon Water Resources Department, 2018). Diversions upstream of the Donner und Blitzen River near Frenchglen are negligible during summer and autumn (Garcia et al., 2022).

The Silvies River has the greatest total magnitude of streamflow and more variability compared to the Silver Creek and Donner und Blitzen basins. However, flow from the Silvies during most years rarely reaches Malheur Lake. The Donner und Blitzen River maintains the most consistent late-season flow among the three basins due to its reliance on snowpack and groundwater, and discharges into Malheur Lake under most conditions. Silver Creek has the smallest watershed and lowest flow with the earliest annual maximum flows. All three streams exhibit substantial interannual variability for flood events.

[1] Wellman, Roy E., J.M. Gordon, and R.L. Moffatt. 1993. Statistical Summaries of Streamflow Data In Oregon: Volume 2--Annual Low and High Flow, and Instantaneous Peak Flow. USGS Open File Report 93-63. 406 p.

Gaging data suggests that the timing and pattern of streamflows in the three watersheds has been affected by recent changes to precipitation and temperature compared to historical conditions. See Rivers and Streams Step 2 Report, Figures 9, 12 and 15. The three systems are achieving peak flows earlier in the season on average, although the Donner und Blitzen appears to be changing at a slower rate.

Figure 9 compares average timing of flow from the three basins showing the similar timing but greater magnitude from the Silvies than Silver Creek and later timing from the Donner und Blitzen.

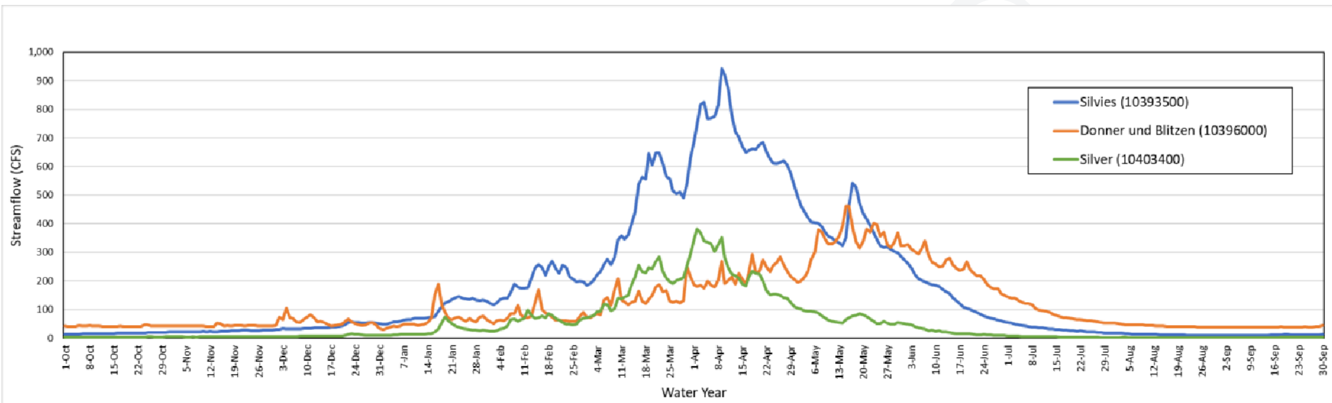

Figure 9 Flow magnitude and timing for Harney Basin Streams (mean daily flow 2011-2019 water years)

Chapter 4 summarizes work done in the Rivers and Streams reports utilizing available data, including streamflow gage records and OWRD's Surface Water Availability Reporting System, to evaluate instream flows and instream flow needs.

Aquatic Resources

Streams in the Harney Basin provide important habitat for redband trout, amphibians, freshwater mussels and other fish and wildlife and support riparian areas. Harney Basin streams, lakes and reservoirs are inhabited by several native and non-native fishes. Fish fauna of the Harney Basin likely originated from tributaries of the Columbia River through two distinct periods when the two basins were hydrologically connected. Connection to the Malheur River during the Pleistocene provided the opportunity for Columbia River species to colonize portions of the Malheur Lakes Basin. The current fish assemblage in the Blitzen River, upland tributaries of the Silvies, and hydrographically isolated creeks closely resembles that of the middle or upper Snake River (Bisson and Bond 1971) and includes redside shiners, a form of mottled sculpin, redband trout and whitefish and suckers.

Redband Trout

Harney Basin redband trout are likely descendants from steelhead that used to travel to and from the ocean in the Malheur, Snake and Columbia Rivers before the connection was lost. Historic photos and reports confirm that large - and large numbers - of trout used to be caught in the Blitzen system. The streams in this basin flow into a series of lakes (no outlet to larger rivers and the ocean) and often do not connect with other nearby streams. As a result, there is little exchange of genetic traits between populations, which has led to each population being genetically unique (Figure 10). The Harney Basin provides important habitat for redband trout, supporting nine populations (Figure 11), with populations found in each of the four sub-basins. One population exists in each of the three major stream systems in the basin, Silver, Silvies, and Blitzen. The Blitzen population occupies the Blitzen River sub-basin and has relatively regular connection to Malheur Lake. The Silvies and Silver populations have potential to access Malheur and Harney Lakes respectively but are excluded from the lower portions of those rivers due to irrigation activities and associated structures. Under current conditions, interchange of fish between these three populations is highly improbable and can only occur during extremely wet climatic conditions when high water levels connect all three lakes.

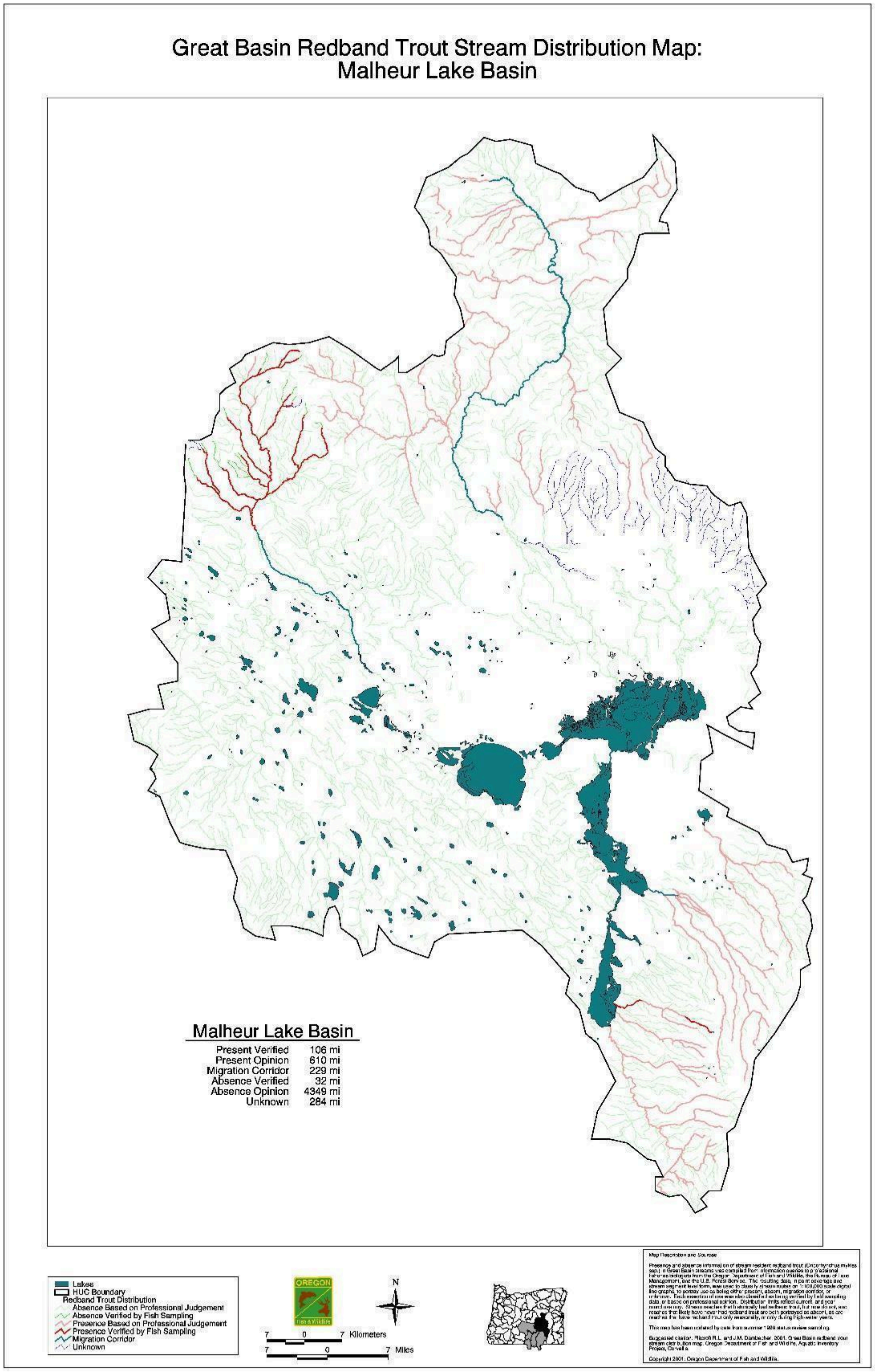

Figure 10. Redband Trout distribution in the Harney basin (from ODFW, 2018)

Five populations of redband trout exist in streams that naturally dissipate onto the Harney Valley floor. Poison, Prater, Coffeepot, Rattlesnake and Cow populations occupy short, small streams that drain King Mountain northeast of Burns. These populations all have extremely limited distributions primarily due to the isolated nature of the streams and the arid climate. The Riddle population occupies Riddle, Smyth and Paul creeks that flow north off of the Steens Mountain. This population is naturally isolated from the Blitzen population by an ancient lava flow that originated near Diamond Craters. A preliminary assessment of the nine populations identify only the Blitzen as being low risk, whereas the others are at moderate risk (Table 4).

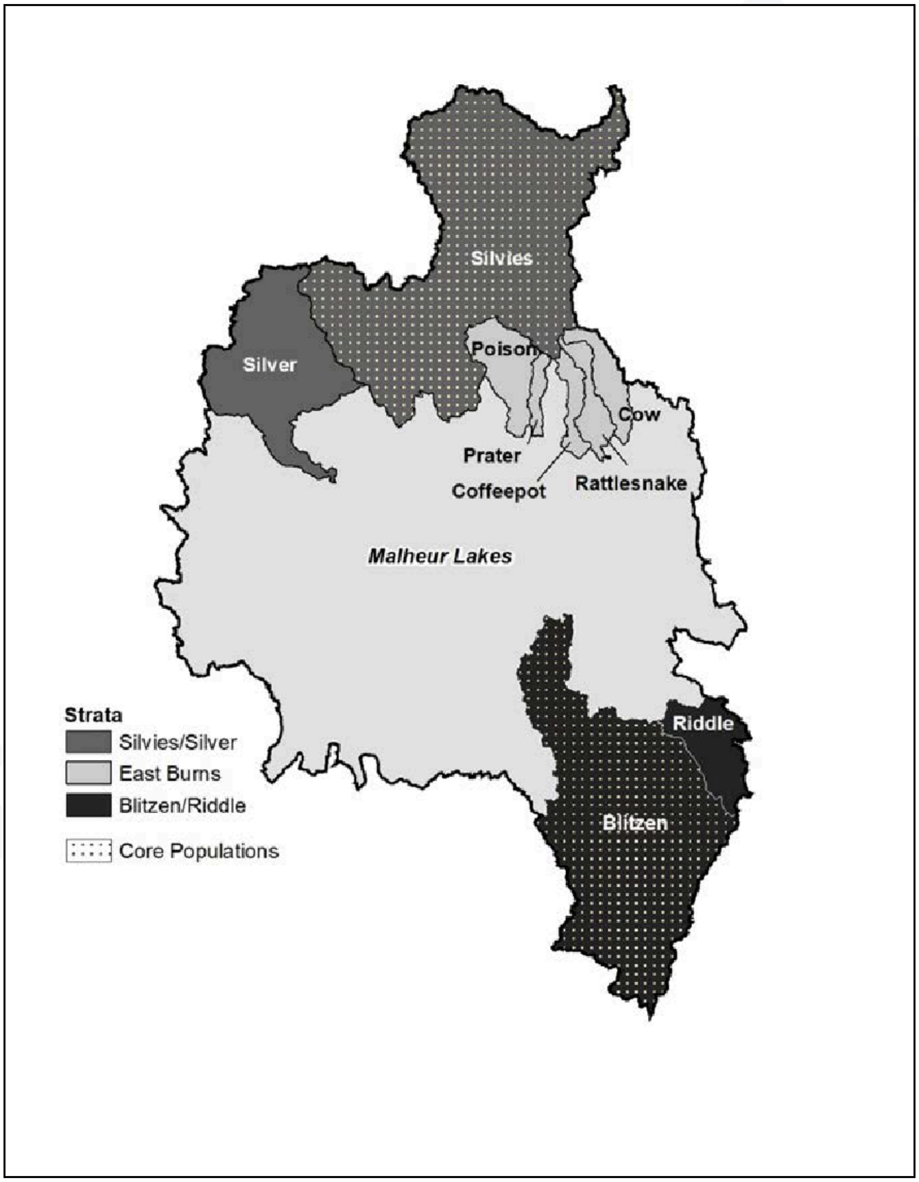

Figure 11. Population Structure of Harney Basin Redband Trout (ODFW, 2018)

Population	Abundance	Productivity	Spatial Structure	Diversity	Current Viability Risk
Silver	Very Low (5)	Low (4)	High (1)	Low (3.5)	***Moderate***
Silvies*	Very Low (5)	Low (4)	High (2.3)	Low (3.5)	***Moderate***
Poison	Very Low (5)	Low (4)	Moderate (2.7)	Low (4)	***Moderate***
Prater	High (1)	High (1)	High (1.7)	High (2)	***High***
Rattlesnake	Very Low (5)	Low (4)	High (2.3)	Low (3.5)	***Moderate***
Coffeepot	Moderate (3)	Moderate (3)	High (2)	Low (3.5)	***Moderate***
Cow	High (1)	High (0)	High (1)	Low (3.5)	***High***
Riddle	Very Low (5)	Moderate (3)	Moderate (2.7)	Low (4)	***Moderate***
Blitzen*	Very Low (5)	Very Low (5)	Low (3.7)	Very Low (5)	***Low***

Table 4. Population Status Evaluation of Harney Basin Redband Trout (ODFW, 2018)

Mussels

Three genera of native freshwater mussel are present in the Harney basin: the western ridged mussel (Gonidea angulata), the western pearlshell (Margaritifera falcata), and floaters (Anodonta sp.). Historically, these species were found in at least 24 water bodies across the four subwatersheds (Donner und Blitzen, Harney-Malheur Lakes, Silvies, and Silver). Freshwater mussels are a key organism native to many of Oregon's rivers and live in the Harney Basin. They filter up to 18 gallons of water a day and can substantially improve water clarity, and increase the abundance and diversity of other invertebrates, including important food sources for juvenile salmonids. There have not been consistent surveys to document the presence or absence of mussel species in the streams of the Harney basin.

Western ridged mussels, which live in the basin, have been found to live past 60 years of age. Recent freshwater mussel surveys at the Malheur National Wildlife Refuge suggest a relatively large and reproducing population of western ridged mussel in the Blitzen River.

Amphibians

The Harney Basin is home to five species of amphibians: Sierran Chorus, Columbia Spotted Frog, Long-toed Salamander, Great Basin Spadefoot Toad, and the Western Toad. They rely on various aquatic habitats including streams and stream edges, but also wetlands, ponds and lakes. Columbia spotted frog is the most widespread species in the Harney basin. There is only limited information on the distribution and abundance of amphibians in the Harney basin.

Streamflow and Precipitation Changes

An analysis was conducted to detect possible changes in runoff patterns that could indicate human influences in the Silvies River, Donner und Blitzen River, and Silver Creek basins. Indication of changes in the Silvies River and Silver Creek were observed by the analysis but specific causal factors were not identified. Analysis of precipitation from 1900 to 2020 does not indicate significant changes and each subbasin reflects regional conditions (Garcia et al, 2022; Figure 12); each of the four subbasins follow very similar dry and wet cycle trends over the full period of 120 years. The driest and wettest periods occurred in the early 1930s and early 1980s, respectively. Analysis using double-mass curves indicate changes in the Silvies River showing changes in the 1930's and 1980's. The same analysis shown no such change in the Donner und Blitzen. The shorter data set from Silver Creek shows changes in1958 and the 1970's.

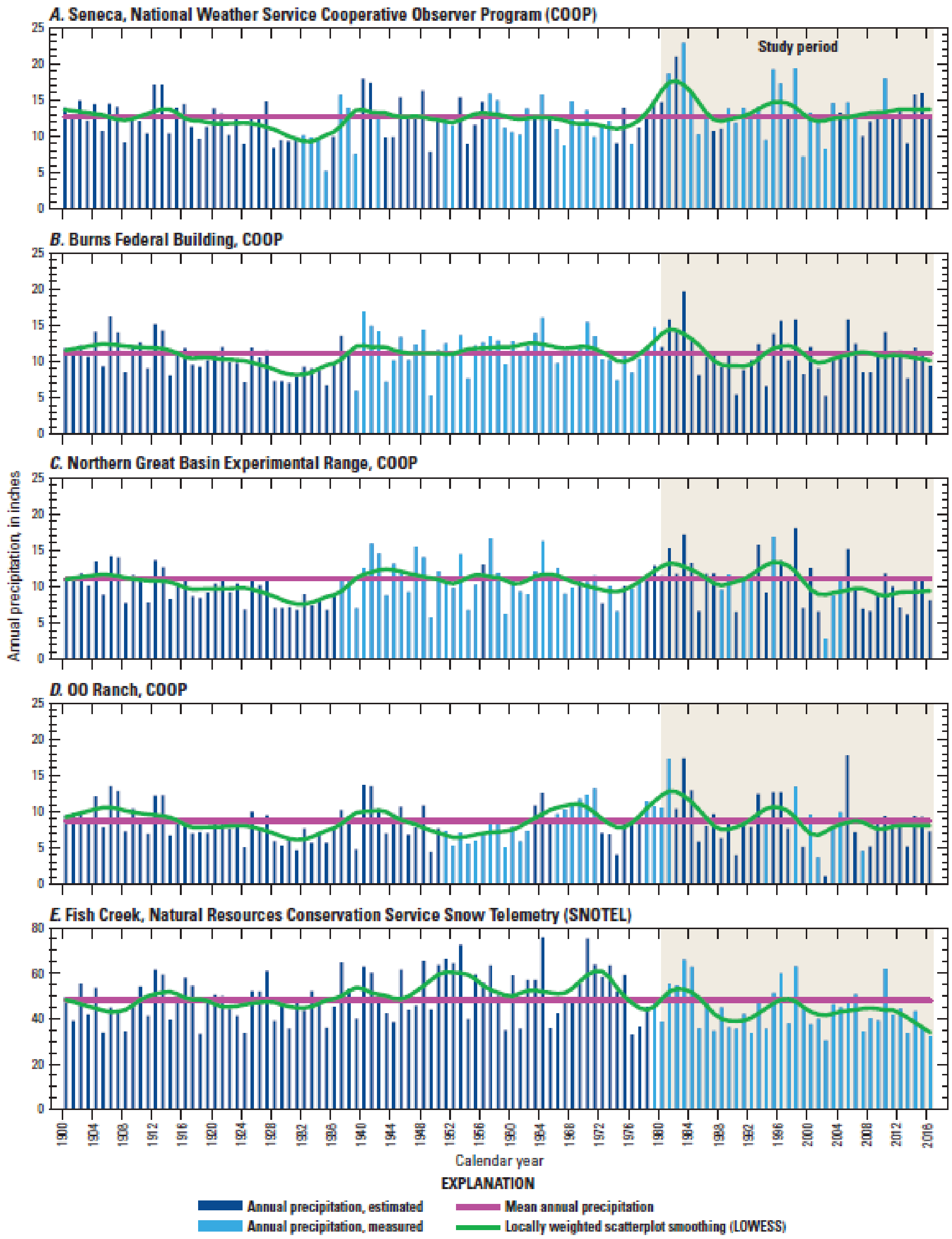

Figure 12. Measured and estimated precipitation for Selected sites in the Harney Basin (from Garcia et al., 2022)

Wetlands

The floodplains of Silver Creek and the Silvies and Blitzen Rivers support a diversity of wetland types (Figure 13), many of which are dominated by emergent plants or woody vegetation such as willows. Emergent wetlands are wetlands characterized by erect, rooted, herbaceous plants. Since settlement, these wetlands, specifically in the form of flood- irrigated wet meadows, have expanded via flood irrigation systems into many historically upland habitat types (e.g., dry meadows) and today many of these wetlands are maintained by a widespread infrastructure system (Langston, 2003; USFWS 2013).

