4. Planning Step 4: Develop Integrated Solutions for Meeting Long-Term Water Needs

In this Planning Step, the DBWC will first describe each viable approach and tool for decreasing demand, improving supply reliability, generating shareable water, restoring flows and habitat for fish and wildlife, and improving water quality, then identify all interdependencies between them. In Planning Step 5, the DBWC will attempt to integrate the available approaches and tools into a comprehensive, detailed, and forward-looking plan for Upper Deschutes Basin water management that will be implemented over a defined and realistic timeline.

4.1 Water Conservation

The water conservation approach considered specific tools related to agricultural and municipal demands, including piping district canals and privately owned laterals, on-farm application infrastructure upgrades (e.g., flood-to-sprinkler shifts in irrigation), and municipal conservation initiatives. Water conservation can decrease demand in particular areas, making water available to meet other water needs in the basin and possibly increasing water security for other beneficial uses.

4.1.1 District canal & lateral piping

Under the summary of water management options in the Basin Study, the opportunities for piping irrigation district-owned canals and laterals are described as varying widely between and within districts. Canal piping projects that the Basin Study Working Group (BSWG) viewed as relatively more cost-effective were estimated to result in approximately 120,000 AF of water savings at total cost of $720M, or an estimated average cost of $6,000 per AF.

Central Oregon irrigation districts began working with private and public partners in the 1990s to reduce water conveyance losses by piping sections of their open distribution canals. This is a proven tool that capitalizes on the fact that these canals, which are dug into porous volcanic basalt, can lose into the underlying aquifer up to 50% of the water they convey.

The districts initially used Oregon's Allocation of Conserved Water (ACW) program to restore instream flows to the Middle Deschutes River and key tributaries during the irrigation season, and, to a lesser extent, firm up their water supply reliability for permitted acreage (Figure 1). As described in Section 2.2.2, the intent of the ACW program is to allow water users who conserve water to apply to the Water Resources Commission for approval to dedicate that water to instream use, lease or sell water, or in some circumstances use a portion of that water on additional lands (in the Deschutes Basin, this cannot be done without mitigation). Through the 2010s, for example, COID had utilized the ACW program to permanently restore 68.47 cfs to the Crooked and Deschutes rivers through implementation of canal piping projects.

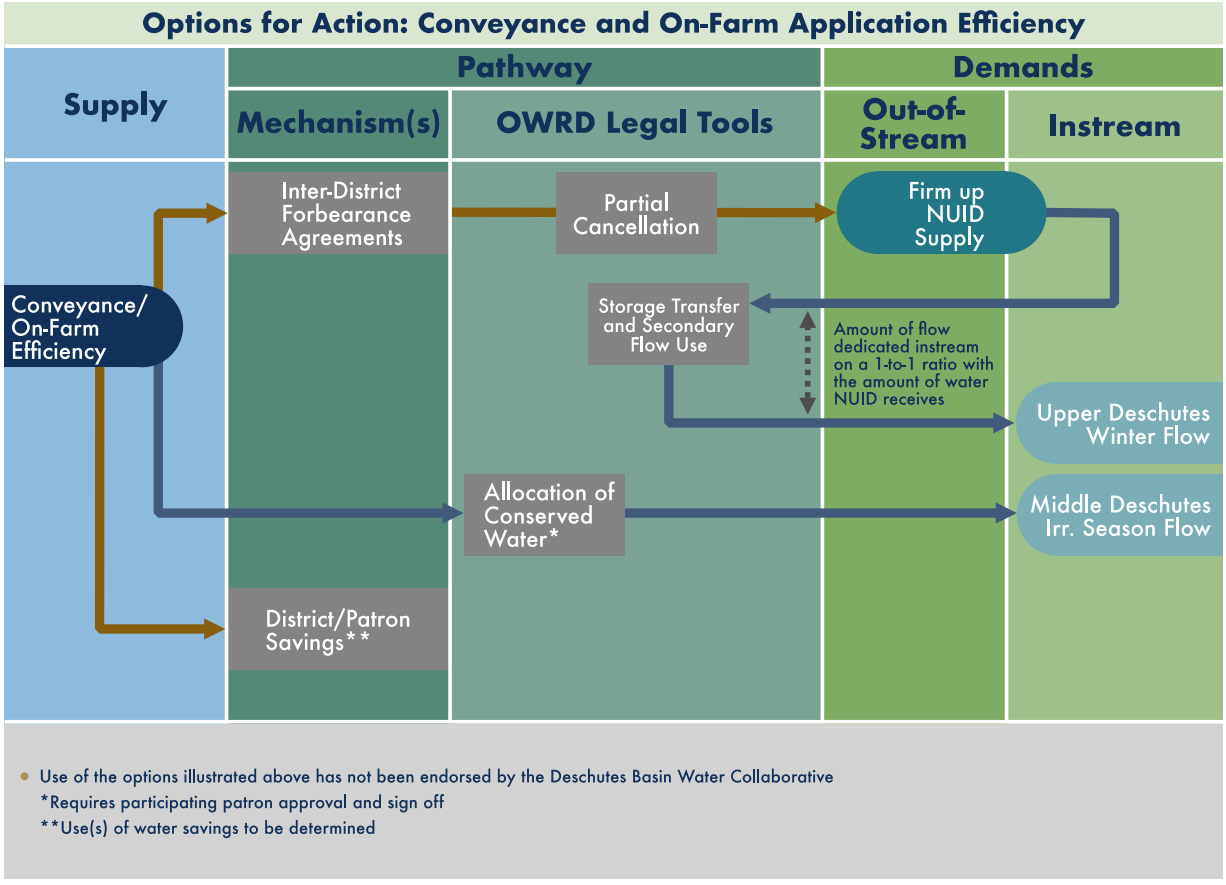
[*Insert photograph of pipe or piping project*]

Since the BSWG completed the Upper Deschutes Basin Study in 2019, the districts have primarily shifted the objective of their canal piping efforts away from restoring flows in the Middle Deschutes during the irrigation season to improving flow in the Upper Deschutes River during the winter to help meet the requirements of the Deschutes River Basin Habitat Conservation Plan (HCP), approved in late-2020 by the USFWS. The HCP is an agreed-upon set

of conservation measures to benefit Oregon spotted frog (OSF) and other aquatic species that enables continued water use through issuance of two Incidental Take Permits (ITP) by NMFS and USFWS. The HCP is intended to deliver predictability to water managers through 2050 by providing certainty on activities covered under the ITP, such as water storage, release, diversion, and return.