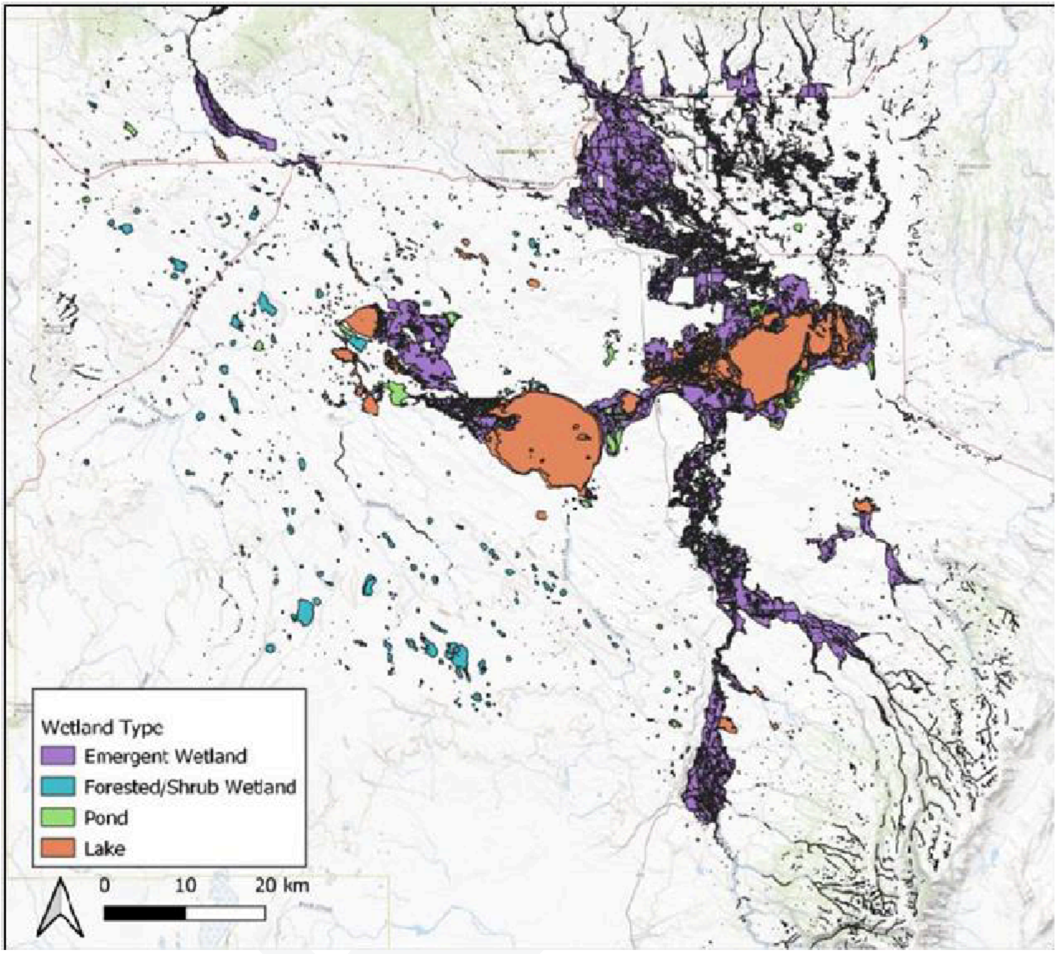

Figure 13. National Wetlands Inventory wetland distribution (USFWS, 2020)

Malheur Lake is a large wetland system which has historically (Duebbert, 1969) supported tens of thousands of acres of emergent vegetation (bullrush, burreed, cattail, etc.) and submergent vegetation (pondweed, milfoil, muskgrass, coontail, etc.). Since the extensive water level rise and ice scour in the 1984-1985 years, Malheur Lake has had very little emergent vegetation (Hamilton et al., 1986). Recent studies of the lake system (Wood and Smith, 2022; Smith and Wood, 2023) highlight the factors that interact to maintain the highly turbid state of Malheur Lake. Studies of the seed bank and vegetation reestablishment (Boos, 2023) identified that a varied and viable seed bank remains in the sediments of Malheur Lake and recent reemergence of bullrush and cattail has significantly changed Malheur Lake wetlands (personal observation, 2024).

The current wetland configuration (Figure 13) is quite similar to historic wetland areas (Figure 14).

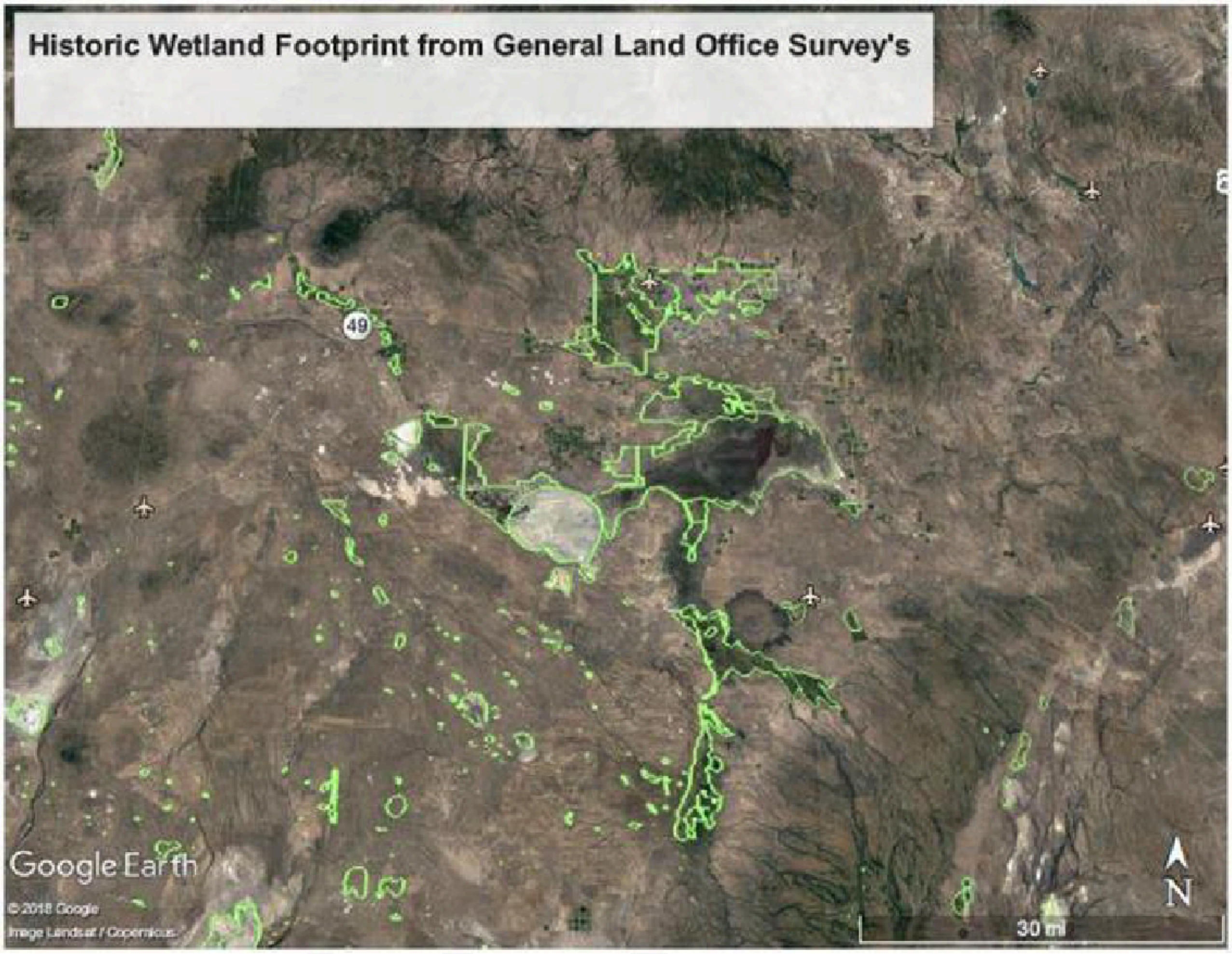

Figure 14. Historic Wetland Distribution (Institute for Natural Resources 2020)

The dynamics of streamflow and diversion of water for irrigation affect the area and distribution of current wetland conditions. These dynamics affect the Malheur Lake area (Figure 15).

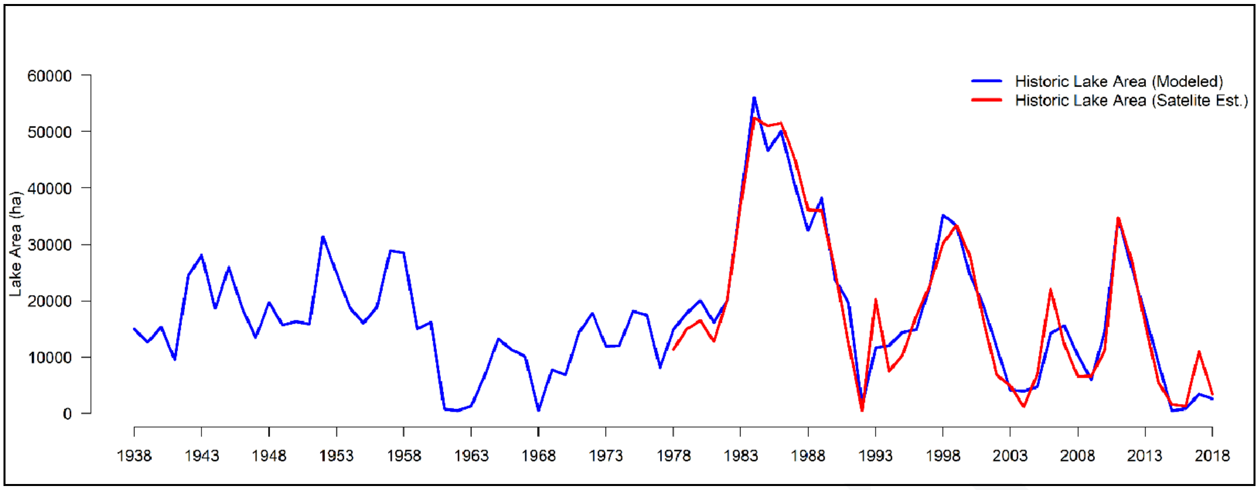

Figure 15. Peak yearly area of Malheur Lake (Pearson, 2018)

Flood Irrigated Wetlands

Most wetlands in the Harney Basin are maintained by spring runoff, primarily driven by snow melt from Steens and Blue Mountains, or surface water diverted from streams, such as the Donner und Blitzen (Blitzen) or Silvies Rivers and Silver Creek. Lev and others (2012) state: "Today, despite human alterations in flow patterns and timing, wetlands still expand and contract with climatic extremes, and conditions may vary greatly from one year to the next. Large areas mapped as upland in 1876-1880 are now perennially, seasonally, or irregularly flooded because of irrigation regimes." The recent recognition of the ecological services provided by flood irrigated hay production (Donnelly et al., 2024) and the importance of these systems for colonial waterbirds (Moulton et al., 2020) and sandhill cranes (Donnelly et al., 2021; Donnelly et al., 2023) highlight the importance of the wetlands of the Harney Basin.

Wetland Dependent Birds

Harney Basin wet meadows comprise nearly 20% of existing flood-irrigated wet meadow habitat in Southern Oregon-Northeastern California (SONEC), a region of continental significance for migratory birds of the Pacific Flyway (IWJV 2013). The wet meadows of the SONEC have local, regional and continental significance for wetland dependent wildlife species and migratory waterfowl, waterbird, and shorebird species. The SONEC is identified as one of the areas of greatest continental significance to ducks, geese and swans in the North American Waterfowl Management Plan (IWJV 2013). The Harney basin wetlands have the greatest potential for assuring long term conservation within the SONEC because of the protected area status and the cooperative relationships developed to address current conservation issues.

While best known for supporting tens of thousands of migratory waterbirds, flood irrigated wetlands are important to Bobolinks, Greater Sandhill Cranes, and Cinnamon teal which serve as indicator species for wet meadow habitat. Other species that use this habitat type include nesting Long-billed curlew, Wilson's snipe, and other shorebirds; and foraging waterfowl, White- faced ibis, deer, pronghorn, and the occasional elk. Small mammals that live in these meadows are an important food source for raptors (USFWS 2013).

Looking at the wetland complex of Malheur Lake and flood irrigated wetlands of the Silver Creek, Silvies River and Donner und Blitzen floodplains, these areas are a critical bird production and migratory stop in the Pacific Flyway. Western Snowy Plover, Long-billed Curlew, Franklin's Gull, Short-eared Owl, Greater Sage-Grouse, Bobolink, and Trumpeter Swan, all breed in the basin. The Malheur National Wildlife Refuge has one of the highest Breeding Bird Survey counts for the watch-listed Brewer's Sparrow. The refuge's riparian habitat supports the highest known densities of Willow Flycatcher, supports up to 20% of the world's population of White-faced Ibis and significant breeding populations of American White Pelican, Cinnamon Teal, Redhead and Greater Sandhill Crane.

Up to half of the world's population of Ross' Geese use the Refuge and surrounding private lands during migration. During migration Snow Geese, Green-winged Teal, Mallards, Northern Pintail, Northern Shovelers, Canvasback, Ring-necked Ducks, Lesser Scaup, and Ruddy Ducks stop in the Harney basin. Breeding populations in the Basin include Green-winged Teal, Northern Pintail, Blue-winged Teal, Northern Shoveler, of Gadwall, American Wigeon, Canvasback, Redhead, Lesser Scaup, and Ruddy Ducks.

Shorebirds in the basin include an intermittent breeding population of California and Ring-billed Gulls. Forster's Terns breed on the Refuge, and Caspian Terns have nested in Malheur Lake when water levels are ideal. Black Terns regularly nest at Malheur Lake. Harney and Malheur Lakes support the majority of the shorebird population at the Refuge, especially during migration in spring and fall. Western Sandpipers, Pectoral Sandpipers, Long-billed Dowitchers, Wilson's Phalaropes, American Avocets, and Black-necked Stilts all use the shallow waters of the Malheur Lake wetlands.

Western Snowy Plover is the most common breeding shorebird at Harney and Stinking Lakes. Great Blue Herons nest on the Refuge every year in scattered colonies, though mostly around Malheur Lake. Great Egrets breed on the Refuge and Snowy Egrets have nested around Malheur Lake. Black-crowned Night-Herons and American White Pelicans breed at Malheur Lake. Malheur Refuge is a concentration point in winter for raptors of many species. Rough-legged Hawks, Red-tailed Hawks, Northern Harriers, American Kestrels, and Bald Eagles have been recorded on Christmas Bird Counts.

Wetland Response to Climate Change

There are a number of factors adversely affecting wet meadow and wetland habitats in the Harney Basin. Annual variability in precipitation has significant effects on wetland habitat availability. Donnely et al. (2020) identified long-term declining trends in wetland availability in the Great Basin associated with climate change and agricultural water use. Projected changes in future precipitation associated with climate change will likely further exacerbate annual wetland habitat availability (Haig et al. 2019). While woody and non-woody riparian plants are adapted to variability in water levels and can survive periods of drought, extended drought associated with climate change may decrease the likelihood of wetland plants recovering during subsequent wet periods (Sandi et al. 2020). Currently, surface water quantities are enough to flood meadows to ecologically beneficial levels for spring migrating dabbling ducks (IWJV 2013). However, in the next 50 years it is unknown how water levels will change. It is possible there will be a similar number of acres of flood-irrigated meadows, distributed in a different way across the landscape.

Donnelly et al. (2020) identified a nearly 50% decline in closed basin wetlands in the Northern Great Basin over 34 years (1984-2018) as a result of increased aridity attributed to climate change and human water use for irrigation. This study indicated a 56%, or 8,605 a, reduction in wetlands in the Harney Basin.

Other potential stressors include water availability and timing (including ensuring adequate water supply to the Refuge), spread of non-native invasive plants and animals (e.g. reed canary grass, common carp), dilapidated infrastructure creating an inability to continue flood irrigation practices. Declining groundwater levels in the Harney Basin are likely impacting spring discharge that maintains wetlands in parts of the basin. This is because wetlands are often associated with shallow groundwater tables or direct spring discharge to support obligate wetland vegetation (Stevens et al. 2021), so alterations to groundwater hydrology can affect wetlands (Aldous and Bach 2014). Wherever there is surface water, it is in constant interaction with groundwater based on pressure differences (Barlow and Leake 2012). Changes to groundwater hydrology affect streams, wetlands, and lakes and changes to surface water hydrology affect groundwater.

Lakes and Playas in the Harney Basin

Harney and Malheur Lakes are the defining terminus of the surface water flow in the Harney Basin. Other small impoundments and natural lakes are scattered across the basin, most only holding water temporarily. Malheur, Mud, and Harney Lakes (Figure 16) lay at the bottom of the ground surface of the basin. Water flows to Malheur Lake from the north via the Silvies River coming from the Blue Mountains, and from the south via the Donner und Blitzen River coming from the Steens Mountains. Harney Lake is the lowest portion of the basin and acts as a sump for the entire watershed. Harney Lake is considered a playa and receives water from Silver Creek and several springs via canals. Flows from these sources typically are lost through infiltration or evaporation (USFWS, 2013).

Malheur Lake has changed significantly since the high water events of 1984-1985. Loss of emergent and submergent vegetation has reduced the productive potential of the lake. Over the last nearly forty years, the lake has been highly turbid, high in chlorophyll-a, and dominated by common carp. Significant effort has been made to manage carp to reduce the level of turbidity. Recent studies of the effect of wind and resulting water turbulence in maintaining high levels of turbidity have shown the processes that help to maintain the turbid state of the lake. Wood and Smith, (2022, 2023) have published results of studies on light attenuation, turbidity suspension, and nutrients as they affect restoration of the lake. Additionally, Boos (2023) has studied the seed bank and emergent vegetation recovery potential of the lake.

Playas are topographically low, flat areas of desert basins which are hydrated by precipitation and local surface water drainage. “Lowland playas” are typically unvegetated or have remnant vegetation (i.e. dead greasewood) from eras when conditions on such playas were different (Clausnitzer, 2001). “Upland playas” are typically vegetated and provide important upland mesic habitat, including a diversity of plants and insects (U.S. DOI, 2012; Clausnitzer, 2001).Harney Lake and other playas fill only during high water events.

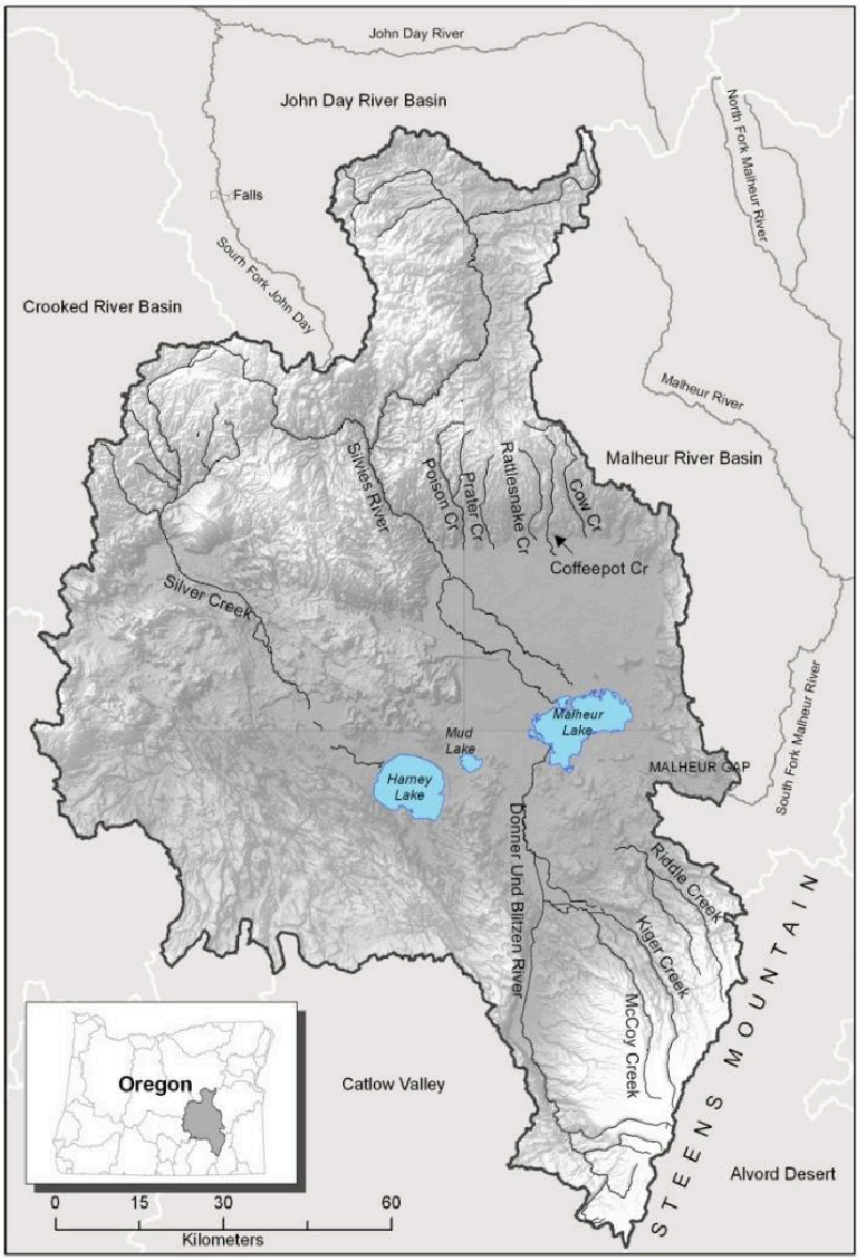

Figure 16. Malhuer, Harney, and Mud Lakes (from ODFW, 2018)

Historically playas make up 5-14% of wetland habitat in the Harney Basin. On Malheur NWR, there are 29,000 acres of playa, on average. According to the Malheur NWR Comprehensive Conservation Plan, playas on the Refuge are believed to be largely intact and remain unaltered (USFWS, 2013). However, diversions from Silver Creek have likely directly contributed to the decline in water availability and expression in Harney Lake.

Water Quality

Surface Water Quality

There is limited information about the water quality of the Harney Basin. The Oregon Department of Environmental Quality (DEQ) has rudimentary data from regular monitoring. The DEQ Water Quality Index program has only three sites in the Harney Basin that are monitored 6 times a year for 'traditional' water quality parameters for status and trend assessment, with annual summaries. The three sample locations are Donner und Blitzen at Page Springs, Donner und Blitzen at Blitzen Crossing and Silvies River at West Loop Road. Both Blitzen River samples are reported as "excellent" water quality and the Silvies River sample is characterized as "good".

Other indications of water quality result from stream reach sampling by land management agencies and others. The data is quality controlled and reviewed against state standards. Those stream reaches that fail to meet state standards are identified as "impaired waters" (Figure 17). Most of the streams do not meet the temperature and/or dissolved oxygen standards for the support of cold-water fish. Malheur Lake has high levels of turbidity and Chlorophyll a. Iron exceeds standards in two locations and pH exceeds standards at one location.

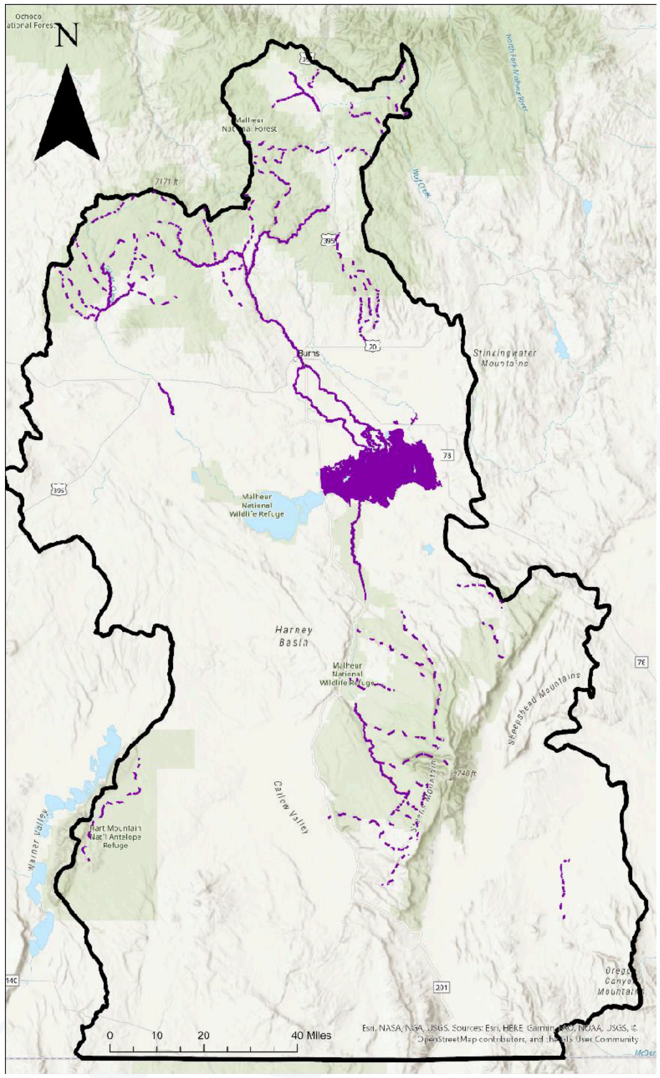

Figure 17. Impaired Waters (From DEQ, 2023)

There is not a complete picture of water quality throughout the basin. Few sample points and limited time series of sampling limits conclusions that can be made about water quality conditions. In the semi-arid environment of the Harney basin increasing temperatures, degraded riparian conditions, and surface water diversions can affect the upland water temperature.

Summary

In this chapter, we explored the Harney Basin's surface water conditions, providing a robust overview of the region's hydrology, surface water-groundwater interactions, and the basin's unique physical attributes using available data. As we move forward, we will investigatehow these physical conditions intersect with the many ways surface water is utilized, both for human activities and ecological needs, in an effort to develop strategies that address the basin's long standing surface water challenges.

Chapter 4: Instream and Out-of -Stream Surface Water Uses and Demands

Having established an understanding of the current surface water conditions and their interactions with groundwater in the Harney Basin, the focus now shifts to the specific ways in which water is utilized. Chapter 4 examines both instream and out-of-stream uses of surface water, reflecting the essential role water plays in sustaining agriculture, ecosystems, and community needs. This chapter provides a detailed assessment of the allocation of surface water rights and the distribution of water across various uses, including irrigation, wildlife habitat, and recreational activities. By analyzing the balance between human activities and ecological requirements, the Collaborative aims to address the longstanding over-allocation of surface water and to outline strategies for improved surface water management.

Out of Stream Surface Water Uses

Residents of the Harney Basin have a strong dependence on surface water for many purposes. Surface water has generally been fully allocated for many decades for most of the Malheur-Harney Lake drainages. The Oregon Water Code was enacted in 1909, providing an exclusive centralized method for issuing new water rights and for determining existing ones. Surface water allocation for agricultural irrigation accounts for a significant use of surface water (Table 5). Water rights for recreation, fish and wildlife total approximately half the amount appropriated for irrigation, this amount is dominated by the water rights for the Malheur National Wildlife Refuge. Commercial, industrial and other uses are a minor fraction (less than 2%) of irrigation use.

Table 5 Water Rights and Irrigated Acreage approved by subbasin (OWRD, undated)

Subbasin	Surface Irrigation Water Rights Approved (ac-ft)	Acreage Irrigated (acres)
Donner und Blitzen	10,894	7,586
Harney-Malheur Lakes	92,382	38,977
Silver Creek	39,285	27,589
Silvies River	89,051	42,336
Total	**231,612**	**116,488**

Most water rights have been adjudicated by court decree (Figure 18). In total, there were 127,213 acre-feet of irrigation water rights issued under decrees within the study area. There still remain 20,310 acre-feet of irrigation water in the form of a claim, or unadjudicated registrations of use of water within the Harney-Malheur Lakes and Silver subbasins. Some 104,399 acre-feet /year includes non-irrigation permitted uses, unadjudicated rights and permits issued since adjudication.

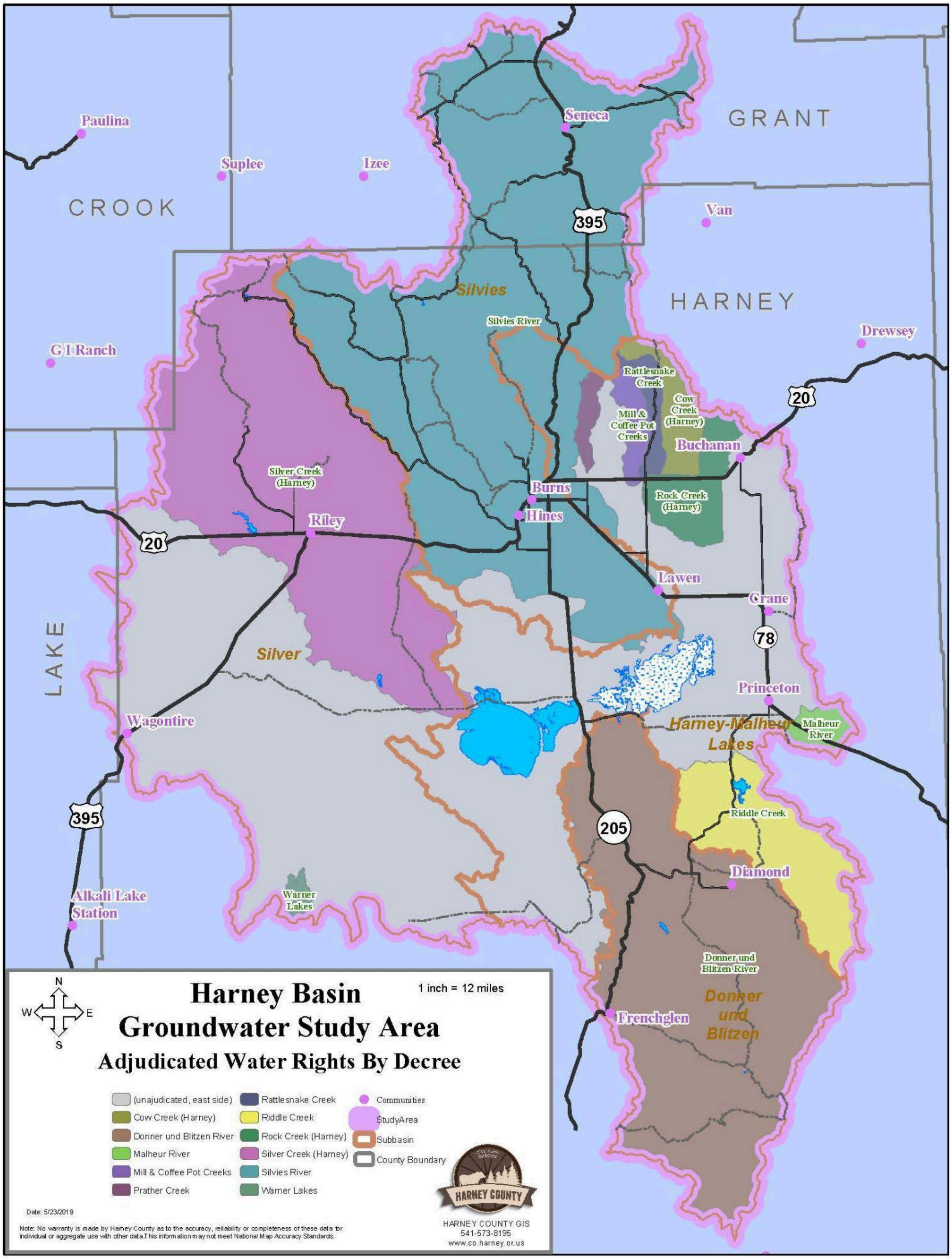

Figure 18. Adjudicated Water Rights in the Harney Basin (OWRD)

Irrigation water use from the Silvies River, and tributaries is concentrated in the Harney Valley, Silvies Valley, and Bear Valley. The use areas are separated by canyon reaches of the Silvies River. Irrigation diversions from Silver Creek are dominantly from the area around and above Riley with some flood irrigation of private ranches in the Double O area. Irrigation rights to the Double O area of the Malheur Refuge are senior rights held by USFWS for the Malheur Refuge. The tributary streams that don't usually have flow getting to Malheur Lake including Rattlesnake Creek, Cow Creek, Mill Creek, Coffee Pot Creek, Rock Creek, Prather Creek, and Riddle Creek have all been adjudicated (Figure 18). Donner und Blitzen River is dominated by water use by USFWS on the Malheur National Wildlife Refuge. It should be noted that Sage Hen Creek and Poison Creek were treated as tributaries to the Silvies River in the adjudication of the Silvies River. Figure 19 from the Harney Basin Groundwater Study (Grondin et al., 2023) shows the areas irrigated in 2018 by source of irrigation.

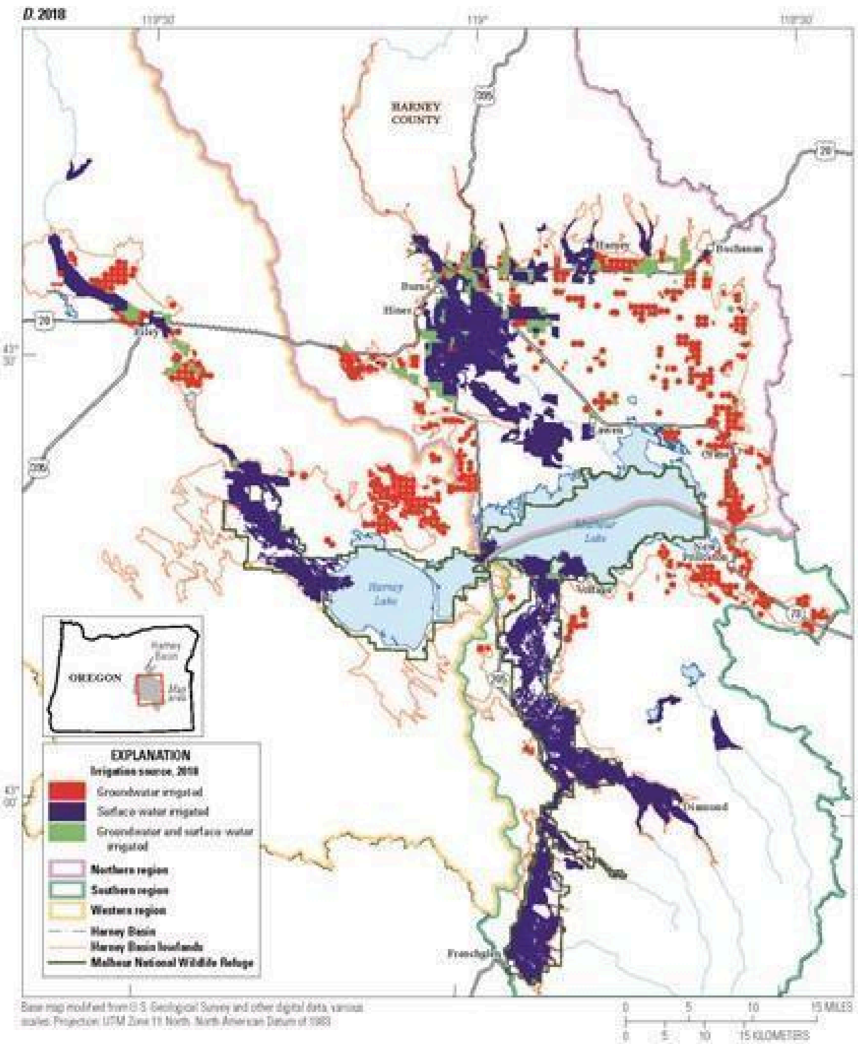

Figure 19. Irrigated Areas by Irrigation Source (Grondin et al., 2023)

Future Estimates of Out-of-Stream Uses

The basin surface water has been over allocated for nearly a century. Harney County has the highest reliance of agriculture on irrigation water among all of the counties in Oregon (OWRD and MWH, 2015). Future demand will be constrained by supply. As stated in the 2024 DRAFT of the Oregon Integrated Water Resource Plan; "Many basins are over appropriated, meaning there is not enough water to meet the full water rights held by people. This means that increasing irrigation to respond to warmer, drier conditions may simply not be an option." Under such circumstances, the collaborative wrestled with ways to improve water management to obtain a balanced suite of ecosystem services.

Instream Water Rights and Other Protections

Only a limited number of streams in the Harney Basin have certified instream water rights (Figure 20). In the Harney Basin, there are ten certificated instream water rights, while another three have not been certificated due to protests pending since 1996; all were requested by ODFW to maintain flows for fish. Instream rights have been certificated for the headwaters of Silver Creek (including Silver Creek {2 reaches} Nicoll Creek, and Sawmill Creek), Tributaries to Donner und Blitzen River (Krumbo Creek and West Fork Krumbo Creek), Tributaries to the Silvies River (Emigrant Creek, Sawtooth Creek, and Trout Creek), and a reach of Rattlesnake Creek. The priority dates are 1989 for the two tributaries to the Blitzen River and the right on Emigrant Creek, all others have the priority date of 1991. Contested applications for instream water rights are for two reaches of Bear Creek (a tributary to the Silvies River), and a reach of the upper Silvies River.

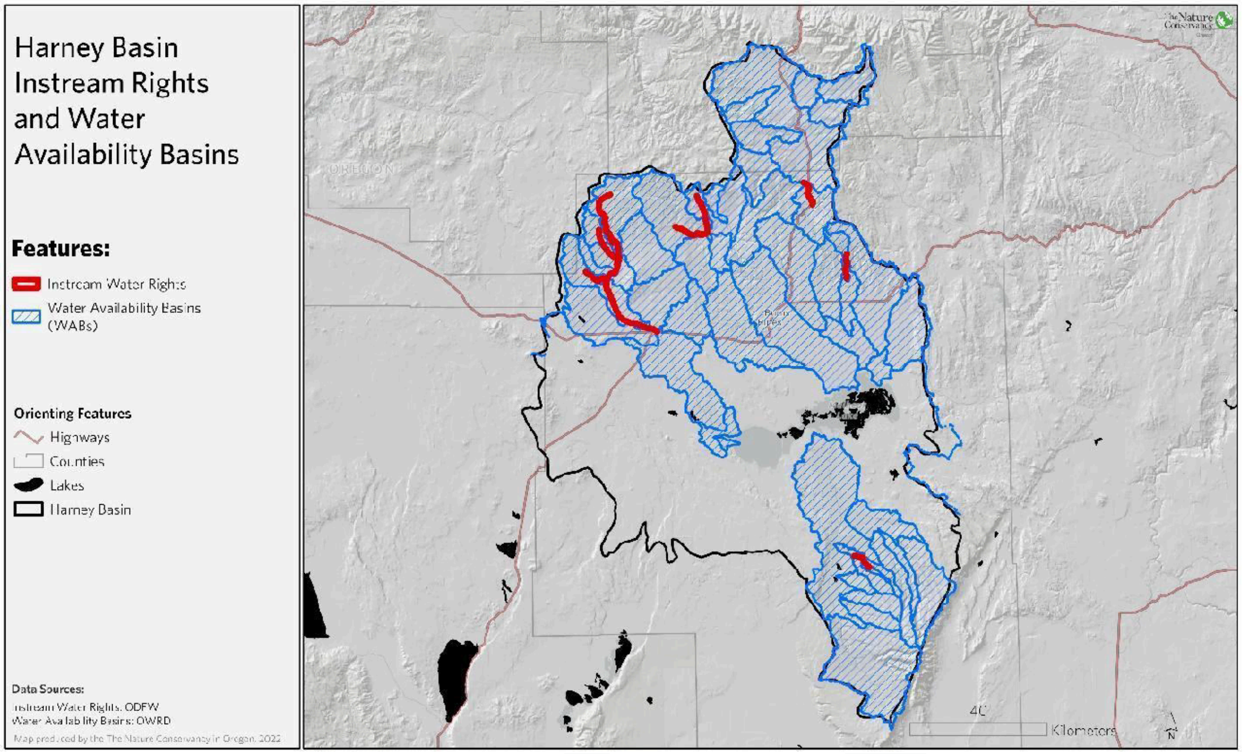

Figure 20 Certified instream Water Rights In the Harney Basin (Rivers and Streams Step 2)

While not for instream use, the Malheur National Wildlife Refuge holds significant water rights for maintaining wildlife habitat on the refuge lands in the lower Blitzen River and Malheur Lake.

Other instream protection is provided under the Steens Mountain Cooperative Management and Protection Act of 2000 that added a number of streams in the upper portion of the Donner und Blitzen River to the Wild and Scenic Rivers program and created a Donner und Blitzen River Redband Trout Reserve. These protections prohibit dams and diversions and provide management direction for natural values.

Instream Need

Human uses have altered patterns seen in Harney Basin waterways. Although it is not possible to return to a natural flow regime in many places, understanding the natural flow conditions expected in the absence of major human activities - and the benefits those conditions provided - are essential pieces of information needed to inform effective place-based planning actions. Understanding the difference between current conditions and conditions that existed without major human influence allows for water use planning practices that better balance human uses and ecosystem needs in a way that is beneficial to both.

Instream flow demand is the flow needed to provide for a healthy aquatic ecosystem. ODFW has provided two summary documents for place based planning groups that provide methods for determining instream demand. (ODFW, 2018b; ODFW, 2022). The documents describe elements within an instream flow demand for ecological needs and provide an overview of tools for assessing instream flow needs, both now and in the future with respect to climate change.

The basin has only three gages with long term records. To identify the best data set for evaluating whether instream flow demands are being met, the Rivers and Streams team compared six streamflow datasets among sixteen stream reaches in the Harney Basin where overlapping model outputs existed: Basin Investigation Reports, USGS StreamStats, the National Hydrography Dataset, a Variable Infiltration Capacity model, the OWRD SWARS data, and the Q50 dataset which represents the outlier-corrected median half month natural flow calculated in Basin Investigation Reports. Among those datasets, the SWARS dataset was the second most representative dataset based on monthly median flow comparisons. However, it was selected over the most representative dataset (which was USGS StreamStats) due to data availability, the importance of SWARS as representative of OWRD's water management decisions, and the inclusion of "expected" streamflow data that accounts for consumptive use.

Instream needs are commonly estimated using a "Presumptive Standard" of environmental flow protection, which is typically set at 10-20% of natural, unaltered flow (Locke & Paul, 2011; Richter et al., 2011; ODFW, 2022). A Presumptive Standard of 80% natural streamflow was calculated for each of the 51 Water Availability Basins in OWRD's Surface Water Availability Reporting System (SWARS) in the Harney Basin (Rivers and Streams Step 2 Report, Figure 2, Table 1). Under current conditions, streamflow failed to meet the Presumptive Standard most frequently in May through September, although some streams are perennially estimated to be below the presumptive standard (such as the Donner und Blitzen at the mouth, Dry Krumbo Creek, and Miller Canyon tributary). The detailed analysis is available in Rivers and Streams Step 3 Report. Similar analysis was done using instream water right application amounts as a measure of instream need; for most of the thirteen instream water right applications (Figure 21), there is not adequate streamflows to meet the application amounts, especially July through October.

Historically, instream flow demand has typically been thought of in terms of minimum instream flows, especially during low flow conditions. Today, it is recognized that maintaining healthy aquatic ecosystems requires maintaining a suite of instream flows, encompassing different parts of the flow regime such as floods, pulsed flows and low flows (ODFW, 2018b). Each part of the flow regime plays an important role in creating and maintaining habitat and supporting the life history of fish, wildlife and plants that rely on the rivers and streams. An instream flow that mimics the natural hydrologic cycle provides the best assurance that the habitat needs of aquatic dependent fish and wildlife species will be met as it is assumed the natural flow regime is the condition to which the system is adapted, and aquatic dependent species have evolved to the full hydrologic flow regime within their habitat (ODFW, 2022). In addition, the Oregon

Conservation Strategy recommends for the purpose of maintaining riparian areas, to maintain flow following the natural hydrological cycle where possible (ODFW, 2016).