OWRD has released water right policy guidance for irrigation district's requesting state funding for canal and lateral piping projects that help satisfy HCP requirements. If awarded state funding, the district completing an irrigation modernization project will reduce its live flow water right certificate by the proposed amount of water conserved by the project, and in turn, through an interdistrict forbearance agreement, NUID will be able to utilize the water conserved for irrigation purposes during the irrigation season. To realize environmental benefit in addition to economic and social benefit, NUID will transfer a portion of its Wickiup Reservoir storage right in an amount equal to the volume of water conserved from the project, and then release the stored water from Wickiup Reservoir under a secondary use right as flow augmentation to protect it from diversion between Wickiup Reservoir and Lake Billy Chinook. This pathway is shown at the top of Figure 1.

Figure 1. Pathway diagram for conveyance (district canal and private lateral) and on-farm application efficiency projects



Implementation Obstacles

While district canal piping projects are moving forward to help meet the requirements of the HCP, there are a few existing obstacles to implementation. First, project budgets have grown due to inflation-related price increases on labor and materials. These increases have made securing sufficient match more difficult as well, resulting in the potential for budget shortfalls. Second, in the urbanized areas within the boundaries of both AID and COID, resistance from local residents has made project implementation more challenging. Finally, specific to LPID, NRCS must approve a new bridge over the Crooked River to carry the planned piping. The DBBC anticipates being able to address each of these obstacles as it moves towards project completion.

Issues Flagged for Stakeholder Consideration

Consensus is lacking amongst stakeholders regarding the status of conveyance (or carry) water allocated to the Upper Deschutes irrigation districts under the 1934 Duffy Decree. Some stakeholders assert that historical conveyance water should no longer remain part of the district's water rights once saved through piping and instead become part of a common pool of water managed to meet other basin water needs (e.g., through a Deschutes Water Bank). However, conveyance water is currently part of district water right certificates that is being utilized to meet the HCP obligations and will be legally accounted for by OWRD when shared with NUID. OWRD's pathway guidance for state-funded canal and private lateral piping projects describes the mechanisms and legal tools by which this saved water will be made available for NUID and winter flows in the Upper Deschutes.

Central Oregon Cities Organization (COCO) has asked the DBWC to consider the opportunity to put a portion of restored winter water into a water bank to serve as future mitigation credits that address the seasonality of impact issue. COCO asserts that this should be considered given the overall net positive benefits of the DBWC's integrated plan on water availability. Upper Deschutes municipalities intend to provide more information to the DBWC regarding the basis for groundwater mitigation credits being generated from restored winter flow.

4.1.2 Private Lateral Piping

In some circumstances, private laterals are used to convey water from district-owned canals and laterals to patron owned properties. Under the summary of water management options in the Basin Study, it was estimated that approximately 35,000 AF/year could be saved through piping of COID's private laterals at an average cost of $1,000 per AF (with other districts expected to have similar costs).

To date, most of the effort and investment in irrigation infrastructure improvements has been focused on piping COID's main canals and sublaterals, primarily due to the larger volumes of water savings can be generated through single projects and a comparative ease of project implementation. On the other hand, piping privately owned conveyance laterals requires action and/or agreement by private landowners and can require more complicated pathways to putting saved water to other uses.

The most effective private lateral improvement projects involve all landowners on a single district lateral in order to both maximize the amount of water savings generated, as well as enable the district's efficient management and conveyance of the piped water to all participating patrons. When tied into segments of district main canal and laterals that have also already been piped, water managers will gain the control that they need to account for water shared by patrons that were historically served through rotation agreements.

Potential Uses of Water Savings

To help meet HCP requirements, water saved through private lateral piping can be used to increase water supply for NUID, allowing NUID to then use stored water to increase critical winter flows in the Upper Deschutes (as is primarily being done with savings resulting from district piping projects).

Water savings can also be dedicated through OWRD's ACW program to an instream water right on the Middle Deschutes River from Bend down into Lake Billy Chinook, which would help meet HCP requirements and provide benefits for other species and habitat as well. However, due to the Deschutes Groundwater Mitigation Program rules, these non-consumptive water savings cannot be allocated through the ACW program to another water user as consumptive use without mitigation of the new use. Thus, using water savings for irrigation can only happen as a result of contractual agreements between district and patron to shore up their supply reliability with savings generated from these projects.

Broader Implementation Obstacles

COID has described the challenges of administering and managing the water that patrons might seek to share through private lateral piping projects. More specifically, it has pointed to the challenge of accurately quantifying and delivering water savings to other uses (both the rate at any moment and the overall volume during an irrigation season).

Issues Flagged for Stakeholder Consideration

Oregon Revised Statute 545.287 authorizes irrigation districts to "construct or maintain improvements" for the distribution or delivery of water to any tract of land within a district. Further, district boards "may levy and collect an assessment upon all tracts specially benefited by the improvement." DBBC does not encourage districts to proactively make improvements themselves without landowner approval, instead favoring voluntary, patron-driven initiatives.

4.1.3 On-farm Irrigation Efficiency Projects

On-farm water application infrastructure upgrades include approaches such as converting from flood irrigation to handlines and sprinklers. Referencing data developed by Farmers Conservation Alliance (FCA) in 2017, the Basin Study estimated that approximately 65,000 AF could be saved annually through on-farm infrastructure improvements at an average cost of $9,700/AF. However, it was also estimated that about half this amount of water, 30,000 AF/year, could be saved from the most cost-effective COID and NUID on-farm projects at an average cost of $4,000 per AF.

[*Insert project highlight box*]

Potential Uses of Water Savings

Pilot application efficiency improvement projects are currently being implemented with participating COID patrons through funding from NRCS. The primary focus of these projects is on accounting for the resulting water savings, with little being determined regarding use of these and potential future savings resulting from use of this tool. Nonetheless, like with water conveyance piping projects, water savings from on-farm improvements can potentially be used to increase water supply for NUID, thereby allowing NUID to use stored water to increase critical winter flows in the Upper Deschutes (as is primarily being done with savings resulting from main canal piping projects).

Water savings can also potentially be dedicated through OWRD's ACW program to an instream water right on the Middle Deschutes River from Bend down into Lake Billy Chinook (see Figure 1 above). However, due to the Deschutes Groundwater Mitigation Program rules, these non-consumptive water savings cannot be allocated through the ACW program to a new consumptive water user without mitigation of the new use. Thus, using any project water savings for irrigation can only happen as a result of contractual agreements between district and patron to shore up their supply reliability on existing water righted acres.

Broader Implementation Obstacles

Project sponsors have indicated that the landowners participating in pilot projects are primarily interested in increasing their water supply reliability when improving their on-farm irrigation systems. Thus, potential lack of landowner willingness to share water savings for alternative uses can be an obstacle to their participation in publicly funded projects whereupon the objective is to generate water savings that can be shared to meet other basin water demands. Nonetheless, some patrons have expressed a desire to use less water than currently delivered to them, creating potential opportunities for this water sharing approach.

4.1.4 Water supplier conservation initiatives (NOT YET DEVELOPED)

[FORTHCOMING from GSI/COCO – discussion of enabling conditions, actions, roadblocks, etc.]

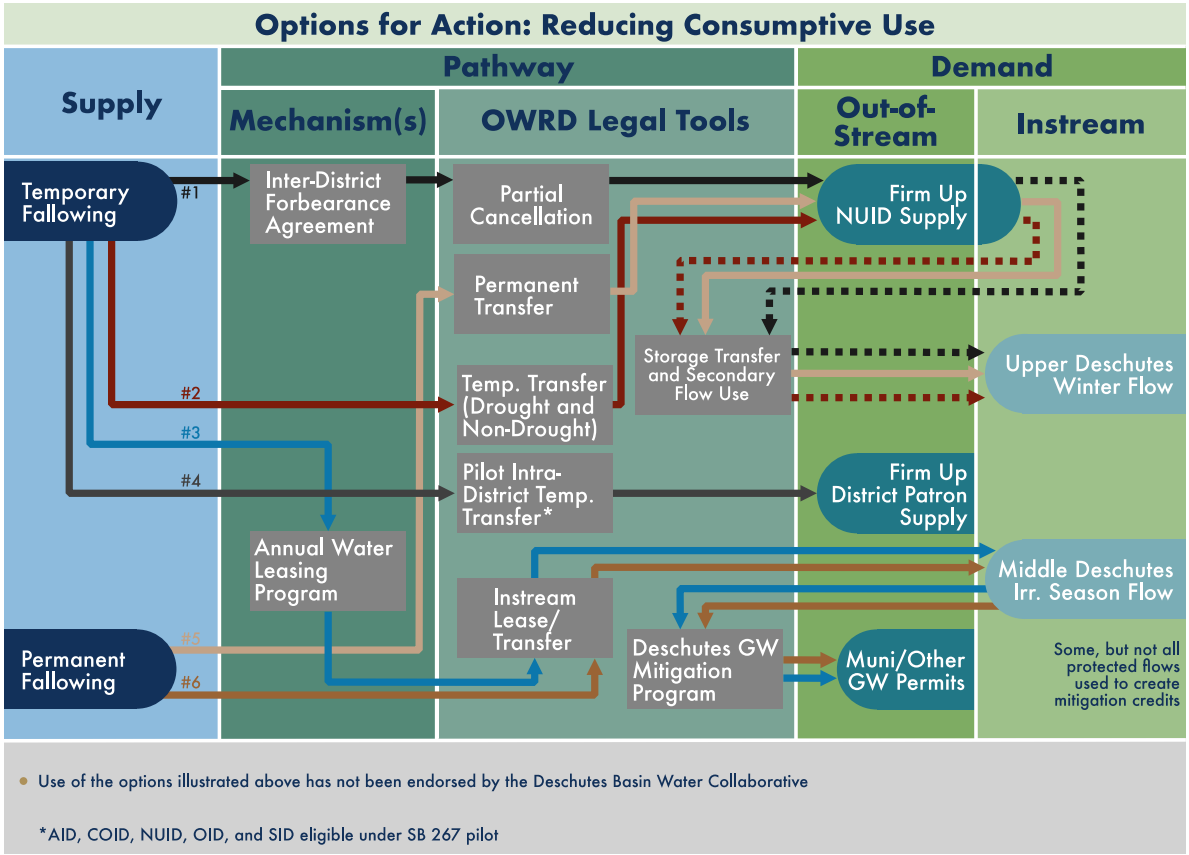
4.2 Market-Based Approaches

Under the summary of water management options in the Basin Study, the market-based option considers the use of price incentives to promote efficient water use and make water supply available to other users and uses. While consensus has not been reached on which specific tools are appropriate for use in the Upper Deschutes, those potentially available to irrigation districts and patrons include the 1) temporary lease of water rights (fallowing acres on an annual, split-season, or multi-year basis), 2) voluntary duty reduction (incentives to reduce water use per acre), and 3) permanent sale of water rights (transferring irrigation water rights off appurtenant acres in perpetuity) (Figure 2).

Assuming district and patron willingness, the Basin Study estimated that market-based approaches provide an opportunity to permanently save up to 160,000 AF of consumptively used water at a total cost of $65M, or an estimated average cost of $400 per AF. (The unit cost of this estimated amount of "economically available" water is based in part on a discount rate being applied to temporary costs to generate a permanent value).

Market-based approaches can effectively decrease consumptive demand in one area, making water available to meet other needs in the basin, such as moving it from one irrigator to another, or keeping it instream to improve flow and create mitigation for a groundwater user's new consumptive use. The districts have raised concerns about their ability to administer and manage their conveyance systems over time if this volume of consumptive use water is shared to meet other demands outside of their boundaries. When occurring where district and private conveyance systems have already been piped, water managers will gain the control that they need to account for water shared by patrons that were historically served through rotation agreements.

Figure 2. Market-based reallocation pathway diagram.



4.2.1 Temporary Water Leasing

For a quarter century, DRC has worked with willing irrigation districts and individual water users to administer an annual water leasing program (AWLP) in the Upper Deschutes (pathway #3 in Figure 2). When water is leased instream through OWRD, it is protected with the same priority date as the original water right – providing significant instream benefits to the Middle

Deschutes River between Bend and Lake Billy Chinook, Tumalo Creek, and other reaches throughout the basin. In addition to the flow benefits, an instream lease satisfies the beneficial use requirements that prevent the water right from being subjected to potential forfeiture if not used for irrigation, benefiting the patron and the district. On average, water rights holders are paid $7 per acre-foot to participate in a lease, but half of the AWLP's instream leasing participants donate their water at no cost.

Eligible district patrons have the following leasing options available to them:

- Five-year lease (with annual option to opt out);
- One-year standard lease; and
- Split-season lease (water used instream part of the season).

Participating districts determine patron eligibility to participate in the AWLP and some districts limit the annual volumes that can be leased instream.