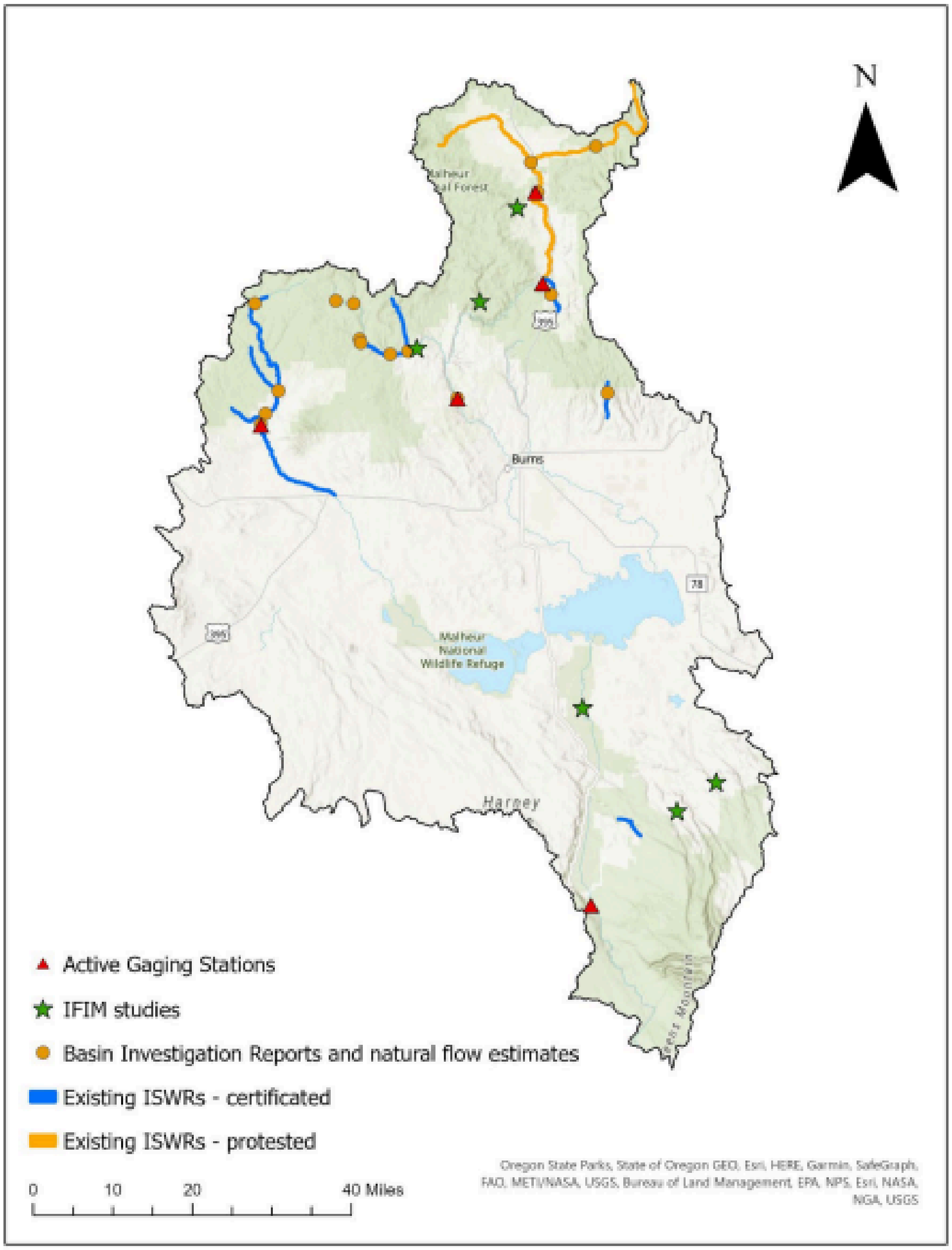

Figure 21. Certificated and Protested Instream Water Rights (ODFW, 2023)

Streamflow has value both to aquatic organisms in the stream and on the floodplain and those needs may be at different times and places. ODFW has identify those watersheds that have natural flow estimates at their outlet and those that do not (Figure 22). A significant portion of the basin

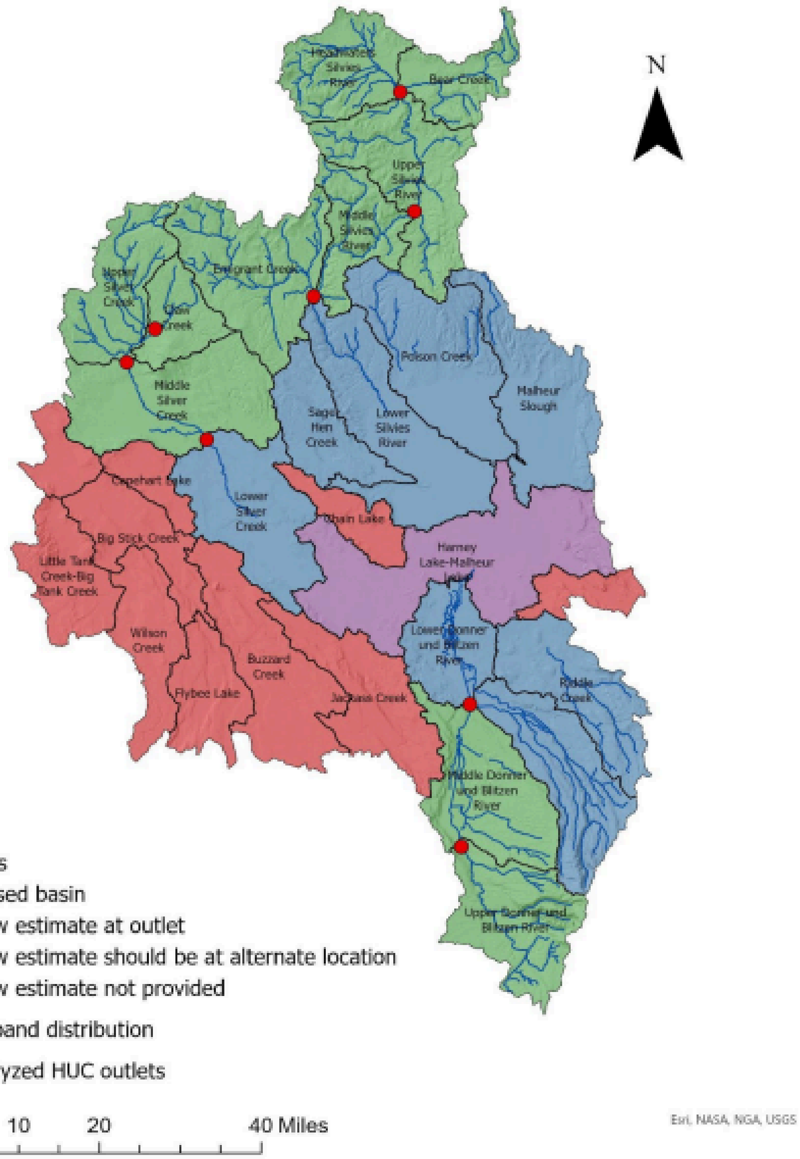

Figure 22. Map showing additional natural flow analysis locations (ODFW, 2023).

In an earlier effort in 2001, using data on streamflow and aquatic resource needs, ODFW, OWEB and OWRD developed an evaluation of priority streamflow restoration watersheds based on Water Availability Basins. Figure 23 shows the priorities established at that time.

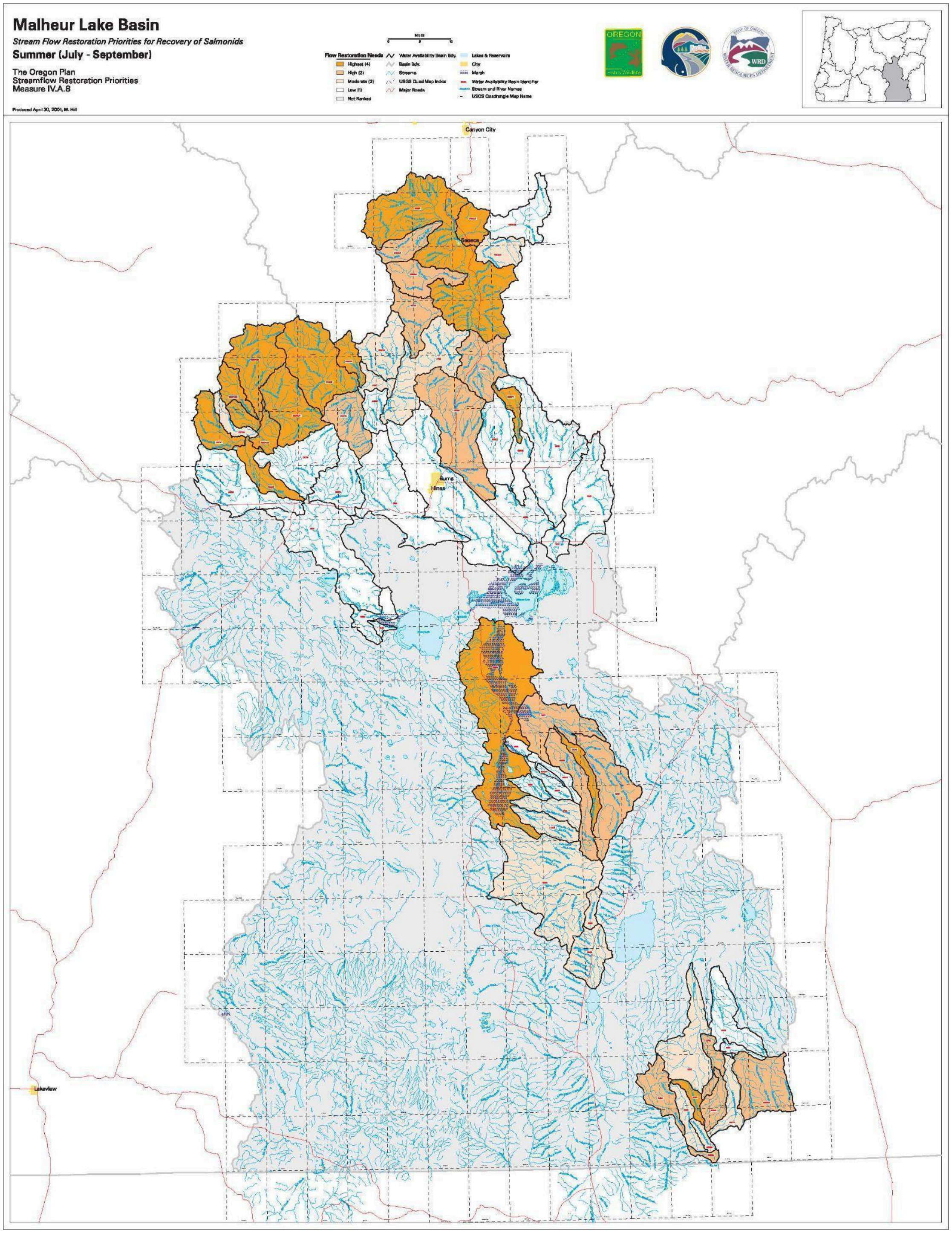

Figure 23.Flow Restoration Priorities (ODFW-OWRD, 2001)

Habitat Impacts on Harney Basin Rivers and Streams

Stream habitats have been altered through time by beaver trapping in the 1820's, timber harvest in the Blue Mountains, Western juniper and cheatgrass expansion in the sagebrush ecosystem, physical stream alteration, and riparian habitat loss. Forest structure changes and wildfire in both forest and rangelands affect watershed yield (see Issues below). Removal of beaver reduces the storage of water in the uplands. An evaluation of historic beaver use and evaluation of potential beaver relocation and potential benefits from water and sediment storage is being evaluated for the Harney Basin for the Harney Basin Wetlands Collaborative. There is no uniform inventory approach for riparian conditions throughout the basin. Recent work on the Malheur Wildlife Refuge to conduct detailed mapping and analysis is being piloted in other parts of the basin through the Harney Basin Wetlands Collaborative. As information on riparian conditions and beaver restoration opportunities are identified, restoration priorities can be set and implemented.

Physical alteration of streams for out of stream uses over time has simplified the stream system by straightening channels, isolating sloughs and other efforts to convert the floodplain for agricultural purposes. Diversion dams for irrigation create barriers for migratory fish passage. Some 15 fish passage barriers have been identified by ODFW on the streams in the Harney Basin. The Page Springs dam is identified as the highest priority fish passage barrier to be removed in the basin. Removal of barriers in the Harney Basin is complicated by the desire to prevent common carp from extending their range when barriers are removed. Recent fish passage at diversion dams in the Harney Valley are managed to block upstream passage except when native migratory fish are present. Similarly, fish screens are important to prevent native fish from being diverted onto fields. ODFW maintains a database on unscreened diversions and identifies a number in both the Blitzen and Silvies River systems.

High Water Flow Effects

Surface runoff from the uplands can be characterized by an annual spring freshet followed by declining flows through the summer and winter. Flow volumes are extremely variable year to year which makes water distribution difficult during low flow years. Since nearly all surface water irrigation in the Harney Valley is through flood irrigation, hay production is significantly determined by the amount and duration of the spring freshet. The timing and duration of flooding also affects migratory bird habitat (Donnelly et al., 2019, Donnelly et al., 2021, Haig et al., 2019).

Flooding

Flood flows affect the communities of Burns and Hines (Figure 24). There are currently some 469 structures that are flooded by less than 0.1 foot during a 100-year flood and 270 structures that are flooded more than 1.0 foot during a 100-year flood. Recent planning to mitigate flood effects has developed alternative approaches to mitigate flooding and reduce the number of structures potentially affected by flood events (Kleinschmidt Associates, 2022).

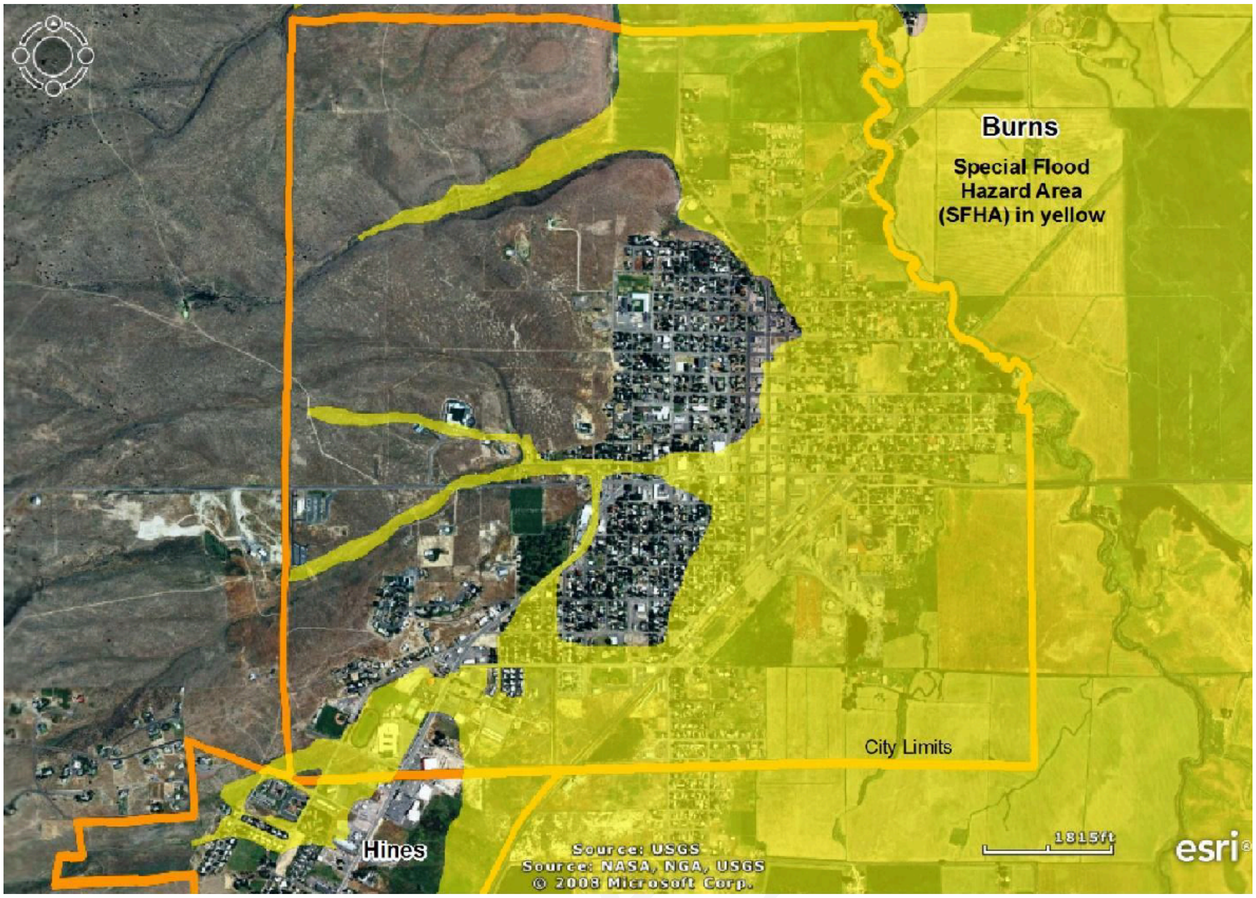

Figure 24. Burns and Hines flood hazard area (NOAA, 2022)

Summary

This chapter examined the multifaceted ways that surface water is utilized in the Harney Basin, from agricultural irrigation to supporting fish and wildlife habitat, and the instream and out-of-stream demands. The existing allocation and utilization patterns underscore the complexities and challenges involved in balancing diverse needs. With surface water resources already fully allocated—and in many cases, over-allocated—meeting the demands of both instream and out-of-stream uses will require thoughtful management and strategic adaptation. In the next chapter, we will identify and assess the critical surface water issues facing the Harney Basin, setting the stage for targeted strategies that address these pressing concerns.

Chapter 5: Critical Surface Water Issues (Step 3.5)

Building on the assessment of surface water uses, Chapter 5 focuses on the critical surface water issues impacting the Harney Basin. This chapter addresses pressing concerns such as watershed management, conditions, historic over-allocation, the balance between instream and out-of-stream needs, climate change impacts, and limited information. Through the work of various Collaborative Working Groups, these issues have been identified and categorized, highlighting the complex challenges that the basin faces. As we explore these critical topics, we will consider how they shape the current and future state of the basin's water resources, guiding the development of targeted strategies to foster sustainable management.

Overview

At the beginning of their surface water planning process the Collaborative identified four Working Groups to develop information regarding current surface water conditions (Step 2) and future surface water needs (Step 3). Topics covered by the Working Groups, composed of Collaborative members, included vegetation management, ecology, surface water-groundwater interaction, and surface water management. Each Working Group convened frequently to collaborate on their approach to compiling information, divvy up responsibilities, and check in on progress. In addition to compiling information necessary for Step 2 and Step 3, all Working Groups were tasked with writing a report encompassing the compiled information, presenting their research and findings to the Collaborative, and identifying the critical surface water resource issues based on their findings. Eligible Collaborative members participated in consensus events to support the Step 2 and 3 reports as written by the Working Groups; Consensus was achieved on all reports.

After consensus, the Collaborative compiled all critical surface water resource issues identified by the Working Groups into one list. An iterative editing process occurred for several months before the Collaborative achieved consensus on the list on December 14, 2023.

The critical surface water resource issues can be generally categorized as:

- Watershed Management
- Watershed Conditions
- Historic Overallocation of Surface Water
- Impacts to Instream Uses and Ecology
- Out-of-Stream Uses
- Climate Change Impacts
- Limited Information

These categories are explained below along with their associated issues.

Watershed Management

Associated Issues:

- There is illegal use of water in the basin.

- There is no central communication network to timely inform irrigators and other water users about seasonal water availability, priority regulation dates, and other information needed for effective irrigation management.
- There are problems with the effective distribution of irrigation water to satisfy water rights and manage water depths and duration for water bird habitats on lands irrigated by the Silvies River in the Harney Valley.
- Antiquated irrigation infrastructure, changes to the irrigation system that have altered the flow of water through the floodplain, and changes since the original Silvies Decree have all created potential difficulty in effectively distributing water across parts of the system.

Water resource management in the Harney Basin is a cooperative effort involving multiple stakeholders due to the significant portion of the watershed managed by the federal government (Figure 25). Private lands are concentrated in the lowlands, while federal ownership dominates the uplands, except for the Malheur National Wildlife Refuge around the lakes. This complex ownership division complicates water management efforts and highlights several pressing issues.

Illegal water use in the basin remains a critical challenge, straining the distribution of water and undermining enforcement efforts to regulate water use effectively. Coupled with this issue is the lack of a central communication network to inform irrigators about water availability, priority regulation dates, and other essential information for managing water resources. The absence of such a system results in miscommunication and further exacerbates water distribution inefficiencies.

In particular, the effective distribution of irrigation water is vital not only for satisfying legal water rights but also for managing water depths and durations to maintain critical water bird habitats, particularly on lands irrigated by the Silvies River in the Harney Valley. The antiquated irrigation infrastructure, which has not been updated since the original Silvies Decree, complicates this further. Outdated infrastructure limits the ability to efficiently manage water resources and adapt to modern needs.

These challenges underscore the need for enhanced infrastructure, stronger enforcement, and improved collaboration among stakeholders. By addressing these issues, the watershed can better ensure sustainable water resource management, balancing the needs of both human activities and ecological health.

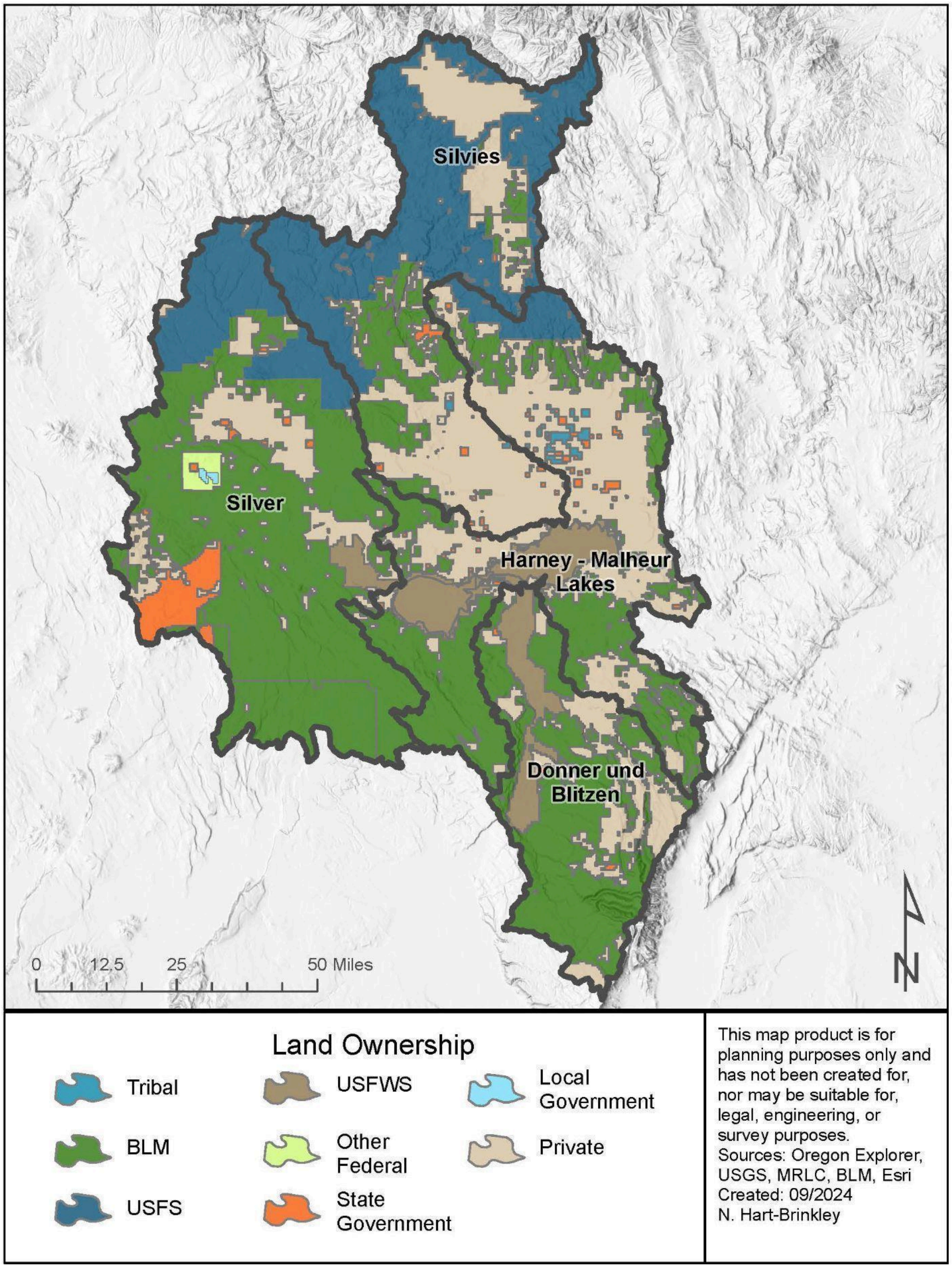

Figure 25. Land Ownership in the Harney Basin (data from Oregon Explorer)

Conifer and Riparian Conditions

Associated Issues:

- Conifer infilling of large areas of forestland and rangeland has led to increased tree density, distribution, and cover which decreases the surface water supply.
- Riparian habitats have been degraded over time resulting in loss of wildlife and aquatic ecosystem support and watershed function.