In addition to helping meet the instream leg of the stool, water can be temporarily moved within (pathway #4) irrigation districts to improve irrigation supply reliability of existing patrons on their water-righted acres. AID, COID, NUID, OID and SID all have pilot authority from OWRD to temporarily transfer water from one patron to another within each district during the irrigation season. Such a temporary transfer can be expected to result from one patron compensating another for the use of their water to improve supply reliability in a given irrigation season. Like with an instream lease, the temporary movement of water between water users also requires approval of the relevant irrigation district board.

OWRD also authorizes water to be temporarily moved from the patron of one district to the patron of another district with the approval of both irrigation district boards (pathway #2). OWRD's temporary transfer process can be cumbersome to use for an annual lease of a water right across districts. Thus, the agency has developed a quicker, easier process to use during a drought declaration when patron demand for additional irrigation water might be greatest. Both the drought and non-drought processes formally reallocate water temporarily between patrons from different districts. This is distinct from the informal forbearance of water by the patron of one district for use by the patron of another district as has recently occurred under the pilot water bank developed by COID and DRC to temporarily share water with NUID patrons in conjunction with partial (25%) winter releases from Wickiup Reservoir (see summary below).

4.2.2 Duty Reductions

Despite being highlighted under the Basin Study, OWRD does not currently authorized "partial-duty" leases or transfers. Thus, any effort to share water derived from diverting and applying less to specific parcels over the course of an irrigation season will need to occur through contractual agreements between district and patron or between patrons. This approach can potentially be developed further as part of the nascent Deschutes Water Bank (see Section 4.2.5 below).

4.2.3 Permanent Water Transfers

Compared to temporary leases, the permanent reallocation of water instream (pathway #6 in Figure 2) or within and across irrigation districts (pathway #5 in Figure 2) has previously been

limited to date (primarily due to district's administrative and management concerns). If district support exists, OWRD is authorized to approve the permanent transfer of water from a district's historical point of diversion to a dedicated instream water right, downstream through the Middle Deschutes River, or from one place of use to another.

Earlier in the DRC's history, a memorandum of understanding (MOU) was developed with COID and SID to permanently transfer instream a small portion of the two districts' overall water rights that were appurtenant to acreage that had been converted from agriculture to residential development in Bend and Redmond. COID permanently transferred nearly 38 cfs instream in the Middle Deschutes by selling the water rights appurtenant to 2,166 urbanized acres. In addition to the purchase price paid for the water rights, payment in the form of "exit fees" were made to the two districts to offset the corresponding reduction in future patron assessment fees. The resulting instream water rights were also the basis for the issuance of permanent groundwater mitigation credits for the City of Bend and Avion Water. These transfers occurred through an earlier iteration of Deschutes Water Alliance's Water Bank, administer by the DRC, which faded as concerns rose within the districts about the potential impacts of additional permanent instream transfers on water rights administration and management.

OWRD also authorizes the permanent transfer of water rights either within or across the Upper Deschutes irrigation districts with board(s) approval (pathway #5 in Figure 2). Such transfers involve a change in the point of diversion and place of use, with the original priority date remaining intact for the recipient district/patron. Demand for more senior and reliable water rights likely exists in the Upper Deschutes, particularly from NUID farmers who have seen a decrease in their irrigation water supply under recent drought conditions due to their relatively junior priority date. To realize environmental benefit in addition to economic and social benefit, NUID will transfer its Wickiup Reservoir storage right in an amount equal to the volume of water conserved from the project, and then release the stored water from Wickiup Reservoir during the winter under a secondary use right as flow augmentation to protect it from diversion between Wickiup Reservoir and Lake Billy Chinook.

4.2.4 Groundwater Mitigation Credits

As described in Section 3.2.2, the Deschutes Groundwater Mitigation Program was developed to provide for new groundwater uses while maintaining scenic waterway and instream water right flows in the Deschutes Basin. To date, the most effective and utilized approach for generating mitigation credits has been through the temporary lease or permanent transfer of the consumptive use portion of existing water rights. Under the earlier version of the Deschutes Water Bank, the portions of COID and SID water rights transferred instream from urbanized acres in perpetuity were the basis for the creation of permanent groundwater mitigation credits acquired by the City of Bend and Avion Water Company. As district reluctance to support permanent transfers of water rights has grown, the recent portfolio of groundwater mitigation credits has been primarily derived from leased water and are temporary in nature. Thus, many groundwater permit holders are currently relying on the ongoing generation of temporary credits from instream leasing on the Middle Deschutes for their permits to remain in compliance with the requirements of the Groundwater Mitigation Program. It is important to note that municipalities have prioritized securing a permanent and reliable supply of mitigation credits to support community water needs in perpetuity.

4.2.5 Deschutes Water Bank

As mentioned above, DRC and DBBC are rebuilding the Deschutes Water Bank, initially through the receipt of a Water Marketing Strategy Grant from Reclamation in 2018 and continued as part of a subsequent $1.37M Drought Resiliency Program award from the federal agency in 2022. The first two years of the effort were spent developing and implementing a water market pilot program involving COID, NUID and Wickiup Reservoir/Upper Deschutes instream flow. The pilot program provided a small amount of water to NUID during the irrigation season (pathway #1 in Figure 2) to mitigate drought-caused water supply shortages. Water was made available to NUID by compensating participating COID patrons (vetted and approved for participation by COID based on operational considerations) to forgo irrigation for a season. Winter flow in the Upper Deschutes was also increased through additional releases from Wickiup Reservoir tied to the amount of water shared with NUID. The program was limited to COID patrons served by the Pilot Butte Canal who have used water in at least one of the past two years.

The pilot water sharing program between DRC, COID, and NUID represented a first step to reestablish a water bank in the Deschutes Basin. Under the first two years of the pilot, NUID agreed to release the equivalent of 25% of the water it receives from COID through the Deschutes Water Bank from Wickiup Reservoir in the following winter to increase instream flows on the Upper Deschutes River as required under the HCP. Given the recent drought conditions in the Upper Deschutes Basin, there was general support for NUID's partial release of winter water relative to what they received from COID during the summer. However, some stakeholders advocate that the winter releases should be equivalent to what NUID receives during normal or wet years, particularly if the program is publicly funded in the future. Moving forward, the DBWC will need to resolve the question of the appropriate amount of NUID winter flow release relative to the summer irrigation water it receives. This will be discussed further in Chapter 5.

4.2.6 Implementation Obstacles

The movement of water through use of market-based approaches is primarily limited by fiduciary and water management concerns raised by the Upper Deschutes irrigation districts (and to a lesser extent concerns raised by individual patrons). The following issues underly the reluctance of the districts to embrace these tools despite their significant potential to cost-effectively help meet other demands in the Upper Deschutes:

- the financial implications of patrons permanently exiting a district and no longer paying annual assessments to that district;
- the operational challenge of conveying (or pushing) water down the system and managing water delivery at the lateral level if one or more parcels is dry (e.g., the rotation schedule used to deliver water along a lateral may need to be altered if one or more of the parcels along that lateral are dry);
- the administrative challenge of managing district water right certificate(s) as water is moved either temporarily or permanently to other uses;
- concern about letting water leave the district to meet other basin needs, particularly during water-short years; and

- equity concerns regarding how acquired water is provided to individual patrons and at what cost.

4.2.7 Issues Flagged for Stakeholder Consideration

Other topics for further discussion include the basis for the 25% Wickiup release percentage during pilot transfers and what the appropriate percentage should be for future temporary sharing or permanent transfers. Regarding the Groundwater Mitigation Program, municipalities will work with districts to expand the pool of mitigation credits from permanent transfers of water to instream use, and work to identify and advance other transactions and mechanisms for generating credits beyond what has currently been utilized.

4.3 Enhanced/New Storage

Enhanced and new storage facilities can potentially support improved streamflows by relocating existing storage and/or adding capacity to provide additional flexibility in water operations. Potential strategies for enhancing or developing new storage include the utilization of built infrastructure, underground storage in aquifers, and natural storage, including forest management, floodplains, wetlands, and snowpack.

The existing storage system in the Upper Deschutes Basin (Wickiup, Crane Prairie, and Crescent Lake Reservoirs) are generally filled during the period outside of the irrigation season. To facilitate filling the reservoirs, flow released below the dams is limited during this period and can significantly reduce flows that benefit downstream ecological functions. During the irrigation season, water is released from the reservoirs to meet the needs of water users holding water rights for the use of the stored water. The Upper Deschutes River is used to convey the water to where it is diverted and used. This release of water can result in streamflows that are higher in the reach below the dams and above the irrigation district diversion canals during the irrigation season than flows would have been prior to dam construction. Water rights mechanisms, such as the movement of conserved water and/or water rights to NUID (as a junior water rights district with lands located downstream in the basin) in exchange for storage releases, provide opportunities for managing storage differently to help address instream flow and other Basin Study objectives (Sussman, Grigsby, and Shropshire 2016).

The Deschutes Basin Habitat Conservation Plan (HCP) included several conservation measures which resulted in definitive adjustments to how the districts and Reclamation managed and operated its existing system of reservoirs, with a number of constraints imposed on the districts. These conservations have been implemented and will continue to be implemented over the 30-year timeline of the HCP. More details on the HCP are discussed in Sections 2.1.8 and 3.5.

4.3.1 Relocated storage

In the Upper Deschutes Basin, one potential strategy for enhancing the water storage system using built infrastructure is to relocate a portion of the existing storage in Wickiup Reservoir downstream to potential off-channel storage sites closer to NUID agricultural lands. The purpose of relocating storage downstream is to facilitate increased winter (i.e., non-irrigation season) flows and to facilitate moderated irrigation season flows in the Upper Deschutes River. The focus of this concept will be on NUID as the junior water district with agricultural lands in the downstream portion of the basin.

The Basin Study examined several off-channel storage concepts to evaluate the potential range of storage capacities and how water operations might be improved. The assessments were completed at an early planning level intended to inform stakeholder consideration of storage as a possible long-term component for future water management (Bureau of Reclamation 2018). The Basin Study identified several locations where off-channel storage facilities can potentially provide storage volumes ranging from less than 5,000 to approximately 70,000 AF. Storing some water in the winter at one or more off-channel facilities located farther downstream, rather than storing that particular volume of water at Wickiup Reservoir, can increase winter flows in the Upper Deschutes by an average of roughly 15 to 200 cfs. Storing water at one or more new facilities will involve using the NUID Main Canal to convey water and then pumping to raise water up to the new storage site(s). Stored water will then be released from the new facility for use by NUID during the irrigation season (Bureau of Reclamation 2018). Potential storage sites include the Monner area east of the city of Madras and near the existing Haystack Reservoir, both located in or near NUID service area (Figure 3).