The shift from old growth ponderosa pine stands to mixed age forest lands in the Blue Mountain uplands has had an effect on evapotranspiration. Using gross comparisons between burned areas and forested areas shows a significant change in ET (Vegetation Management Work Group Report). Increased tree density, particularly in areas with more than 60% tree cover, leads to elevated rates of evapotranspiration, where conifers withdraw large amounts of water from the soil. This diminishes the water available for runoff and groundwater recharge, thereby affecting water yield in the region. While it is clear that conifer thinning can improve water availability, there has not been a thorough analysis of the water resource effects of conifer forest thinning. The focus of forest thinning has been on fire resilience rather than water resource impacts.

Juniper encroachment into sagebrush habitats, especially in areas of less than 16 inches of annual precipitation will not likely have an effect on surface or groundwater. The effect of Western juniper removal has been to enhance sagebrush habitats and enhance soil moisture for perennial grasses. While water yield benefits are small (Carroll et al., 2017) benefits at local scale to shallow groundwater has been documented. Western juniper can affect snowpack distribution affecting the timing and distribution of runoff.

There has been widespread degradation of riparian habitats throughout the basin. Riparian zones play a critical role in water storage, stream habitat quality, and overall ecosystem health. Over time, factors such as stream channelization, invasive species, and reduced shading have degraded these habitats, resulting in reduced water storage capacity, diminished stream shading, and less stable streambanks. This degradation negatively impacts water availability for aquatic life, reduces stream quality, and diminishes the ability of these ecosystems to buffer against environmental changes.

Addressing these vegetation management challenges is essential not only for improve water, and also help restoreg the overall health of the watershed (Malheur National Forest 2014, 2019). Targeted conifer thinning and juniper removal are actions that may improve water yield, while riparian habitat restoration is necessary to enhance water storage, stabilize streambanks, and support biodiversity.

Coordinating with federal land management agencies, such as the U.S. Forest Service and Bureau of Land Management, is crucial to implement these actions in areas where they will have the greatest impact. This includes conducting comprehensive assessments of riparian and forest conditions to guide restoration efforts and strategically prioritize critical areas for intervention. Such coordinated efforts are vital to improving water availability, enhancing watershed resilience, and maintaining ecosystem health in the face of ongoing environmental challenges.

Historic Overallocation of Surface Water

Associated Issues:

- There is inadequate measurement and reporting of surface water) in the Harney Basin to manage for instream and out-of-stream uses.

The over-appropriation of surface water in the Harney Basin has been a long-standing issue, with legal water rights exceeding the available water supply by substantial margins. The judicial adjudication of the Silvies River in 1929 set the stage for over-allocation, as the State Engineer expressed concerns about the excessive amounts of out-of-stream water allocated. The situation was formally recognized in the 1967 Malheur Lake Basin Plan, which identified a 370,300 acre-feet/year over-appropriation. The plan noted the need for storing floodwaters to reduce flood damage and supply late-season water for agriculture but concluded that "surface water is not available for additional developments or for supporting any appreciable changes in water use" due to the significant over-allocation.

This over-allocation continues to pose a major challenge today, as legal water rights still exceed the actual available water, creating persistent water shortages for both instream needs—which are vital for aquatic ecosystems—and out-of-stream uses such as irrigation. The strain on water resources is compounded by ongoing infrastructure challenges and increasing demand for water, exacerbating the scarcity problem.

A critical component of managing this over-allocation is the inadequate measurement and reporting of surface water use throughout the basin. Without accurate and comprehensive streamflow data, it is difficult to assess how much water is available, how it is being used, and where improvements can be made to ensure that both human and environmental water needs are met. Effective water management requires robust data collection systems to track water use and distribution, yet many areas remain ungauged, leaving gaps in the understanding of water availability and allocation.

Additionally, groundwater withdrawal has raised concerns about its potential impacts on surface water. Declining flows from springs and streams suggest that concentrated groundwater pumping may be negatively affecting surface water resources, further complicating the already over-allocated system. This ongoing over-allocation and the interplay between surface water and groundwater add layers of complexity to water management efforts in the Harney Basin, underscoring the need for improved data, better infrastructure, and adaptive management strategies to balance out-of-stream uses with instream environmental needs.

Impacts to Instream Uses and Ecology

Associated Issues:

- There is a lack of adequate streamflow to provide for instream needs in certain streams and rivers.
- There is a need for additional streamflow data to understand, manage, and restore aquatic ecosystems in the basin's rivers and streams.
- There is a need to address fish passage barriers and impediments to fish movement.
- The lack of fish screens on some irrigation diversions harms native fish and contributes to the spread of invasive fishes.
- Stream temperature and dissolved oxygen conditions exceed Oregon water quality standards in some places. More data is needed.
- Malheur Lake is a wetland affected by flows from the Silvies River and Donner und Blitzen River and currently is in a highly turbid state due to sediment input, sediment resuspension, and carp disturbance.

Existing certificated instream water rights for the protection of flow to support cold water native fish (principally redband trout) are limited to ten stream reaches in the upper Silver Creek and upper Silvies River systems, Krumbo Creek and a West Fork Krumbo Creek reach tributary to the Donner und Blitzen River, and a reach of Rattlesnake Creek. However, four out of the nine redband populations in the Harney Basin are in streams for which there is no streamflow data (Prater, Coffeepot, Cow and Riddle Creeks). Even in the stream reaches that have instream water right certificates, those rights are junior to surface water irrigation rights, resulting in inadequate summer flow to maintain cold water fish habitat and fulfill instream water rights.

Recent studies suggest that streamflow patterns necessary to support stream ecosystem functions extend beyond baseflow and include large floods, small floods, high flow pulses, natural low flows and natural extreme low flows (ODFW, 2023). The relatively undisturbed flow pattern of the Donner und Blitzen shows frequent low flows and small floods, reflecting a typical spring snowmelt freshet, while the Silver Creek and Silvies River have experienced increased frequency of extreme low-flow events. This demonstrates the importance of groundwater-surface water interactions in maintaining flow during low-flow periods.

The basin's irrigation infrastructure further complicates instream conditions. Many stream dams and field ditches were constructed before fish passage barriers and fish screen requirements were established. Addressing these fish passage barriers and installing fish screens at irrigation diversions would greatly benefit native fish species and reduce the spread of invasive fish. Upgrading the irrigation infrastructure should include provisions for volitional fish passage and screening to prevent further harm to aquatic species.

Flood irrigation during spring freshets is critical for supporting migratory birds, particularly waterbirds. Water management that retains semi-permanent and seasonal wetlands maximizes stopover habitats for migratory birds in the Pacific Flyway. While specific flow needs are not fully known, limiting upstream diversions where practicable will help maintain wetlands that are critical for a wide range of migratory and resident bird species. Additionally, maintaining wetland conditions into the fall will provide vital stopover habitats for fall-migrating birds.

Ensuring sufficient water reaches Malheur Lake is also essential for the Malheur National Wildlife Refuge and the birds, wildlife, and ecosystems it supports. The refuge holds water rights to the Blitzen River, but it lacks an assured right for storage in Malheur Lake. Restoring ecological functions at Malheur Lake involves efforts to manage the invasive common carp population, which disturbs the lakebed and contributes to sediment resuspension. Limiting sediment inputs from tributaries and promoting the growth of emergent vegetation will help transition the lake from its turbid state toward a marsh condition, especially as climate change brings potentially drier conditions in the future.

Out-of-Stream Uses

Associated Issues:

- Antiquated irrigation infrastructure, changes to the irrigation system that have altered the flow of water through the floodplain, and changes since the original Silvies Decree have all created potential difficulty in effectively distributing water across parts of the system.

In the Harney Basin, the dominant out-of-stream water use is for agricultural flood irrigation, a practice that has been in place since the Silvies Decree of 1925. This decree recognized the nature of spring floods driven by snowmelt in the high mountains, which were traditionally used to naturally irrigate large expanses of pastureland. As these floods receded, dams, dikes, levees, and other obstructions were used to raise the water level, creating reservoirs in sloughs and depressions to provide subirrigation throughout the growing season.

However, despite this long history, the basin has faced persistent challenges due to severe over-allocation of water resources. The 1967 Basin Plan identified that legal water rights far exceed the available water supply, concluding that surface water was not available for any further developments or significant changes in water use. This over-allocation issue continues today, creating conflicts in water distribution and regulatory difficulties for water management in the basin.

The antiquated nature of much of the flood irrigation infrastructure, including ditches, dams, and dikes, complicates efforts to effectively manage and distribute water. In many areas, this infrastructure is in poor condition and unable to provide the necessary flow regulation, making it difficult to ensure that senior water rights are satisfied, especially during periods of low flow. While modern engineering improvements in some areas have upgraded infrastructure, the uneven condition of the systems creates inequities in water distribution, leading to inefficient water use and disputes between irrigators.

Another complicating factor is the presence of illegal water use across the basin, which adds strain to an already over-allocated water system. Poor communication between irrigators and water managers further exacerbates these challenges, making it difficult to regulate water use effectively and ensure that the rights of senior water users are protected.

Finally, irrigators in the basin frequently express concerns about the security of their water rights, fearing the potential for loss of legal access to water due to regulatory changes or water scarcity. This concern is deeply tied to the region's economic reliance on agriculture, where access to water is critical for sustaining livelihoods.

Moving forward, addressing these challenges will require upgrading flood irrigation infrastructure, improving monitoring and reporting systems, and developing better communication networks between water users and regulators to ensure fair and sustainable water distribution.

Climate Change Impacts

Associated Issues:

- Climate conditions in the Harney Basin are warmer and drier, impacting surface water resources.

The Harney Basin is experiencing warmer and drier conditions, significantly impacting surface water resources and creating challenges for both agriculture and the aquatic environment (Figure 26). Increasing temperatures, altered runoff patterns, and more frequent stream desiccation threaten water availability across the basin, with reduced summer flows placing additional stress on both human and ecological systems. The cumulative effects of climate change are evident in the Silvies River, where earlier peak flows have been observed over the past decade (Figure 27), disrupting flood irrigation practices and potentially reducing agricultural output.

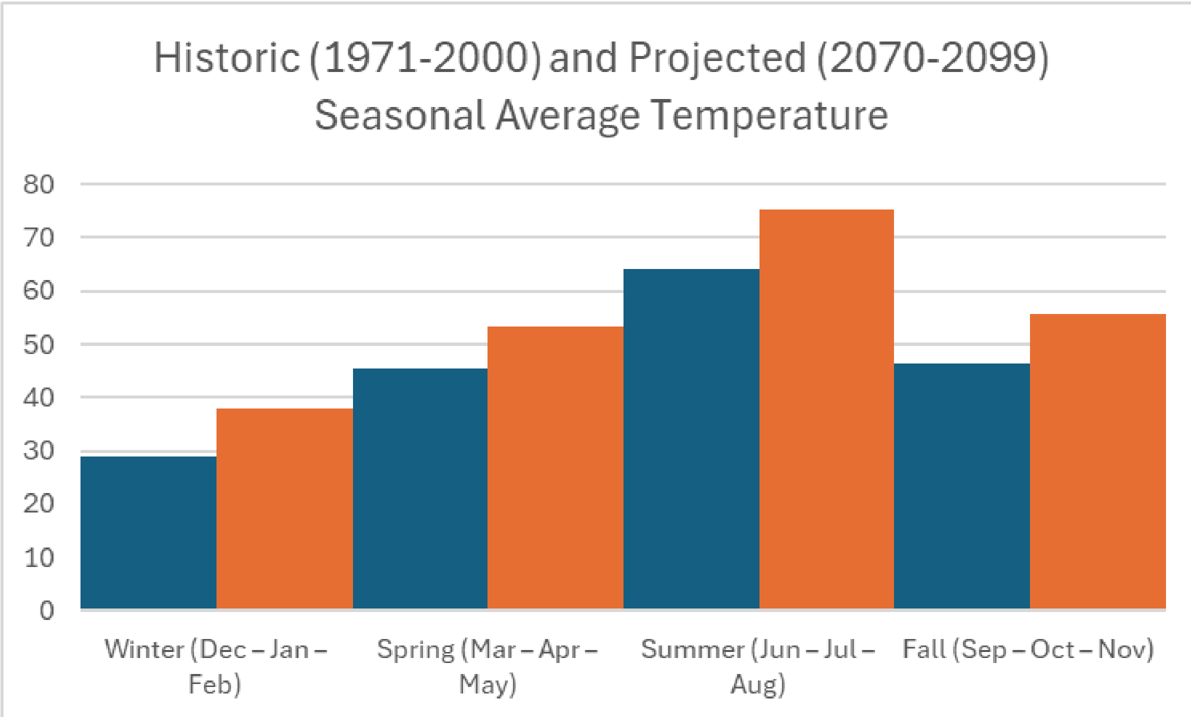

Figure 26. The projected increase in temperatures for the Harney Basin (from Hegewisch and Abatzoglou "Climate Mapper" web tool).

Cold-water aquatic species, such as redband trout, face growing challenges as stream temperatures rise and thermal refuges become less accessible. These changes could further disrupt stream ecosystems, which rely on the seasonal freshets that have historically supported both irrigation and wetland habitats. Reduced flooding duration threatens critical wetland areas, such as those in the Malheur National Wildlife Refuge, which provide important stopover points for migratory birds along the Pacific Flyway (Figure 26). The transition from semi-permanent to seasonal wetlands due to changes in hydrology is expected to impact the basin's ability to support waterbird populations.

To adapt to these changing conditions, irrigators will need to modify flood irrigation practices to align with new seasonal flow patterns. At the same time, conservation efforts must prioritize the preservation and restoration of wetlands and riparian habitats to mitigate the effects of climate change. Collaborative management strategies that incorporate natural solutions, such as the reintroduction of beavers to increase natural water storage, will be essential for maintaining the balance between water use and ecosystem health.

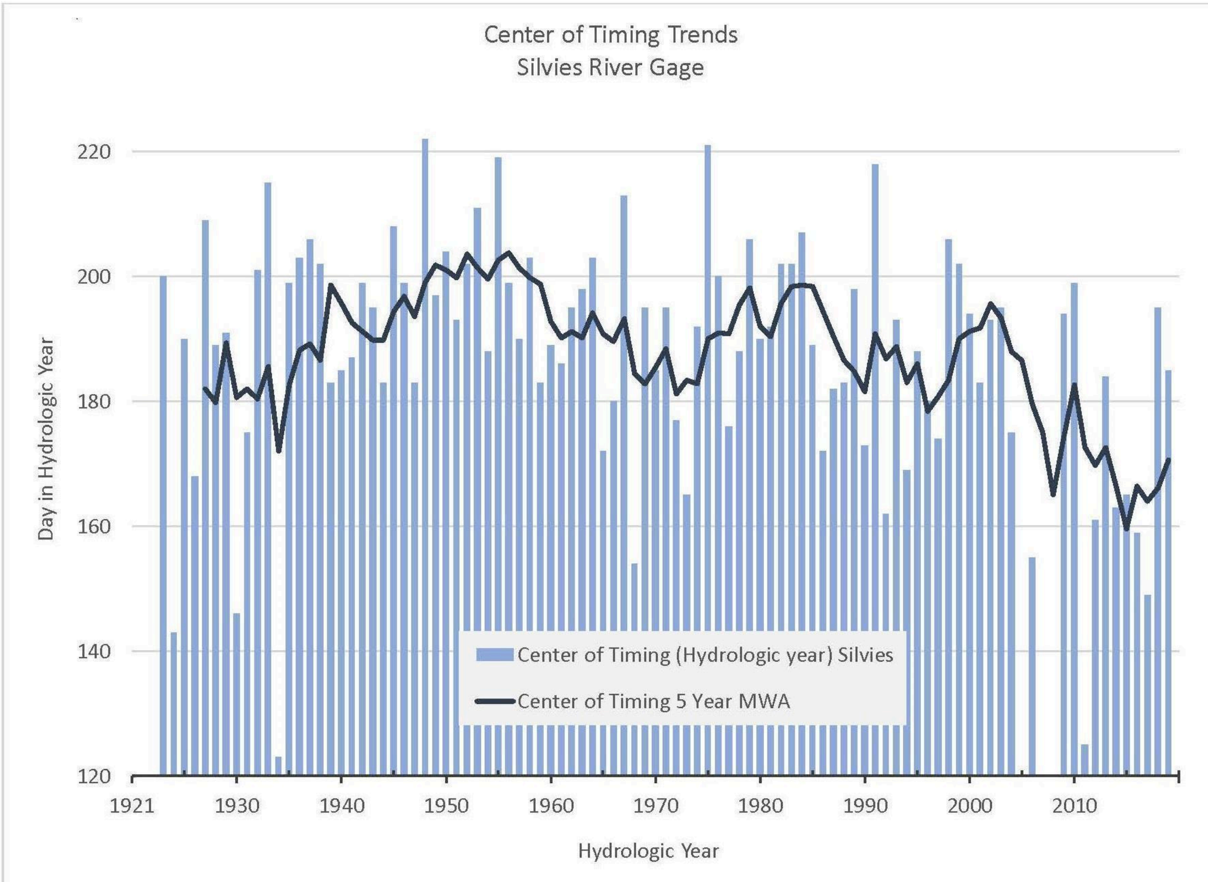

Figure 27. Center of timing of flow in the Silvies River (Svejcar, 2020)

Fire Impacts

Wildfire risks have increased across the basin, particularly in areas with overstocked conifer stands and juniper encroachment (Figure 28) which not only reduce water availability but also increase fuel loads for fires. Recent wildfires in the Blue Mountains and other parts of the basin have highlighted the potential for fires to significantly disrupt runoff patterns, degrade water quality, and further fragment habitats. Post-fire landscapes are more prone to erosion and sediment runoff, which can result in degraded water quality and increased stream heating.

Fires also destroy riparian habitats, removing vegetation that provides critical shade and cooling for aquatic species. This is particularly detrimental to cold-water species, such as redband trout, which rely on cooler stream temperatures for survival. Large-scale fires also increase the likelihood of extreme low flows and rapid stream desiccation in late summer, further stressing aquatic ecosystems.

To mitigate future fire risks, proactive vegetation management is essential. Thinning overstocked conifer stands and removing juniper encroachment will improve water availability, reduce wildfire risks, and enhance the overall ecological function of the basin. These actions will not only protect water resources but also help maintain the health of both upland and riparian areas.

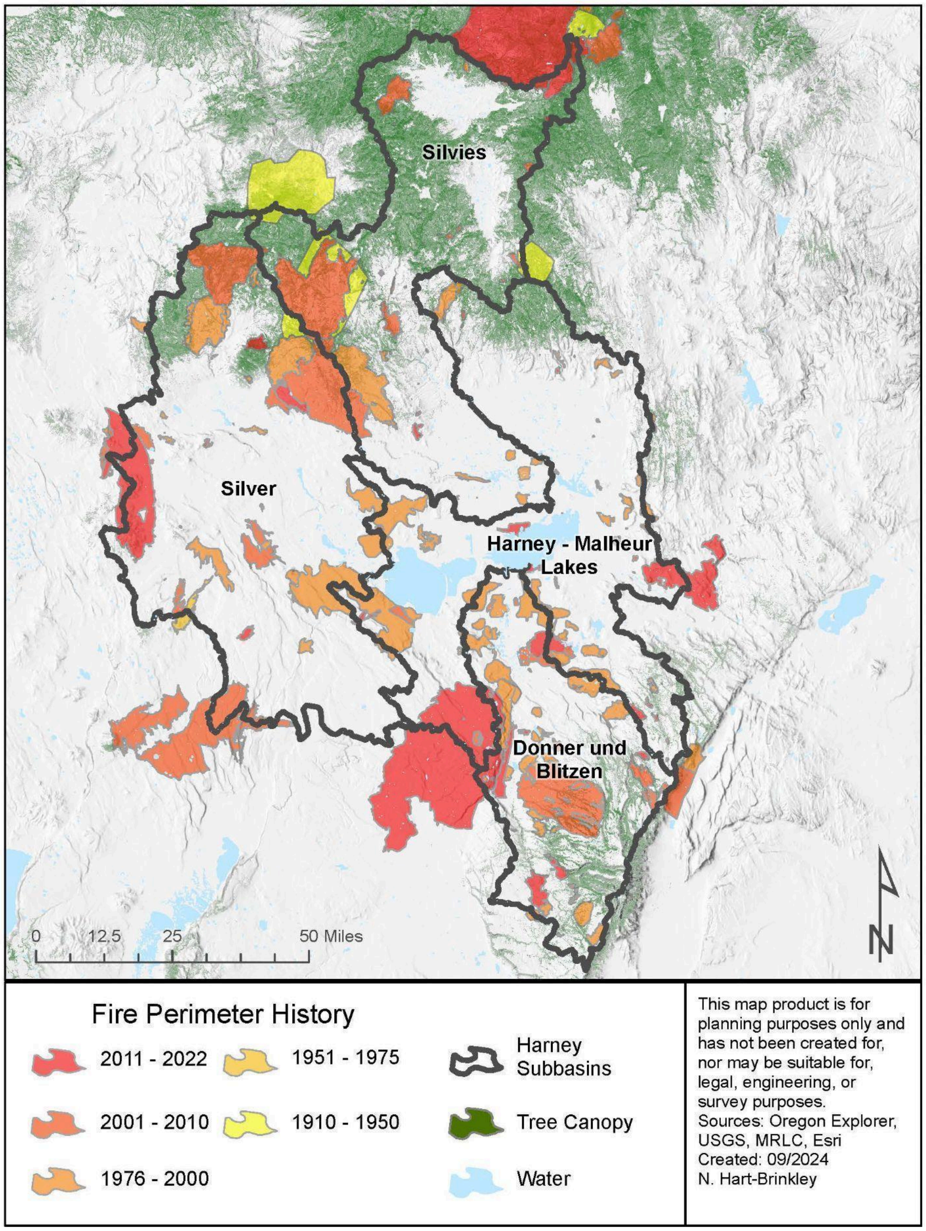

Figure 28. Historic fire perimeters (data from Oregon Explorer)

Flood Impacts

Flood risks remain a significant concern for the communities of Burns and Hines, where disconnected floodplains limit the natural ability of rivers to store and absorb floodwaters, increasing the threat to urban areas. Nearly half of Burns lies within a Special Flood Hazard

Area, and Hines faces similar risks, highlighting the need for effective flood mitigation strategies to protect homes and infrastructure (Kleinschmidt Associates, 2022).