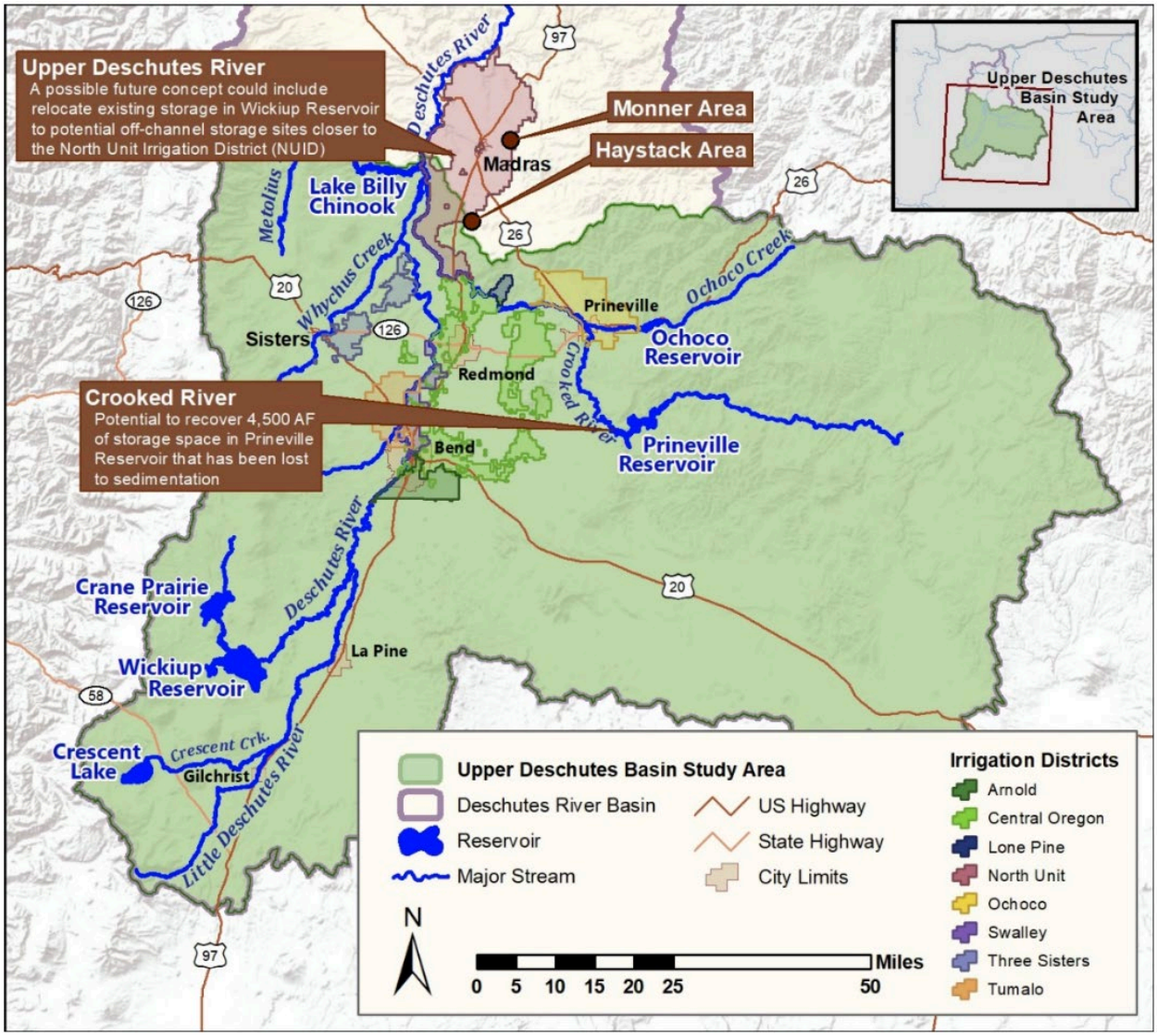
In the Monner area, a potential new off-channel dam can store water, which can be served to NUID agricultural lands. Storage in this potential new reservoir can range from about 20,000 to 70,000 AF and allow for enhanced flexibility in the operation of Wickiup Reservoir to maximize benefit to Oregon spotted frog and other fish and wildlife. Soil survey information collected in the Monner area indicated that favorable seepage conditions are likely. In the Haystack area, off-channel storage can either be located just upstream of the existing Haystack Reservoir or an expansion of the existing Haystack Reservoir. Potential storage volumes can range from less than 5,000 to about 40,000 AF. Based on the performance of the existing Haystack Reservoir, seepage issues are likely manageable at this site, although there may be seepage issues for the coarse-grained soils found in the eastern areas of the Upper Haystack concept. For both potential reservoir sites, water flows through the Upper Deschutes River during the winter non-irrigation season, to a diversion point in Bend, where it is then conveyed through the NUID Main Canal and pumped up to the reservoir (Bureau of Reclamation and Oregon Water Resources Department 2019).

Based on prior studies of other storage concepts, potential construction costs can range from $30 million for a smaller facility, like the 5,000 AF option at Haystack, to more than $300 million for the scale of the larger facilities considered. Ongoing costs after construction include power costs for pumping water into, and in some cases from, new storage facilities. Power costs are dependent on many concept-specific factors but may be $1 million or more annually. Significant additional costs are incurred for other elements of any new storage project, such as: land acquisition; environmental impacts and mitigation; engineering design to address site-specific conditions; existing utilities, road, and other infrastructure; historic properties; cultural resources; permitting; and other issues (Bureau of Reclamation 2018).

In addition to the cost considerations, the ability to release water from Wickiup Reservoir storage during the winter to transport it to a new storage location poses another potential challenge, since water is overappropriated in the Upper Deschutes River for all months of the year. It may be possible that storage water released in the winter to meet OSF requirements in the Upper

Deschutes could potentially be diverted at Bend to fill another storage reservoir, though further discussion is needed to determine whether this would be a viable approach.

Figure 3. Map of potential storage relocation sites in the Upper Deschutes Basin (Bureau of Reclamation and Oregon Water Resources Department 2019). Note that this figure was from the Basin Study and thus includes Prineville Reservoir – this is outside the Phase I Planning Area and does not provide benefits to the Upper Deschutes River.



All information in the Reclamation (2018) assessment was pre-decisional, and no project or plan is recommended or proposed; years of investigation is needed before any particular project can be advanced, and numerous local, state, and Federal permits and approvals are required before any project can be implemented.

4.3.2 Above & below (i.e., aquifer)

Given the high costs and onerous permitting requirements for storage projects, which require the construction of new infrastructure, other strategies may consider utilizing underground storage in

the basin's regional aquifer as a strategy for expanding total storage capacity and addressing groundwater level declines. One such strategy includes managed aquifer recharge, in which storage water from Wickiup Reservoir is released in the winter to be diverted off-channel and allowed to spread out over an area with porous soils to increase infiltration into the aquifer. This strategy can improve local groundwater levels, which improves reliability of exempt groundwater wells and increase discharge from springs/seeps which support streamflow in the lower portion of the planning area.

Managed aquifer recharge was not evaluated as a water management option in the Basin Study. In the Upper Deschutes Basin, aquifer recharge has generally been seen as a non-starter strategy due to the state's permitting requirements for projects of this type. According to OWRD statute on artificial groundwater recharge, adopted in 1961, "the appropriation of water from any source for the purpose of recharging a groundwater reservoir requires a permit. Likewise, any beneficial use of artificially recharged groundwater in any such groundwater reservoir requires a secondary groundwater permit" (OAR 690-350-0120). This is particularly difficult to do in the Upper Deschutes Basin given that surface water (which is used as the source for recharged water) is overappropriated and any permit allowing new uses of groundwater require mitigation under the Groundwater Mitigation Program. Similar to relocated storage, the ability to release water from Wickiup Reservoir storage during the winter to move that water into a recharge basin is also a potential challenge. It may be possible that storage water released in the winter to meet OSF requirements in the Upper Deschutes could potentially be diverted at Bend to fill another storage reservoir, though further discussion is needed to determine whether this would be a viable approach.

In addition, the interconnectedness of the regional aquifer in the Upper Deschutes Basin poses a challenge within the existing regulatory framework, which focuses on water being recharged and recovered from one confined aquifer. There is no regulatory framework to allow water to be recharged in one location and extracted somewhere else, as is needed given the movement of groundwater throughout the Deschutes Basin. Another key issue is that exempt wells may potentially be the biggest benefactor from increased recharge, which poses the potential administrative challenge of requiring mitigation for exempt well users.

However, the administrative and regulatory challenges described above are based on the concept that recharged water is extracted again for consumptive use (i.e., aquifer storage and recovery (ASR)). A potential new concept in which water is recharged for the purpose of benefitting groundwater levels and connected streamflow, without the intention of extracting it for consumptive use (aquifer recharge (AR)), should be explored further. Aquifer recharge without recovery may potentially be a viable option within OWRD's existing regulatory framework – in theory it potentially only requires one permit for the source water used for recharge. The legal and regulatory implications of such a recharge activity will need to be studied further as part of a feasibility study if this new concept were to be considered as a priority strategy.