Beyond the impacts on developed areas, flooding plays a crucial role in maintaining the basin's natural ecosystems. Disconnected floodplains reduce the availability of seasonal wetlands and riparian habitats, which are vital for migratory birds and aquatic species. Floodplains act as natural buffers, absorbing excess floodwaters while supporting key ecological processes essential to the basin's biodiversity.

Efforts to restore riparian areas and reconnect floodplains will be critical for reducing flood risks while enhancing the resilience of wetlands and wildlife habitats. By integrating floodplain restoration with community protection measures, local authorities can balance the need to protect human settlements with the preservation of natural flood regimes that support the ecological health of the Harney Basin.

Limited Information

Associated Issues:

- There are concerns that groundwater withdrawal has an adverse effect on surface water as expressed by declining or halted spring flow, declining stream flow, and possibly lake level effects near concentrated groundwater withdrawal areas. **It should be noted that we don't know the full impacts of groundwater withdrawal
- There is a lack of locally-based information about the current distribution of persistent wetlands, by type, throughout the Basin to aid in conservation and management.
- There is a lack of information needed to manage the changing quantity of water needed to maintain diverse wetlands types, including semi-permanent marshes and other seasonal wetlands.
- Rivers and streams are disconnected from floodplains in some parts of the basin.

Each of the Work Groups identified significant information limitations that affect the ability to specify and quantify surface water needs across the Harney Basin. These data gaps are detailed in Chapter 8, with one of the most pressing issues being the lack of stream gages throughout the basin. Despite the Harney Basin being identified as the highest priority in the state for additional gages more than a decade ago (LaMarche, 2011), this critical need remains largely unmet. The limited and sporadic streamflow data creates substantial challenges in analyzing and measuring both natural and human-induced changes. Without comprehensive streamflow data, it is difficult to effectively plan for water resource management or assess the condition of aquatic ecosystems.

Additionally, water quality data across the basin is both limited and inconsistent. While some headwater streams have temperature data collected by public land managers, many lowland streams—especially outside of the Malheur National Wildlife Refuge—lack such monitoring. Inconsistent data collection impedes efforts to address stream temperature and other critical water quality issues, affecting both aquatic habitats and human water use.

A similar gap exists for aquatic and riparian habitats. Information on the distribution and abundance of key species, such as freshwater mussels and amphibious organisms, is poorly documented. Recent eDNA studies have provided some broad-scale insights, but detailed data on species distribution and habitat conditions is still lacking. Riparian habitat conditions are also under-documented, though recent inventories in the Malheur National Wildlife Refuge and other parts of the basin aim to fill this gap.

Filling these information gaps is essential for improving water management across the basin. A comprehensive inventory of riparian conditions, combined with expanded streamflow and water quality monitoring, will significantly enhance the ability to relate in-stream conditions to habitat quality and identify future restoration actions. Prioritizing continuous and uniform data collection across the basin will be critical for effective resource planning, better monitoring of ecosystem changes (whether natural or human-driven), and supporting adaptive management decisions.

Summary

The Harney Basin faces a complex web of issues related to surface water use and management, including historic over-allocation, climate change impacts, and the effects of altered watershed conditions. This chapter has provided a foundation for understanding these challenges by categorizing them into specific areas of concern and highlighting their impacts on both human and ecological needs. Recognizing these critical issues is a necessary step towards developing effective surface water management strategies. The following chapter will outline the desired conditions for the basin, illustrating a vision for a future that balances the needs of people, the economy, and the environment.

Chapter 6: Desired Conditions for Meeting Instream and Out-of-Stream Needs/Demands (Step 3)

Building upon the identification of the critical issues affecting the Harney Basin, this chapter summarizes the plan's vision for a balanced future for the basin's surface water resources. The desired conditions summarized in this chapter reflect the need to address both instream and out-of-stream water demands, emphasizing the importance of agricultural productivity, ecological health, and community resilience. By establishing these desired conditions, the Harney CBWP Collaborative creates a clear path forward to develop actionable strategies that address the basin's complex surface water issues.

Overview

The Harney Basin, located on the northern edge of the Great Basin, has long been shaped by its arid geography, distinct climate, and complex history. Originally central to tribal livelihoods and a key stopover for migratory birds along the Pacific Flyway, the basin has shifted toward an economy based on ranching, timber harvesting, and groundwater-irrigated agriculture. These economic transitions have introduced significant water management challenges, complicated further by fragmented watershed ownership, the over-allocation of surface water resources, and reliance on flood irrigation.

Today, the CBWP Collaborative seeks to secure a sustainable supply of high-quality water to support the basin's people, economy, and environment. However, emerging pressures such as climate change, increasing wildfire risks, and inadequate flood management are amplifying existing challenges, making it critical to establish desired conditions that balance competing water needs.

This chapter outlines the current conditions and desired outcomes for water management across key categories in the Harney Basin:

- Watershed Management
- Watershed Conditions
- Historic Overallocation of Surface Water
- Impacts to Instream Uses and Ecology
- Out-of-Stream Uses
- Climate Change Impacts
- Limited Information

Through collaboration, strategic investment, and adaptive management, the Harney Basin can transition toward a more resilient water future that meets the needs of its communities, economy, and natural ecosystems.

Watershed Management

The desired outcomes for watershed management issues in the Harney Basin focus on improving infrastructure, communication, and water distribution to ensure both agricultural productivity and environmental sustainability. A key challenge is the illegal use of water, which can be addressed through enhanced enforcement and better oversight to reduce violations. The establishment of a central communication network is also crucial for informing irrigators about water availability and priority regulation dates, which would allow for more effective and timely water management. This would reduce conflicts and help stakeholders plan their water usage more efficiently.

Additionally, improvements in irrigation ditch maintenance are essential to ensure that irrigation water is distributed properly to satisfy both water rights and the water depth and duration requirements for maintaining water bird habitats. These improvements must be complemented by a deeper understanding of how irrigation infrastructure changes affect water distribution, with a focus on the broader impact on bird habitats and aquatic ecosystems. Antiquated infrastructure and unregulated changes since the original Silvies Decree have complicated water distribution, but through infrastructure upgrades and better monitoring systems, these challenges can be mitigated to ensure equitable and sustainable water use.

Watershed Conditions

Addressing watershed conditions in the Harney Basin requires a combination of vegetation management and riparian restoration to improve water availability and ecological health. Conifer infilling of forestland has reduced surface water supply, leading to decreased runoff and lower groundwater recharge. To combat this, the desired outcome focuses on increase later-season flows of surface water through conifer thinning. These vegetation management practices can improve water yield, support habitat restoration, and reduce fire risks by reducing fuel loads.

Riparian habitats have degraded over time, impacting the health of aquatic ecosystems and the capacity for natural water storage. By restoring riparian areas, the desired outcome is to cool streams, improve water quality, increase dry season flows, and enhance overall resilience to climate change. Healthier riparian zones will provide better habitat for fish, wildlife, and other species reliant on these ecosystems. Coordination between federal land management agencies and local stakeholders is essential to ensure that restoration efforts target the most critical areas and maximize the benefits for both water supply and ecosystem health.

Historic Overallocation of Surface Water

The Harney Basin faces significant challenges related to the historic overallocation of surface water, where legal water rights far exceed available water supply. Inadequate measurement and reporting of surface water flows have exacerbated this issue, making it difficult to manage water resources effectively for both instream and out-of-stream uses. The desired outcome for this category is to ensure that surface water flows and water use are measured consistently across the basin, providing accurate data that will inform water management decisions.

By increasing the efficiency and accuracy of streamflow measurement and water use measurement, water managers can gain a clearer understanding of the true water supply and how it aligns with demand. This would allow for more informed decisions to be made regarding allocation, usage, and conservation, reducing the strain caused by over-allocated water rights. Improved measurement and reporting systems are critical to ensuring that all water users, from agricultural irrigators to environmental stakeholders, can manage water resources in a way that promotes long-term sustainability.

Impacts to Instream Uses and Ecology

Ensuring adequate streamflow to meet the needs of aquatic ecosystems is a major concern in the Harney Basin. The desired outcomes in this category focus on improving streamflow to support fish, wildlife, and other aquatic organisms, while also mitigating the impacts of climate change. Increasing streamflow during the summer and dry season is essential for alleviating high stream temperatures, which threaten cold-water species such as redband trout. Improving stream connectivity through the removal of fish passage barriers will allow fish and other organisms to access critical habitats, further supporting ecosystem health.

In addition to connectivity, the lack of fish screens on irrigation diversions poses a serious threat to native fish species, contributing to fish mortality and the spread of invasive fish. The desired outcome is to install screens on priority diversions to prevent fish from being trapped in irrigation ditches, thereby supporting healthy populations of native species.

Stream temperature and dissolved oxygen (DO) levels are other critical factors in maintaining aquatic ecosystem health. Many streams in the basin exceed Oregon water quality standards for temperature and DO, which can significantly stress aquatic organisms. The desired outcome here is to improve water quality through targeted restoration activities, including riparian restoration to shade streams, improve water temperatures, and maintain healthy oxygen levels.

Out-of-Stream Uses

Out-of-stream water use in the Harney Basin is primarily for agricultural irrigation, which relies on flood irrigation practices. However, the antiquated infrastructure and unregulated changes since the original Silvies Decree have created significant challenges in effectively distributing water across the basin. The desired outcome for this category is to gain a better understanding of how irrigation infrastructure affects water distribution and identify ways to improve it, ensuring that water is delivered where it is needed most.

Improving irrigation infrastructure will also allow for more efficient water use, reducing losses and ensuring that senior water rights are satisfied during low-flow periods. These changes will be critical for maintaining agricultural productivity while balancing the needs of other water users and the environment. Additionally, addressing communication gaps between irrigators and water managers will help ensure that out-of-stream water use is managed in a more equitable and sustainable way.

Climate Change Impacts

The Harney Basin is experiencing the effects of a warming climate, with higher temperatures, more erratic rainfall patterns, and drier conditions becoming more common. These changes are affecting both water availability and ecosystem health. The desired outcome for climate change impacts is to improve the resilience of water management systems to cope with these changing conditions, ensuring that water is available for both human and environmental needs.

Increased wildfire risks, particularly in overstocked conifer stands and juniper-encroached areas, pose a significant threat to watershed health. The desired outcome is to mitigate these risks through proactive vegetation management, reducing fuel loads, and protecting watersheds from post-fire erosion and habitat fragmentation. This will not only help maintain stable water supply and quality but also protect critical habitats for wildlife.

Flood risks are also a concern, particularly for the communities of Burns and Hines, where disconnected floodplains increase the threat of urban flooding. Reconnecting floodplains to rivers and restoring riparian areas are key strategies to enhance natural flood storage capacity, protecting both urban areas and the ecosystems that rely on seasonal flooding.

Limited Information

A lack of comprehensive information regarding surface water-groundwater interaction, wetlands, and stream-floodplain connections is a significant barrier to effective water management in the Harney Basin. The desired outcome for addressing limited information is to fill these data gaps through expanded monitoring and research, enabling more informed and adaptive management practices.

One key concern is the lack of data on the impacts of groundwater withdrawal on surface water resources, particularly as it relates to declining spring and stream flows. Building an understanding of how groundwater pumping affects surface and river baseflows is essential for managing water resources sustainably. Similarly, more information is needed on the distribution of wetlands, particularly the types of wetlands that are most vulnerable to changing hydrology.

Managing the changing quantity of water required to maintain diverse wetland types is another priority. The desired outcome here is to develop a metric that helps quantify water needs for wetlands and wildlife, supporting conservation efforts. Finally, better understanding of where rivers and streams are disconnected from floodplains will help guide restoration efforts and improve water quality, habitat connectivity, and overall watershed function.

Summary

In this chapter, we articulated the desired conditions that the Harney Basin CBWP Collaborative envisions for the future. These conditions aim to foster improved water management, ensuring that instream and out-of-stream needs are met while enhancing the resilience of local ecosystems and communities. Achieving these goals will require a coordinated effort among diverse stakeholders and a willingness to adopt adaptive strategies in response to changing conditions. Next, we will present a suite of targeted strategies and actions designed to bridge this vision with actionable steps, guiding the basin towards a more sustainable and balanced water future.

Table 6. Harney CBWP Collaborative Critical Surface Water Issues and Associated Desired Outcomes (in no particular order).

Category	Issue	Desired Outcome
Watershed Management	There is illegal use of water in the basin	Improve water management by ending illegal water use.
	There is no central communication network to inform irrigators about water availability and priority regulation dates	Timely information provided to irrigators regarding water availability, regulation with priority dates, and any other issue associated with water regulation.
	There are problems with the effective distribution of irrigation water to satisfy water rights and manage bird habitats	Develop tools to effectively manage irrigation ditch water distribution at locations, depths, and durations that are effective for satisfying water rights and ensuring water bird habitat.

	Antiquated irrigation infrastructure, changes to the irrigation system that have altered the flow of water through the floodplain, and changes since the original Silvies Decree have all created potential difficulty in effectively distributing water across parts of the system.	To obtain a better understanding of how irrigation infrastructure affects distribution of irrigation water and how changes to the infrastructure affect bird habitat, and aquatic life.
Watershed Conditions	Conifer infilling of large areas of forestland and rangeland has led to increased tree density, distribution, and cover which decreases the surface water supply.	Increased later season flows of surface water.
		To obtain data needed to inform strategic application of tree reduction treatments to improve watershed function.
	Riparian habitats have been degraded over time resulting in loss of wildlife and aquatic ecosystem support and watershed function.	Improved riparian habitat conditions throughout the Harney Basin, with cooler streams, higher summer flows, and enhanced ecosystem resilience.

		Cooler streams with higher summer and dry season flows that are better able to support fish, wildlife and invertebrates that rely on Harney Basin rivers and streams. Greater resilience for stream ecosystems as the climate changes. Better habitat for species that rely on the riparian areas.
Historic Overallocation of Surface Water	There is inadequate measurement and reporting of surface water in the Harney Basin to manage for both instream and out-of-stream uses	Surface water flows are measured throughout their flow paths to the lakes, providing accurate data for managing both instream and out-of-stream uses.
Impacts to Instream Uses and Ecology	There is a lack of adequate streamflow to provide for instream needs in certain streams and rivers.	Streamflows that support fish, other aquatic organisms including freshwater mussels, wildlife, and healthy riparian areas, and help alleviate high stream temperatures. Increasing streamflows during the summer and dry season will help mitigate changing hydrology resulting from climate change.

	There is a need for additional streamflow data to understand, manage, and restore aquatic ecosystems in the basin's rivers and streams.	Data contribute to a better understanding of opportunities to maintain and restore aquatic habitat across the basin. Data inform the approaches, tools, and methods with which those opportunities can be implemented.
	There is a need to address fish passage barriers and impediments to fish movement.	Stream habitat that is better connected, allowing fish and other aquatic organisms to access and utilize the best habitat; Cooler streams, likely with increased flow in certain seasons.

	The lack of fish screens on some irrigation diversions harms native fish and contributes to the spread of invasive fishes.	Prevent native fish entrainment into irrigation ditches leading to mortalities and prevent access to habitats that increase invasive populations.
	Stream temperature and dissolved oxygen conditions exceed Oregon water quality standards in some places. More data is needed.	Improved water quality that supports a diverse aquatic and riparian community.

	Malheur Lake is a wetland affected by flows from the Silvies River and Donner und Blitzen River and currently is in a highly turbid state due to sediment input, sediment resuspension, and carp disturbance.	A more complete understanding of the factors affecting turbidity conditions in the marsh.
		A more complete understanding of the variable lake level conditions resulting from changing inputs from surface and groundwater and their effects on the ecology of Malheur Lake.
	Rivers and streams are disconnected from floodplains in some parts of the basin.	Streams throughout the basin are well connected to their floodplains resulting in improved water quality, higher water quality riparian vegetation, reduced erosion, and more natural functionality of rehabilitated river reaches.
Out-of-Stream Uses	Antiquated irrigation infrastructure, changes to the irrigation system, and issues since the original Silvies Decree have created difficulties in effectively distributing water.	Better understanding of how irrigation infrastructure affects water distribution, and how changes to the infrastructure affect bird habitat and aquatic life.

Climate Change Impacts	Climate conditions in the Harney Basin are warmer and drier, impacting surface water resources.	Improved knowledge of limitations and ability of of irrigators to adapt to changing conditions, protection of Burns/Hines from repeated flood damages, maintenance of ecological and geomorphological conditions of streams entering the Harney Valley, Increased upland surface water storage in beaver ponds
Limited Information	There are concerns that groundwater withdrawal has an adverse effect on surface water as expressed by declining or halted spring flow, declining stream flow, and possibly lake level effects near concentrated groundwater withdrawal areas. **It should be noted that we don't know the full impacts of groundwater withdrawal	Build an understanding of how groundwater pumping effects spring and river baseflow.

	There is a lack of locally-based information about the current distribution of persistent wetlands, by type, throughout the Basin to aid in conservation and management.	An understanding of how surface water irrigation can be used to benefit diverse wetland types in the Harney Basin, particularly as water availability becomes increasingly uncertain.
	There is a lack of information needed to manage the changing quantity of water needed to maintain diverse wetlands types, including semi-permanent marshes and other seasonal wetlands.	Development of a quantity metric for understanding how much water is needed to manage wetlands for diverse bird species and for other wildlife. This will help with future water planning.
	Rivers and streams are disconnected from floodplains in some parts of the basin.	Streams throughout the basin are well connected to their floodplains resulting in improved water quality, higher water quality riparian vegetation, reduced erosion, and more natural functionality of rehabiilitated river reaches.

Chapter 7: Surface Water Strategies (Step 4)

Achieving the desired conditions outlined in the previous chapter requires collaboration, data-driven decision-making, and targeted strategies that address the Harney Basin's unique water management challenges. These strategies must balance the basin's diverse needs—supporting ecosystems, communities, and agriculture—while adapting to ongoing pressures like climate change, over-allocation of resources, and outdated infrastructure. In this chapter, we present a range of strategies aimed at addressing key areas such as watershed management, water infrastructure, instream and out-of-stream uses, and ecological health. By focusing on proactive management, innovative solutions, and sustainable practices, these strategies provide a path forward for effective and resilient water management across the basin.

Overview

The CBWP Collaborative has worked through a multi-phase process of identifying and addressing critical issues impacting the Harney Basin's surface water resources. Through extensive collaboration, input from working groups, and iterative review, the strategies outlined in this chapter were agreed upon to address the basin's most pressing surface water challenges. This chapter organizes select strategies into categories that align with the key areas of concern, including:

- Watershed Management
- Conditions
- Historic Overallocation of Surface Water
- Impacts to Instream Uses and Ecology
- Out-of-Stream Uses
- Climate Change Impacts
- Limited Information

See Appendix D for a complete list of strategies, desired outcomes, and recommended actions.

Watershed Management

Watershed management in the Harney Basin focuses on improving compliance, communication, and infrastructure to ensure sustainable water use. To address illegal water use, enhanced enforcement will be key. The strategy emphasizes using tools such as remote sensing to monitor and detect violations, allowing for timely interventions to reduce illegal water use, and instituting water use measurement and reporting. Additionally, developing a central communication network will provide irrigators with timely information on water availability, priority regulation dates, and other critical issues. This will facilitate better water management and reduce conflicts between water users.

In terms of irrigation distribution, maintaining and upgrading irrigation ditches will improve the flow and allocation of water, ensuring that both water rights and water bird habitat needs are met. By employing tools that help manage water distribution effectively, stakeholders can better balance agricultural needs with ecological requirements. Moreover, antiquated irrigation infrastructure requires modernization. By evaluating the effects of current infrastructure and making necessary upgrades, water distribution can be optimized to address challenges stemming from outdated systems and changing environmental conditions.

Watershed Conditions

Improving watershed conditions in the Harney Basin includes effective vegetation management and riparian restoration. These strategies target priority areas where thinning efforts have the potential to reduce ET for a period of time, which may in turn impact water yield and ecosystem health.

Similarly, riparian restoration efforts will focus on assessing degraded areas and prioritizing them for restoration. Healthier riparian zones provide cooler stream conditions, improve water quality, and offer more resilient habitats for fish and wildlife. This restoration work will also support increased dry-season water flows and help buffer the effects of climate change. Coordination between federal land management agencies and local stakeholders will be crucial to ensure these restoration efforts are effectively targeted and maximized for both water and habitat improvements.

Historic Overallocation of Surface Water

The Harney Basin faces historic challenges with over-allocated water resources. To address this, the key strategy is improving the measurement and reporting of surface water use and streamflows. Accurate and consistent streamflow data is essential for balancing water use between instream and out-of-stream needs. By increasing the efficiency and coverage of streamflow measurement and water use measurement and reporting, water managers can better understand the true supply and align it with demand. These improvements will ensure more informed decisions about water allocation, reduce overallocation strains, and help support both agricultural and environmental water users.

Instream Uses and Ecology

To support aquatic ecosystems in the Harney Basin, strategies are focused on restoring streamflow, improving habitat connectivity, screening unscreeneed irrigation ditches, improving riparian health and addressing water quality issues. Streamflow restoration programs will prioritize efforts to increase summer and dry-season flows, which are essential for supporting cold-water fish species like redband trout and other aquatic organisms. Additionally, expanding streamflow data collection through the installation of more stream gages will provide critical information to manage and restore aquatic habitats.

Efforts to remove fish passage barriers and install fish screens on irrigation diversions will allow fish to access critical habitats and prevent mortality from getting trapped in irrigation systems. These actions will improve overall stream connectivity and protect native species from the spread of invasive fish. Addressing stream temperature and dissolved oxygen (DO) levels through targeted restoration activities, including riparian restoration, will further improve water quality, ensuring streams meet Oregon's water quality standards and support diverse aquatic and riparian communities.