4.3.3 Natural storage (forests, floodplains, wetlands, snowpack)

Watershed restoration and forest stewardship are other ways in which storage can be enhanced, often with additional benefits for habitat and water quality. Natural storage refers to the ecological functions served by floodplains, wetlands, forests, and snowpack to help increase a

watershed's capacity to store water. Healthy floodplains and wetland habitats store excess floodwater, which release water slowly, later in the year, and can protect downstream property from flooding (Oregon Water Resources Department 2024). They also filter pollutants and provide valuable habitat for fish and wildlife and are particularly important in the Upper Deschutes Basin for OSF habitat. In the uplands portion of the watershed, healthy, well-managed forests can store and filter water as well as reduce surface runoff and flood risk (USFS 2021). The State of Oregon's Draft 2024 Integrated Water Resources Strategy (IWRS) identified that "watershed restoration is needed at many scales, including uplands and lowlands, to improve degraded habitat, restore resiliency, improve water quality, and capacity for natural storage" (Oregon Water Resources Department 2024). The pathways through which natural storage can be enhanced include watershed restoration, forest stewardship, land acquisition, and land use changes.

Watershed restoration covers a broad category of conservation activities, which include channel restoration and floodplain enhancements, riparian vegetation planting, forest management, fish passage improvements, and decommissioning roads and trails impacting water quality. All of these projects, and others like them, are designed to protect, restore and improve watershed health and function. Of these strategies, floodplain and wetland restoration most directly benefit natural storage capabilities of the Upper Deschutes River. The Upper Deschutes Watershed Council (UDWC) is the lead organization on the implementation of watershed restoration activities in the Upper Deschutes Basin. Examples of wetland/floodplain restoration projects UDWC has completed include restoration of the Big Marsh wetland in 2018-2019, reconnection of the Upper Deschutes River to the Ryan Ranch marsh in 2019, and various riparian enhancement projects on Tumalo Creek, Fall River, and the Deschutes River in Bend (summarized in UDWC map tool). UDWC often partnered with the USFS, ODFW, Trout Unlimited, private landowners, and other entities for these projects, which were mostly funded through Oregon Watershed Enhancement Board (OWEB) grants.

Forest management in the headwaters of the Upper Deschutes Basin can provide benefits for water resources through partnerships between agencies and nonprofits. The Central Oregon Forest Stewardship Foundation (COFSF) has outlined a framework for shared stewardship of forest resources, with the goal of engaging multijurisdictional partners to proactively plan and identify a broader range of conservation concerns (Central Oregon Forest Stewardship Foundation 2021). For example, a State Park manager might work with the Bureau of Land Management (BLM), the Upper Deschutes Watershed Council (UDWC), and the Deschutes Land Trust (DLT) to engage in a project that advances watershed health, reduces hazardous fuels in a high-use recreation area, and increases public safety. It is important to continue to foster collaborations of this kind and identify opportunities where shared stewardship of forest resources can provide benefits to forest health, water storage capacity, and streamflow in the Upper Deschutes River.

4.4 Monitoring

Expanding monitoring efforts to better understand water quantity, water quality, ecological issues, and program effectiveness is a key recommendation of the State's draft 2024 IWRS (Oregon Water Resources Department 2024). Planning groups may need to install measurement devices or include monitoring as part of plan development, or the group may recommend

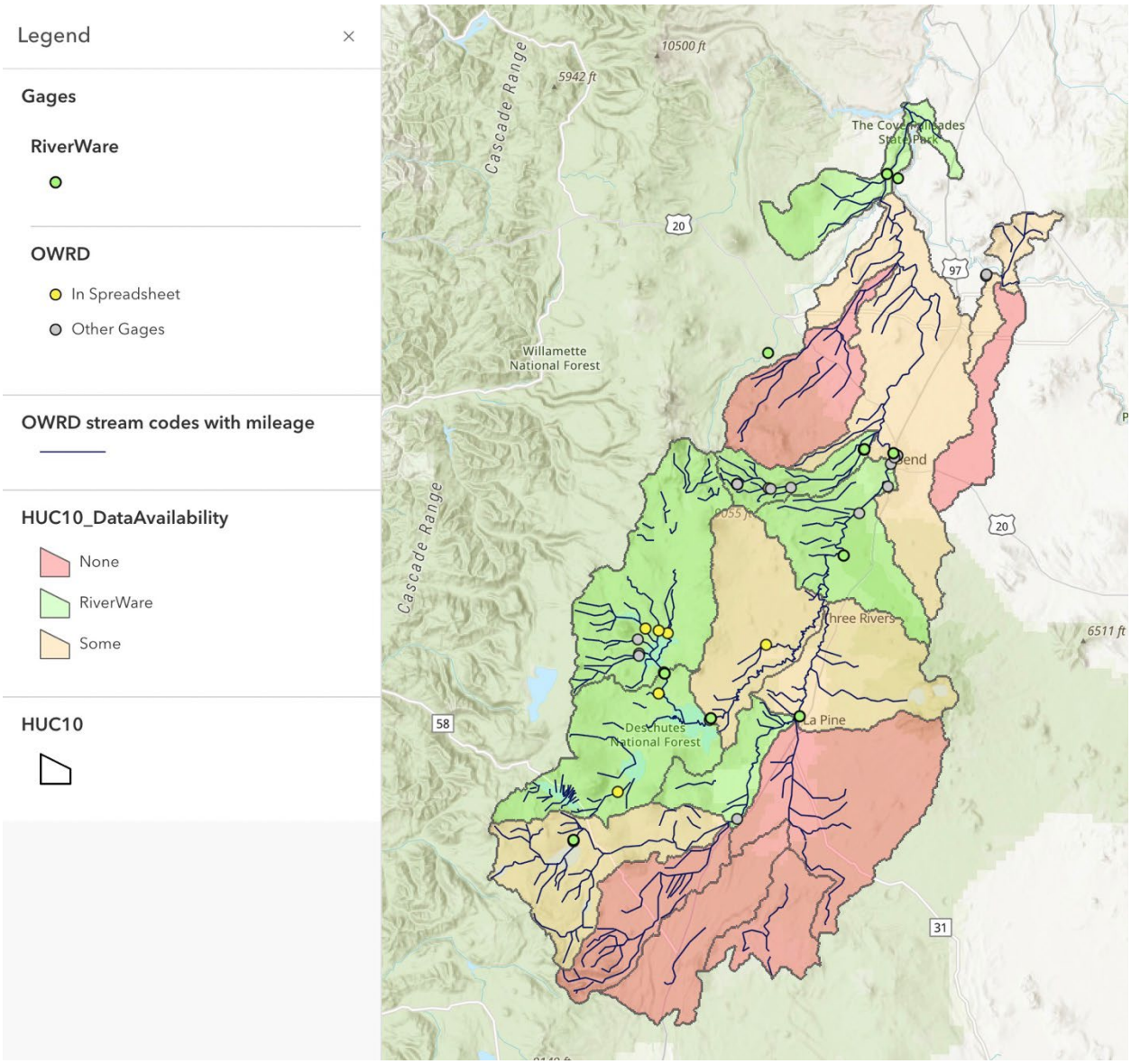
increasing monitoring efforts as a management tool. Place-based planning efforts can help identify additional data needs, which can include monitoring and evaluating streamflow (e.g. adding real-time capabilities), groundwater levels, water use, water quality, habitat conditions, and watershed functions. Per the place-based planning guidelines, this Plan should include a description of any current or proposed monitoring activities occurring in the watershed (Oregon Water Resources Department 2015). The Basin Study also evaluated tools involving adding snow telemetry stations to improve runoff forecasts, expanding gaging of diversions, and improving drought and hydrologic forecasting methods (Bureau of Reclamation and Oregon Water Resources Department 2019).