Add narrative re: Malheur Lake

Out-of-Stream Uses

Out-of-stream uses, primarily for agricultural flood irrigation, require significant infrastructure improvements to manage water efficiently. The strategy focuses on modernizing irrigation infrastructure to address the water distribution difficulties caused by antiquated systems. Evaluating and upgrading irrigation systems will improve water delivery, reduce losses, and ensure that water is efficiently allocated to meet agricultural and environmental needs. Measurement and reporting of water use will help improve water management and increase accountability.

Additionally, more accurate streamflow measurement will be implemented through the installation of stream gages, which will help monitor water use and ensure senior water rights are satisfied. Additionally,These improvements are essential to maintaining agricultural productivity while balancing the needs of out-of-stream water users with environmental sustainability.

Climate Change Impacts

The Harney Basin is experiencing the effects of climate change, with warmer temperatures, drier conditions, and erratic rainfall patterns impacting water availability and ecosystem health. The strategy for adaptive water management will focus on making the basin's water systems more resilient to these changing conditions. By adapting water management practices to new climate realities, the basin can ensure water availability for both human and environmental needs.

Floodplain reconnection will play a key role in managing flood risks for urban areas like Burns and Hines. Reconnecting floodplains to rivers will enhance natural flood storage capacity, reducing the risk of flooding in urban areas and simultaneously supporting riparian ecosystems. This integrated approach will improve both flood resilience and ecological health.

Limited Information

The Harney Basin faces significant gaps in data that are critical for effective water management. Strategies to address these information gaps include expanding streamflow monitoring, improving understanding of groundwater-surface water interactions, and enhancing wetland mapping. These actions will provide the data needed to inform decision-making and adaptive management practices.

Key concerns include a lack of comprehensive data on how groundwater withdrawal impacts surface water resources and streamflow. Conducting evaluations on groundwater withdrawal will help build a clearer understanding of how it affects spring and river baseflows. Additionally, efforts to expand wetland distribution mapping will support conservation and better water management, particularly for wetland types most vulnerable to changing water availability.

By addressing these data limitations, the basin can improve its ability to manage water resources sustainably and ensure that both human and environmental water needs are met.

Table 7. Harney CBWP Collaborative Critical Surface Water Issues, Associated Desired Outcomes, and Strategies (in no particular order).

Category	Issue	Desired Outcome	Strategies
Watershed Management	There is illegal use of water in the basin	Improve water management by ending illegal water use.	Prioritize enforcement to diminish and ultimately stop illegal water use.
	There is no central communication network to inform irrigators about water availability and priority regulation dates	Timely information provided to irrigators regarding water availability, regulation with priority dates, and any other issue associated with water regulation.	Develop a communications and information program to inform irrigators about surface water conditions (including water availability and current priority date for regulation).
	There are problems with the effective distribution of irrigation water to satisfy water rights and manage bird habitats	Develop tools to effectively manage irrigation ditch water distribution at locations, depths, and durations that are effective for satisfying water rights and ensuring water bird habitat.	Adequately maintain irrigation ditches.

	Antiquated irrigation infrastructure, changes to the irrigation system that have altered the flow of water through the floodplain, and changes since the original Silvies Decree have all created potential difficulty in effectively distributing water across parts of the system.	To obtain a better understanding of how irrigation infrastructure affects distribution of irrigation water and how changes to the infrastructure affect bird habitat, and aquatic life.	Inventory irrigation and other infrastructure that affects distribution of water. Use that inventory to evaluate distribution and efficiencies that consider irrigation water, bird habitat, and aquatic life.
			In the lower Silvies, explore feasibility of installing stream gages or other structure to assist with accurate gross division of water.

Watershed Conditions	Conifer infilling of large areas of forestland and rangeland has led to increased tree density, distribution, and cover which decreases the surface water supply.	Increased later season flows of surface water.	Provide input to federal land management agencies to include and prioritize the location and level of conifer reduction treatments designed to decrease water losses associated with evapotranspiration and promote snow distribution patterns that contribute to improved capture, storage, and safe (slow) release of water and maintenance of wildlife habitat in coordination with ODFW in the Basin.

		To obtain data needed to inform strategic application of tree reduction treatments to improve watershed function.	Targeted conifer (ponderosa pine, mixed conifer, and juniper) reduction in snow accumulation (higher elevation) areas of the Silver Creek, Silvies, Malheur-Harney Lakes, and Donner und Blitzed Sub-basins receiving over 17.7 inches of annual precipitation to decrease losses associated with evapotranspiration and promote snow distribution patterns that contribute to improved capture, storage, and safe (slow) release of water in the Basin.
	Riparian habitats have been degraded over time resulting in loss of wildlife and aquatic ecosystem support and watershed function.	Improved riparian habitat conditions throughout the Harney Basin, with cooler streams, higher summer flows, and enhanced ecosystem resilience.	Conduct a comprehensive assessment of riparian conditions and implement restoration actions in priority areas. Identify potential opportunities for beaver reintroduction.

		Cooler streams with higher summer and dry season flows that are better able to support fish, wildlife and invertebrates that rely on Harney Basin rivers and streams. Greater resilience for stream ecosystems as the climate changes. Better habitat for species that rely on the riparian areas.	Identify and prioritize riparian habitat conditions for restoration or management to improve ecosystem functions.
			Implement riparian restoration and management actions in priority areas and early opportunity areas throughout the basin.
			Identify potential opportunities for beaver reintroduction.
Historic Overallocation of Surface Water	There is inadequate measurement and reporting of surface water in the Harney Basin to manage for both instream and out-of-stream uses	Surface water flows are measured throughout their flow paths to the lakes, providing accurate data for managing both instream and out-of-stream uses.	Increase the efficiency and accuracy of streamflow measurement in the basin for both instream and out-of-stream uses.
			Measure the quantity of water being diverted out-of-stream at primary diversions, report to OWRD and make publicly available.

Impacts to Instream Uses and Ecology	There is a lack of adequate streamflow to provide for instream needs in certain streams and rivers.	Streamflows that support fish, other aquatic organisms including freshwater mussels, wildlife, and healthy riparian areas, and help alleviate high stream temperatures. Increasing streamflows during the summer and dry season will help mitigate changing hydrology resulting from climate change.	Identify streamflow restoration needs and develop a program to address the needs.
	There is a need for additional streamflow data to understand, manage, and restore aquatic ecosystems in the basin's rivers and streams.	Data contribute to a better understanding of opportunities to maintain and restore aquatic habitat across the basin. Data inform the approaches, tools, and methods with which those opportunities can be implemented.	Achieve more complete streamflow gaging in the Harney Basin.
	There is a need to address fish passage barriers and impediments to fish movement.	Stream habitat that is better connected, allowing fish and other aquatic organisms to access and utilize the best habitat; Cooler streams, likely with increased flow in certain seasons.	Establish appropriate volitional fish passage throughout the basin, recognizing that the prevention of expansion of common carp is an important consideration.

	The lack of fish screens on some irrigation diversions harms native fish and contributes to the spread of invasive fishes.	Prevent native fish entrainment into irrigation ditches leading to mortalities and prevent access to habitats that increase invasive populations.	Install screens to encourage healthy populations of native fishes.
	Stream temperature and dissolved oxygen conditions exceed Oregon water quality standards in some places. More data is needed.	Improved water quality that supports a diverse aquatic and riparian community.	Take appropriate actions to improve factors affecting degraded water quality.
	Malheur Lake is a wetland affected by flows from the Silvies River and Donner und Blitzen River and currently is in a highly turbid state due to sediment input, sediment resuspension, and carp disturbance.	A more complete understanding of the factors affecting turbidity conditions in the marsh.	Continue investigations of sediment sources to Malheur Lake.
		A more complete understanding of the variable lake level conditions resulting from changing inputs from surface and groundwater and their effects on the ecology of Malheur Lake.	Continue investigations of water quantity and flow influences on Malheur Lake conditions

Out-of-Stream Uses	Antiquated irrigation infrastructure, changes to the irrigation system, and issues since the original Silvies Decree have created difficulties in effectively distributing water.	Better understanding of how irrigation infrastructure affects water distribution, and how changes to the infrastructure affect bird habitat and aquatic life.	Inventory irrigation and other infrastructure that affects distribution of water.Explore feasibility of installing stream gages or other structures in the lower Silvies to improve water distribution.
			In the lower Silvies, explore feasibility of installing stream gages or other structure to assist with accurate gross division of water.
Climate Change Impacts	Climate conditions in the Harney Basin are warmer and drier, impacting surface water resources.	Improved knowledge of limitations and ability of of irrigators to adapt to changing conditions, protection of Burns/Hines from repeated flood damages, maintenance of ecological and geomorphological conditions of streams entering the Harney Valley, Increased upland surface water storage in beaver ponds	Manage surface water resources during climate change/drought events in a way that helps to meet the short-term and long-term needs of the Harney basin's people, ecosystems, and economy.

Limited Information	There are concerns that groundwater withdrawal has an adverse effect on surface water as expressed by declining or halted spring flow, declining stream flow, and possibly lake level effects near concentrated groundwater withdrawal areas. **It should be noted that we don't know the full impacts of groundwater withdrawal	Build an understanding of how groundwater pumping effects spring and river baseflow.	Conduct an evaluation on the local-scale effects on springs and river baseflow that are near concentrated groundwater withdrawal areas
	There is a lack of locally-based information about the current distribution of persistent wetlands, by type, throughout the Basin to aid in conservation and management.	An understanding of how surface water irrigation can be used to benefit diverse wetland types in the Harney Basin, particularly as water availability becomes increasingly uncertain.	Expand the Open Range Consulting (ORC) mapping off refuge to allow for a fuller understanding of on-the-ground conditions

	There is a lack of information needed to manage the changing quantity of water needed to maintain diverse wetlands types, including semi-permanent marshes and other seasonal wetlands.	Development of a quantity metric for understanding how much water is needed to manage wetlands for diverse bird species and for other wildlife. This will help with future water planning.	Install appropriate measuring devices to understand how much water is needed to irrigate specific wet meadows and associated seasonal and semi-permanent wetlands.
	Rivers and streams are disconnected from floodplains in some parts of the basin.	Streams throughout the basin are well connected to their floodplains resulting in improved water quality, higher water quality riparian vegetation, reduced erosion, and more natural functionality of rehabiilitated river reaches.	Reintroduce beavers to the watershed where habitat exists and landowners and public land managers are willing.
			Identify stream restoration actions that reintroduce meanders and floodplain reconnection where appropriate and feasible.

Summary

This chapter outlines comprehensive strategies that target the key challenges facing surface water management in the Harney Basin. From modernizing irrigation systems and addressing illegal water use to mitigating wildfire risks and improving water quality, these strategies offer a clear roadmap toward improved sustainable water management. By focusing on both short-term actions and long-term solutions, the Collaborative aims to create a resilient water future for the basin's ecosystems, communities, and economy. The success of these strategies will depend on accurate data, effective collaboration, and adaptive management practices. The following chapter will focus on the critical data needs required to fully implement these strategies and support ongoing progress toward the basin's water management goals.

Chapter 8: Data Needs (Step 4)

In Chapter 7, we outlined the strategies and actions necessary for sustainable water management in the Harney Basin. However, the successful implementation of these strategies hinges on a robust foundation of accurate and comprehensive data. The identification of data gaps in this chapter underscores the critical role that precise information plays in understanding the basin's complex hydrological and ecological systems. By addressing these data needs, the Collaborative can enhance decision-making and ensure that water management practices are grounded in sound science. Chapter 8 explores these essential data needs, detailing the gaps and proposing solutions to build a resilient, data-informed approach to water resource management.

Overview

The Harney Basin's water management strategies are hindered by a lack of comprehensive data across several areas, from streamflow monitoring to species distributions. The limited availability of stream gages and other essential data collection systems impedes effective surface water management. As highlighted by Stoeckl et al. (2022), a strategic approach to data collection is critical: "We do not have sufficient data to adequately describe the integrated socio-ecological systems that support us. It is prohibitively expensive to collect enough data to describe all, so it is important to think strategically about how to (i) use the information we do have and (ii) prioritize the collection of new data." This chapter outlines the data needs identified by the CBWP Collaborative, detailing specific gaps and potential approaches to address them.

Common Data Concerns

A recurring concern is the shortage of stream gages to measure and monitor streamflow, which limits our ability to assess water distribution accurately. Equally pressing is the need for more data on the impacts of flood irrigation practices on bird habitats and the distribution of irrigation water to senior water right holders. Developing tools that provide timely data and leveraging digital technology for better communication with water users could greatly enhance water management efforts. Effective dissemination of data to stakeholders, from irrigators to conservation organizations, will improve both decision-making and resource management across the Harney Basin.

Addressing Data Gaps

Table 8. Harney CBWP Collaborative Identified Data Needs and How Data Need Could be Addressed

Data Need	How data need could be addressed
Ecological: Rivers and Streams	
Lack of uniform information on water quality (see the end of the Water quality section for more information and discussion).	Work with Oregon DEQ to develop a water quality monitoring program to better characterize conditions in the basin.

Continuous data from streamflow gages is patchily distributed in time and space.	More consistent discharge information from additional gages would help provide a clearer hydrologic understanding of the streams and rivers in the basin.
Lack of data for watersheds not included in OWRD's Surface Water Availability Reporting System (SWARS). SWARS is not available for significant parts of the Harney Basin, including some of the watersheds important to redband trout (Coffeepot, Cow, Prater, and Riddle Creeks).	Request that OWRD fill in gaps in SWARS for the Harney Basin.
Lack of data on consumptive uses in the basin.	Data on how much and at what points on the stream system water is being diverted and what the amount of consumptive use. This data can help build a better picture of the timing and magnitude of streamflows.
Improved information on species distribution, including fish and freshwater mussels needed.	Find funding for and work with ODFW, HDP, and MNWR to conduct appropriate inventories of fish distribution and other aquatic species.
Information on specific species of host fish for Western Ridged mussel in the Harney Basin is needed.	Explore funding for ODFW, TNC, Xerces, FWS for studies of host species.
Riparian conditions (and the spatial relationship of those to populations of fish and other species of concern) are not well known.	Explore funding to match riparian inventory information with habitat use information.
Impacts of watershed conditions across the Harney Basin on streamflow and water quantity are unknown.	Combine remote sensing and GIS mapping of land use changes with historical streamflow data analysis and field monitoring to identify correlations between watershed conditions and streamflow/water quantity.
Relation between water quality and invasive species distribution/spread are unknown.	Conduct a targeted literature review and consult experts, then map invasive species distribution alongside water quality sampling to identify potential correlations, supplemented by controlled experiments if feasible.

Relation between streamflow, stream temperatures, and groundwater depletion are unknown.	Utilize hydrological and temperature monitoring, combined with groundwater-surface water interaction models and statistical analysis of existing data, to explore the relationships between groundwater depletion, streamflow, and stream temperatures.
Ecological: Lakes and Reservoirs	
There is only estimated information on historic contributions of surface water to the lakes. Contributions to Malheur Lake have been estimated but changes to Silver Creek and subsequent contributions to Harney Lake are poorly understood	As information on the ecology of Malheur Lake is improved through the Harney Basin Wetlands Collaborative, the effects of changing surface and groundwater hydrology can be better evaluated.
There is limited information on the invertebrates of the Lakes and the relationship between habitats of the lake edge and macroinvertebrate communities. There remains uncertainty about the lack of emergent vegetation reestablishment in Malheur Lake.	Systematic monitoring of emergent vegetation will help in identifying the conditions that enhance establishment and expansion of emergent vegetation. Connecting avian use data with lake condition information (seasonal size, turbidity, drawdown rate, etc.) could provide management information for the Refuge.
Lack of information on sources of turbidity in Malheur Lake.	Development of a hydrodynamic model as proposed in Gingerich and others (2022) to help forecast Malheur Lake levels and turbidity would assist in management. Development of information on sediment supplies to the Lake would help in further assessing turbidity in the Lake.
Ecological: Wetlands	
Current information about specific species, particularly non-game species outside of the Refuge, is difficult to come by. Historic, baseline, data are available through agency biologists, though there is little published data for the Harney Basin.	There are Community Science databases, e.g., eBird, and "expected distribution" maps available from ODFW via the Compass website. Some efforts are being made to collect information about vegetation in flood-irrigated wet meadows on and off Refuge, though this data is not publicly available yet. Additionally, a Community Science project inventorying birds in the

<table>
<tr><td></td><td>Silvies Floodplain (Project IBiS) is ongoing. This effort includes six flood-irrigated sites associated with work being done by the Harney Basin Wetlands Collaborative.</td></tr>
<tr><td>Wetland and woody riparian distribution is largely unmapped in the Harney Basin.</td><td rowspan="6">There is a long-term and ongoing effort to both manage and develop a better understanding of the flood irrigated wet meadow systems of the Harney Valley. The Harney Basin Wetlands Collaborative has acquired funding that built information on the ecology of Malheur Lake, the management options for common carp, and has invested in monitoring bird use of flood irrigated wet meadows with efforts to better understand the relationships between plant communities (especially aggressive species like reed canary grass and smooth brome) and water regimes by tracking plant response to timing, duration and depth of flooding. Linking information on hydrology to bird response will also help to develop management responses to changing seasonal flooding patterns.</td></tr>
<tr><td>Generally a lack of information about how declining groundwater levels have and will affect wetlands in the basin.</td></tr>
<tr><td>Information about the relationship between hydroperiod, vegetation, and bird communities is needed to understand climate resiliency in wetland habitats.</td></tr>
<tr><td>Accurate measurements of water quantities needed to maintain diverse wetland types across the Harney
Basin.</td></tr>
<tr><td>Other data gaps associated with plant species may be identified in other sections of the larger CBWP document.</td></tr>
<tr><td>There are also data gaps regarding wetland distribution, particularly for wetlands other than flood irrigated wet meadows. We lack data regarding how the declining groundwater levels have and will affect wetlands throughout the basin. There are ongoing efforts through the HBWC to fill some of these gaps.</td></tr>
<tr><td>There is a general need for better understanding of floral and faunal communities, and the relationships between these communities, surface water, and groundwater throughout the Harney Basin.</td><td>From 2019-2021, volunteers identified 129 species using the flood-irrigated wet meadows at some point in their life cycle (Wicks, personal comm.). Information about specific focal species using the Silvies Floodplain will be available in fall of 2023. These efforts will help fill some data gaps.</td></tr>
<tr><td colspan="2">Surface Water - Groundwater Interaction</td></tr>
</table>

Lack of long-term measurement of stream flow. Without knowledge of changes in flow regime in tributary streams and lower reaches of larger streams it is difficult to accurately understand the interaction between surface and groundwater.	Establish additional sites for long-term measurement of stream flow.
Lack of information regarding the potential for managing lowland recharge and/or identifying opportunities to increase lowland recharge.	Spatially explicit measurement of lowland recharge under different spring freshet regimes.
Lack of information on prioritization of vegetation management for water yield purposes.	Quantify the relationship between vegetation conditions of different portions of the catchment and contribution to the surface and groundwater.
Lack of information on surface and groundwater management needs in the future.	A basin scale evaluation of changing snowpack regime.
Lack of information regarding beaver reintroduction.	An evaluation of beaver reintroduction and/or the effect of beaver dam analogs (Silvies Valley Ranch) on timing and storage of surface and groundwater would help in determining whether beaver reintroduction is an advisable strategy. The Harney County Watershed Council has contracted for the evaluation of potential for beaver restoration using remote sensing information and selected site visits throughout the basin. As with many of the information needs, special studies will be required (e.g. Western Ridged Mussel hosts, diversion inventory, non-game species distribution, etc.) to fill data gaps.

Lack of information on priority restoration areas.	Evaluating the extensive stream simplification and canal system in the lower river systems for effects on recharge and discharge would help to identify if there are reaches important to restore to a more complex pattern. Evaluating the effects of stream alteration through channelization, diversion, and removal of beaver can provide information useful for prioritizing and evaluating restoration potentials.
Spring flooding and flood irrigation accounts for nearly 70% of the Harney Valley groundwater recharge. It is unknown if there are areas that are more efficient at recharge than others in the Harney Valley that would allow management of recharge.	Explore funding to research groundwater recharge differences across the Silvies River floodplain.
Vegetation management through conifer forest thinning and western juniper clearing in the uplands may have an effect on catchment yield but it is unknown the magnitude and significance of the effect on surface-groundwater contributions.	Work with Harney Forest Collaborative, BLM, and USFS to obtain data on the effects of vegetation change on watershed yield.
Lack of information on the current state of the surface water infrastructure system in Harney County.	A professional evaluation of the current state of the surface water infrastructure system in Harney County along with a recommendation of improvements with the goal of increasing groundwater recharge.
Changing snowpack conditions will affect runoff amount, timing and duration of flow and flooding. This, compounded with little monitoring has led to ineffective management of surface water.	Developing improved monitoring to better predict spring conditions (flow amount, timing, duration, etc.) will enable more effective management of surface water.

Lack of information on headwater conditions and hillslope water storage.	Increased information on headwater conditions and hillslope water storage would improve understanding of upland surface-groundwater interactions. This will be particularly important for the Steens Mountain area since some 60% of groundwater recharge comes from the Blitzen catchment.
Surface Water Management	
There is no complete inventory of river diversion structures with data on type, condition, working status, and diversion measurement.	Since 2010 a significant number of headgate and measurement devices have been installed. NRCS has cost shared on water control structures in the Silvies floodplain under the Working Lands for Waterbird Habitat Conservation - Harney County initiative. Some 96 structures have been completed and some 68 additional are in progress affecting irrigation to some 4,150 acres.
There is no headgate on the Foley Slough as it is legally considered a tributary of the Silvies River.	A headgate at this location would enable better management of the water of the Silvies River. A number of design solutions have been evaluated but all have exceeded cost benefit considerations. Management of flows in Foley Slough occurs at the East Fork Silvies River. There is also a need for a telemetry equipped stream gage on the Foley Slough in order to closely monitor and manage flows at this critical location in real time. The gage would probably be a velocity–index gage, given the site conditions. In addition, as mentioned previously, some type of control structure needs to be installed to manage the division of flow.

At the bifurcation of the East and West Forks of the Silvies River there are dams without measurement devices.	There is a need for infrastructure changes and a telemetry equipped stream gage on each fork, in order to closely monitor and manage flows and this critical location in real time. The gages may have to be a velocity–index gage, given the site conditions. In addition to a new gage on the West Fork Silvies near the bifurcation, a weir on the West Fork Silvies at the Highway 205 crossing (near Island Ranch) would greatly aid in monitoring and water management for these users.
Vegetation Management	
Lack of information on modeling and measuring vegetation and other influences on snow accumulation and redistribution in snow accumulation zones of the Basin.	Engage appropriate experts in pursuing relevant information for modeling and measuring vegetation and other influences on snow accumulation and redistribution in snow accumulation zones of the Basin.
Lack of capacity to help the interagency workgroup complete the photo-monitoring assessment of the Silvies Subbasin.The group includes: the Bureau of Land Management, Eastern Oregon Agricultural Research Center, Harney Soil and Water Conservation District, and U.S.D.A. Forest Service.	Staff capacity to help the interagency workgroup (see Riparian Conditions section) complete the photo-monitoring assessment of the Silvies Subbasin.
Lack of information on historical and current vegetation conditions.	Improved information on historical and current vegetation conditions will be useful for defining management objectives and expectations.Such information will also be useful for prioritizing management and restoration actions aimed at improving hydrological cycling within the Basin.
Lack of information needed to evaluate the potential magnitude of impact associated with larger scale (e.g. watershed, subbasin, etc.) contemporary forest management practices.	Future work that leverages a Simplified Surface Energy Balance model to compare evapotranspiration rates between areas of more moderate tree reduction treatments and dense forest cover where measurements of

	hydrologic parameters are also taken.
Lack of information on cover classes.	Use the Forest Service Landscape-Pattern Monitoring Portal tool to evaluate cover classes. This could help in the future for conducting "what-if scenarios" around vegetation management options. The tool may also be useful for quantifying changes in tree cover and associated effects to Basin hydrology resulting from tree reduction treatments and wildfire. An additional tool is the Climate Engine Application (http://climateengine.org/), a useful tool to look at trends in vegetation greenness (NDVI) over the LANDSAT satellite archive (1984-present) and could indicate changes in vegetation, primarily juniper encroachment in this case.

Summary

Chapter 8 has highlighted the essential role that accurate and comprehensive data will play in implementing sustainable water management practices in the Harney Basin. Addressing these data needs is not merely a logistical task but a fundamental step in the planning process. By filling the identified data gaps, particularly in areas such as streamflow monitoring, water quality, and species distributions, the Collaborative will be better equipped to make informed decisions that balance ecological health with community and economic needs. With a robust data infrastructure, the Harney Basin can move towards a future where water resources are managed proactively and with greater precision. In the following chapter, we will take a look at the implementation framework that will turn these strategies into actionable steps, ensuring that the basin's water management efforts are both effective and sustainable.

Chapter 9: Implementation (Step 5)

Having identified the critical data needs in Chapter 8, the next step is to translate this understanding into concrete actions that support improved surface water management. Accurate and comprehensive data will form the foundation upon which effective strategies can be built, but implementing these strategies requires a detailed roadmap. Chapter 9 presents the [2]Implementation Framework, outlining the steps necessary to address the Harney Basin's water challenges.

Implementation Framework

This Implementation Framework is derived from a compilation of critical issues, strategies that address these issues, desired outcomes for each strategy, recommended actions, budget and funding opportunities, potential responsible parties, timing of implementation, status of each strategy (e.g., ongoing, completed, not started), performance metrics (how progress and success will be measured), and monitoring metrics (ways in which performance metrics can be measured).

The development of this Implementation Framework has guided the CBWP Collaborative in determining its proposed approach for implementing its strategies. All information in the framework is for consideration by the Collaborative and its partners and will be regularly updated. *See Appendix E for the Implementation Framework.*

An Approach for Implementation of Strategies

Given the number and breadth of proposed strategies, it is important to develop a general timeline for implementation. The designation of near-term, mid-term, and long-term is a relative timeframe for managing surface water resources more effectively. Evaluating the cost-effectiveness or cost-benefit of these strategies is challenging; however, this was considered during the development of this approach. Further evaluation of implementation costs will be necessary once the Integrated Water Resources Plan is approved by the Commission.

Near-Term Strategies

In the near-term, the strategies that will make the most difference will be those strategies already initiated or have the possibility of being initiated in the next 3 years. While these strategies are developed and being implemented, other strategies will require attention over the next few years. Table 9 lists the near-term strategies to address the surface water issues identified by the CBWP Collaborative.

[2] As of November 11, 2024 the Surface Water Implementation Framework is still being drafted by the CBWP Collaborative.

Table 9. Near-Term Strategies for Addressing Harney Basin Surface Water Issues

Strategy	Status
Prioritize enforcement to diminish and ultimately stop illegal water use	Initial meetings sponsored by Harney County Court. (though deemed inadequate by some Collaborative members).
Implement riparian restoration and management actions in priority areas and early opportunity areas throughout the basin.	Ongoing
Continue investigations of sediment sources to Malheur Lake.	Work funded by Harney Basin Wetlands Collab
Continue investigations of water quantity and flow influences on Malheur Lake conditions.	Ongoing
Adequately maintain irrigation ditches.	Funding provided for Harney SWCD to provide the opportunity to conduct work
Conduct a comprehensive assessment of riparian conditions of the streams associated with the Harney Basin.	Contract work started through the Harney Basin

	Wetlands Collaborative
Identify and prioritize riparian habitat conditions for restoration or management to improve ecosystem functions.	Contracted work as part of the Harney Basin Wetlands Collaborative
Identify potential opportunities for beaver reintroduction.	Contracted with Dr. Emily Fairfax to identify potential reintroduction areas.
Expand the Open Range Consulting (ORC) mapping off Refuge to allow for a fuller understanding of on-the-ground conditions.	Funded through Harney Basin Wetlands Collaborative
Conduct an evaluation on the local-scale effects on spring and river baseflow that are near concentrated groundwater withdrawal areas.	Not Started
Inventory irrigation and other infrastructure that affects distribution of water. Use that inventory to evaluate distribution and efficiencies that consider irrigation water, bird habitat, and aquatic life.	Not Started
Develop a communications and information program to inform irrigators about surface water conditions (including water availability and current priority date for regulation).	OWRD website provides information, additional effort appears necessary
Increase the efficiency and accuracy of stream flow measurement in the basin for management of water use.	Not Started
Measure the quantity of water being diverted out-of-stream at primary diversions, report to OWRD, and make publicly available.	Not Started

Identify streamflow restoration needs and develop a program to address the needs.	Not started
Achieve more complete streamflow gaging in the Harney Basin.	Not started
Establish appropriate volitional fish passage throughout the basin, recognizing that the prevention of expansion of common carp is an important consideration.	Not started
Install screens to encourage healthy populations of native fishes.	Not Started

In the near term, it is essential to prioritize a range of strategies aimed at addressing both instream and out-of-stream surface water issues in the Harney Basin. Strengthening enforcement measures to curtail illegal water use will help reduce overallocation and improve the availability of water for lawful users. Implementing riparian restoration and management actions in priority and early opportunity areas throughout the basin will enhance ecosystem functions and biodiversity. Ongoing investigations into sediment sources and the impacts of water quantity and flow on Malheur Lake remain critical for developing effective mitigation strategies. Proper maintenance of irrigation ditches is essential to ensure efficient water distribution and reduce water loss. A comprehensive assessment of riparian conditions across the basin will establish a baseline for monitoring changes and identifying high-priority areas for restoration. Riparian habitat restoration efforts will also improve water quality, provide critical habitat for fish and wildlife, and enhance flood management. Beaver reintroduction is another promising strategy for supporting ecosystem restoration and natural water storage.

Additionally, evaluating the local-scale effects of groundwater withdrawal on spring and river baseflows will inform adaptive management decisions, while inventorying irrigation infrastructure will highlight inefficiencies and areas for improvement. Expanding Open Range Consulting (ORC) mapping off the Refuge will offer valuable data for managing surface water conditions more effectively. Developing a communications program for irrigators will foster compliance and promote efficient water use, and efforts to increase the efficiency and accuracy of streamflow measurements will be vital for the overall management of water resources. Monitoring and reporting water diverted from primary diversions will support transparency and improve management. Finally, identifying streamflow restoration needs, establishing appropriate fish passage, and installing screens to protect native fish populations are key steps toward healthier aquatic ecosystems in the basin.

Mid-Term Strategies

In the next decade (years 4-10) there will need to be significant progress on the strategies that result in improved management of surface water resources. As the early efforts take place there will be a better understanding of the effects of voluntary and regulatory approaches. Table 10 lists the mid-term strategies for addressing Harney Basin surface water issues.

Each of the mid-term strategies will require the preparation of a specific plan for development and implementation. Implementation of these mid-term strategies will depend on the record of effectiveness of the near-term strategies and the successes learned from their implementation or issues developed when trying to implement them. Some mid-term strategies may become more important as conditions change either in Oregon Water Law, economic drivers, effectiveness of near-term strategies, climate change, regulatory action or other events affecting the use of groundwater.

Table 10. Mid-Term Strategies for Addressing Harney Basin Surface Water Issues

Strategy	Status
In the lower Silvies, explore feasibility of installing stream gages or other structure to assist with accurate gross division of water.	Not Started
Take appropriate actions to improve factors affecting degraded water quality.	Not Started
Reintroduce beavers and/or construct beaver dam analogs to the watershed where habitat exists and landowners and public land managers are willing.	Not Started
Identify stream restoration actions that reintroduce meanders and floodplain reconnection where appropriate and feasible.	Not Started
Install appropriate measuring devices to understand how much water is needed to irrigate specific wet meadows and associated seasonal and semi-permanent wetlands.	Wet Meadow Partners have started this process

In the mid-term, it is critical to implement strategies that support sustainable water management and ecosystem restoration in the Harney Basin. Installing stream gages or other structures in the lower Silvies will provide accurate water measurement, ensuring fair and efficient water distribution. Improving the efficiency and accuracy of streamflow measurement throughout the basin will optimize water use and support effective monitoring. Measuring the quantity of water diverted at primary diversions and making this data publicly available will enhance transparency, promote accountability, and inform stakeholders. Identifying streamflow restoration needs and developing targeted programs will help improve habitat conditions for aquatic species and overall watershed health.

Achieving comprehensive streamflow gaging across the Harney Basin will further support informed water management decisions. Establishing appropriate volitional fish passage will enhance native fish populations and control the spread of invasive species like common carp. Installing fish screens at diversions will protect native fish and contribute to healthier aquatic ecosystems. Addressing factors contributing to degraded water quality will benefit both human communities and ecological systems, improving overall basin health. Reintroducing beavers and constructing beaver dam analogs in areas where habitat exists and where landowners are willing will promote natural water storage, reduce erosion, and improve habitat conditions.

In addition, restoring streams by reintroducing meanders and reconnecting floodplains will enhance water flow, improve aquatic habitats, and reduce flood risks. Installing stream measurement devices in specific wet meadows and wetlands will ensure efficient water use, support wetland ecosystems, and enhance the overall functionality of the basin's water system.

Long-term strategies

Over the long-term (10 years out and beyond) there are strategies that will either take longer to develop support for or need more deliberation. Table 11 lists the strategies and their status.

Table 11. Long-Term Strategies for Addressing Harney Basin Surface Water Issues

Strategy	Status
Target conifer (ponderosa pine, mixed conifer, and juniper) reduction in snow accumulation (higher elevation) areas of the Silver Creek, Silvies, Malheur-Harney Lakes, and Donner und Blitzen Sub-basins receiving over 17.7 inches of annual precipitation to decrease losses associated with evapotranspiration and promote snow distribution patterns that contribute to improved capture, storage, and safe (slow) release of water in the Basin.	Started by the Harney Forest Collaborative
Provide input to federal land management agencies to include and prioritize the location and level of conifer reduction treatments designed to decrease water losses associated with evapotranspiration and promote snow distribution patterns that contribute to improved capture, storage, and safe (slow) release of water and maintenance of wildlife habitat in coordination with ODFW in the Basin.	Started
Manage surface water resources during climate change/drought events in a way that helps to meet the short- and long-term needs of the Harney basin's people, ecosystems, and economy.	Not Started

Over the long term, conifer reduction in key areas will enhance snow accumulation, improve water availability, and reduce evapotranspiration losses. Providing input to federal land management agencies will ensure conifer reduction efforts are targeted and effective. Managing surface water resources during drought events will develop adaptive strategies to ensure resilience and support community and ecosystem needs. Developing a comprehensive approach to address these long-term strategies will require collaboration with various stakeholders and continuous monitoring to adjust actions based on evolving conditions and new information.

Considerations to Implementation

Ensuring surface water availability for a balanced range of uses is crucial. Given the basin's surface water overallocation, the challenge is to figure out ways to support the most vulnerable uses, such as ecosystem support, while also providing for abundant uses, primarily agriculture. This is complicated by the economic significance of flood irrigation. Key considerations include determining essential community needs, identifying actions with the greatest near-term and mid-term impact, and ensuring long-term balance. The broad goals for the Surface Water Portion of the Integrated Water Resources Plan are to manage surface water resources sustainably, meet instream and out of stream needs, identify strategies that can best achieve those goals, and develop an implementation framework and system that results in a balanced set of strategies actually being implemented.

Summary

The Implementation Framework outlined in this chapter is a dynamic tool designed to guide the Collaborative's decision making. By detailing specific actions, timelines, and responsible parties, this framework provides a pathway for addressing both immediate needs and long-term challenges. The Collaborative's commitment to adaptive management ensures that as new data emerges and conditions evolve, strategies can be refined to stay aligned with the basin's ecological and community goals. With this framework in place, the Harney Basin is better equipped to move from planning to action, fostering a balanced and resilient water future that serves both human and environmental needs.

Chapter 10: Adaptive Management (Step 5)

As the Harney Basin prepares to implement its Surface Water Management Plan, it is essential to recognize that achieving sustainable water management is not a static process. The complexities of water resources require a dynamic approach that can adapt to changing conditions, new information, and evolving priorities. This need for flexibility brings us to the concept of adaptive management. Chapter 10 will delve into adaptive management as a central component of the plan, emphasizing the importance of continuous monitoring, learning, and adjusting to ensure that strategies remain effective in the face of ongoing environmental and socio-economic shifts.

Adaptive management is the process of learning while doing. It is dependent on monitoring outcomes of interventions (implemented strategies) and is based on a planning process that produces strategies that have expected outcomes. As specific strategies are implemented the expected outcome should be identified and the timeframe to accomplish those outcomes should be identified.

Central to any adaptive management program is monitoring the effects of implemented actions (strategies). Only by monitoring and evaluating the outcomes of implemented actions can judgements be made about progress towards accomplishment of goals. Monitoring demonstrates progress or lack thereof for achieving critical milestones and allows for strategies to be adjusted for maximum efficacy. This process requires: 1) a commitment to identifying the expected outcomes in some measurable manner and the timeframe the expected outcome will likely respond, 2: regular monitoring of the indicator of the expected outcome, 3) reporting on the monitoring results, 4) Evaluation of the effectiveness given the expected timeframe for response, and 5) a commitment to adjust strategies based on feedback from monitoring and evaluation.

The adaptive management cycle (Figure 28) involves applying interventions, monitoring outcomes, and adjusting tactics as outcomes indicate is necessary. Strategies to address the elements of the adaptive cycle have been identified by the Collaborative.

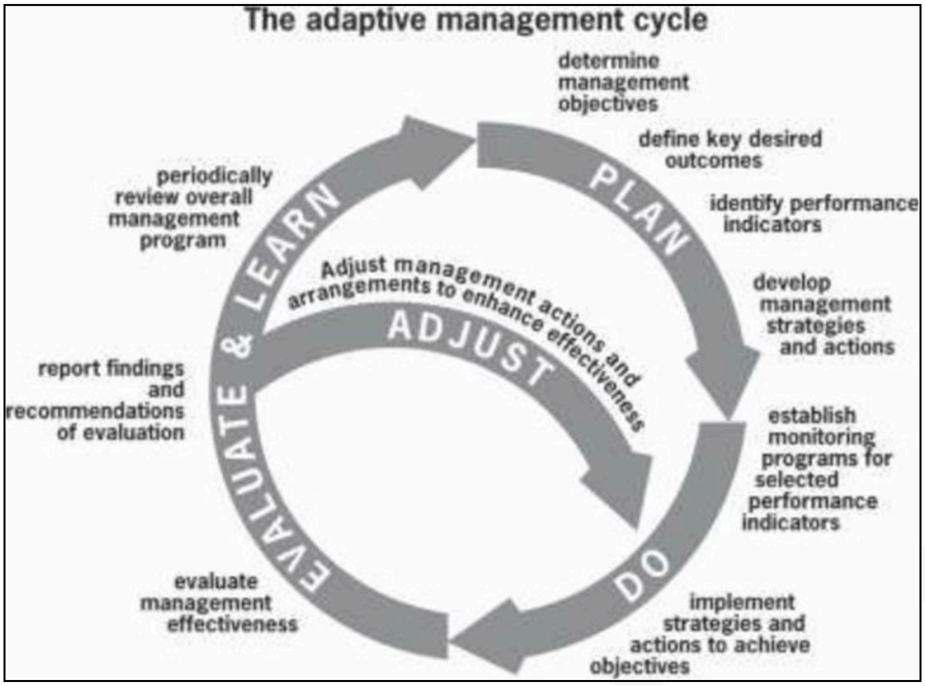

Figure 29. The Adaptive Management Cycle (Gleeson et al. (2012)

The management strategies for surface water are adaptive approaches developed over time to respond to variable runoff conditions. Ongoing efforts to better understand the relationship between runoff conditions, forage production, and bird use is designed to provide information for adaptive management under changing climate conditions. Management strategies that involve better communication and response to water management also allow adaptive response to changing conditions.Building a better understanding of the hydro-socio-ecological system of the Harney Basin will identify the multiple values, management effects, and impacts to aquatic ecosystems, and human communities. A hypothetical interaction of the Harney Basin hydro-socio-ecological system is illustrated in Figure 28. Gleeson et al. (2012) highlights that "adaptive management to changing conditions (e.g., population growth, cultural or climate change, better theory or understanding, new measurements) allows for more resilient long-term management and potentially provides a bridge within and across generations for addressing the longer-term issues of groundwater sustainability"

A significant number of the strategies identified by the Collaborative address the consideration of changing conditions and preparing to address them as they occur. As these strategies are implemented, they can lead to changes that affect tactical approaches to managing differences in available surface water.

Summary

Adaptive management provides the Harney Basin Collaborative with a framework to respond proactively to changes in the region's hydrological and ecological conditions. By incorporating regular monitoring, outcome evaluation, and responsive adjustments, the Collaborative can continuously refine its strategies to better meet the needs of the basin's ecosystems and communities. This iterative process not only enhances the resilience of water management practices but also ensures that stakeholders remain engaged and informed. As the Collaborative moves forward, adaptive management will serve as a guiding principle, facilitating long-term sustainability and building capacity to tackle future challenges with agility and insight.

Chapter 11: Conclusions

The Harney CBWP Collaborative's Surface Water Plan offers a detailed and adaptive approach to tackle the critical challenges in the Harney Basin. This plan highlights the importance of collaborative efforts among various stakeholders, including agricultural and conservation groups, government agencies, and local communities. These collaborations have been vital in identifying issues and formulating strategies.

Addressing historic overallocation, watershed conditions, impacts on instream and out-of-stream uses, and climate change impacts, the plan addresses these issues and provides a clear roadmap for action. The implementation framework categorizes strategies into near-term (initiated or possible to initiate within three years), mid-term (four to ten years), and long-term (beyond ten years). This phased approach ensures systematic progress and adaptation through ongoing monitoring and evaluation.

The plan's primary goal is to achieve a balance between agricultural, ecological, and community water needs. Strategies like riparian restoration, beaver reintroduction, improved irrigation practices, streamflow restoration, and enhanced streamflow measurement support this balance and promote sustainable water use.

Recognizing the significance of data, the plan calls for enhanced stream gaging, water use measurement and reporting, water quality monitoring, and detailed assessments of riparian and wetland conditions. This data is critical for informed decision-making and effective strategy implementation.

By addressing surface water issues comprehensively, the plan aims to benefit both human and ecological communities. Ensuring water availability for flood irrigation supports agricultural livelihoods, while maintaining wetland habitats benefits migratory birds and other wildlife.

In conclusion, the CBWP Collaborative'sSurface Water Plan seeks to address the region's complex challenges. Through collaborative efforts, adaptive management, and a focus on sustainability, the plan aims to ensure a secure and balanced water future for the Harney Basin. Continued community involvement, monitoring, and flexibility in implementation will be key to the plan's success.

Meaning of State Recognition to the CBWP Collaborative

While the pilot program for Place-Based Planning requires interagency review and Oregon Water Resources Commission recognition, there is only limited information on what recognition by OWRC means. For the CBWP Collaborative, implementation and State recognition of the plan go hand in hand. First and foremost, the collaborative is optimistic that support of this plan means the CBWP Collaborative's vision- A sustainably managed supply of quality water for people, the economy, and the environment- is also supported. The Collaborative is hopeful that achieving State recognition of a plan reflects positively on the ability of the plan's components, including strategy implementation, adaptive management, effectiveness monitoring and community engagement, to successfully compete in available funding programs. Through State recognition, the Collaborative would also like the State to recognize that this plan has been broadly discussed and agreed to by the Collaborative, which includes a balanced set of interests. The Collaborative is hopeful that the State will support the components of the plan and will incorporate those into its management of water where suitable. The Collaborative would like to see adequate agency staffing and guidance on how OWRD plans to maintain partnership with the Collaborative, an essential piece of the implementation puzzle.

Chapter 12: References

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Appendices

Appendix A. CBWP Working Agreement

Appendix B. Working Group Reports

B.1. Ecological Working Group

B.1.1 Rivers and Streams Step 2 Report

B.1.2 Rivers and Streams Step 3 Report, Step 3 Appendix

B.1.3 Lakes and Rivers Step 2 Report

B.1.4 Lakes and Rivers Step 3 Report

B.1.5 Wetlands Step 2 Report

B.1.6 Wetlands Step 3 Report

B.2 Surface Water-Groundwater Interaction Working Group

B.2.1 Surface Water-Groundwater Interaction Step 2 Report

B.2.2 Surface Water-Groundwater Interaction Step 3 Report

B.3 Surface Water Management Working Group

B.3.1 Surface Water Management Step 2 Report

B.3.2 Surface Water Management Step 3 Report

B.4 Vegetation Management Working Group

B.4.1 Vegetation Management Step 2 and 3 Report

Appendix C. Critical Surface Water Resource Issues List

C.1 Critical Issue Submission Worksheet

Appendix D. Strategy List

Appendix E. Implementation Framework (Decision Support Tool)