4.4.1 Measurement (streamflows/water use)

Installing measurement devices for both streamflow and out-of-stream water use allows resource managers in the Basin to track changes in surface water availability to meet in- and out-of-stream water needs in a changing climate (Oregon Water Resources Department 2024). Streamflow is measured by stream gages operated by OWRD and other entities. In reaches where no gages are present, streamflow is modeled using Riverware (described in Section 3.1.1). The coverage of stream gage and Riverware data throughout the Upper Deschutes Basin has been mapped as part of ODFW's spatial tool (Figure 4). In the Deschutes Basin, expansion of stream gages and/or Riverware data points should be prioritized in the HUC10 subwatersheds for which there are no data (in red in Figure 4). Most of the subwatersheds have flow data, with the exception of Dry Canyon, Mayfield Pond-Central Oregon Canal, the Upper Little Deschutes, and Long Prairie/Sellers Creek. All of these subwatersheds, with the exception of Dry Canyon, are listed by ODFW as the lowest priority for fish habitat either by professional opinion or because no salmonid species have historically or are currently present in those reaches. Dry Canyon is listed by ODFW as priority level 3 for redband trout and historical salmonids use.

OWRD's stated objective in the Draft 2024 IWRS is to continue expanding and maintaining its network of stream gages across the state to improve water resource data collection and monitoring (Oregon Water Resources Department 2024). In addition to flow, temperature is also measured at many of the existing OWRD streamflow gages. Measuring stream temperature helps to monitor instream habitat suitability for fish species, as well as to understand the various relationships between processes like flow restoration, groundwater discharge, streambank vegetation restoration, and others on temperature.

Figure 4. Location of stream gages, Riverware data points, and HUC10 streamflow data availability for the Upper Deschutes Basin (from ODFW spatial tool).



Improving data collection of out-of-stream water use, particularly for agricultural use as the primary user of surface water in the basin, has been identified as a priority enabling action to better meet the challenges of piping district and private conveyance systems and enabling market-based tools. Irrigation districts already measure how much water is diverted at the intake of each of their canals, but measurement can be expanded to track "beyond the POD" water use at the patron level. Measurement devices located on private laterals and farms can track water deliveries and application efficiency, respectively, and will allow any water conserved by patron activities to be accounted for water to meet both instream and irrigation uses. This is a key enabling condition to ensure that water marketing activities, which conserve water achieve their intended benefit for the river and for junior irrigation districts.

4.4.2 Plan Effectiveness

To track the effectiveness of this Plan in meeting the needs of instream, agricultural, and municipal uses of water in the Upper Deschutes Basin, specific objectives will need to be defined. These objectives can work backwards from the water supply shortages and needs for each type of demand described in Chapter 3. This will be less straightforward for the instream/ecological demands, as there was no one set of numbers that can be identified upon which objectives can be based (as discussed in Section 3.1.1). However, progress towards meeting HCP flow restoration targets can provide one method of tracking effectiveness (while understanding that HCP targets are not fully representative of ecological needs and restoration beyond those targets will be required as well). Other ecological indicators of plan effectiveness may be ODFW population analyses for salmonids, riparian assessments, or water quality index (WQI) attainments. Agricultural objectives can be tracked by recording the progress made in reducing irrigation demands from historic diversion levels to on-farm crop water requirements through the implementation of conservation activities. Another indicator of progress can be to track the number of miles of canals and laterals which have been successfully piped in each district. Objectives for municipal demands can be in terms of the amount of flow that has been secured to generate a supply of mitigation credits, and progress made towards meeting their demands for mitigation credits. In addition, the effectiveness of ongoing conservation measures can be tracked by evaluating changes in per capita demand over time. Expanded measurement and monitoring of streamflow and water use will help to account for water from agricultural conservation and track its benefits to instream flow as an indicator of the effectiveness of those strategies in restoring flow.

4.4.3 Quality assurance

The implementation of any of the strategies outlined in this Chapter will follow defined protocols to ensure that they achieve the desired benefit and do not have any unintended consequences. For piping or other construction projects, this is in the form of Environmental Assessments or Environmental Impact Statements to ensure no harm is caused to the environment as a result of an implemented piping project. Conservation measures or market-based approaches which make water available for another use will require a legal review to ensure no other water uses or users are harmed as a result of the project. This includes a review by the Confederated Tribes of the Warm Springs for any transactions completed as part of the Annual Water Leasing Program or Water Bank.

4.4.4 Shared information

For any new or expanded data that is produced in an effort to fill the critical data gaps identified by this Plan, there is an opportunity to share that data broadly with the public. The DBWC will explore ways to ensure that data are open and accessible for stakeholders and the general public.

4.5 Watershed & Habitat Restoration

As discussed in Chapter 3, meeting ecological demands for water in the Upper Deschutes Basin often requires the implementation of aquatic habitat restoration activities to complement flow restoration. This includes channel modification to create instream habitat or reconnect floodplains and wetlands, reestablishment of native riparian vegetation, removal of fish passage barriers, and other strategies. Habitat restoration ties in more broadly with watershed restoration, which involves restoring natural hydrologic function of all aspects of a watershed, including

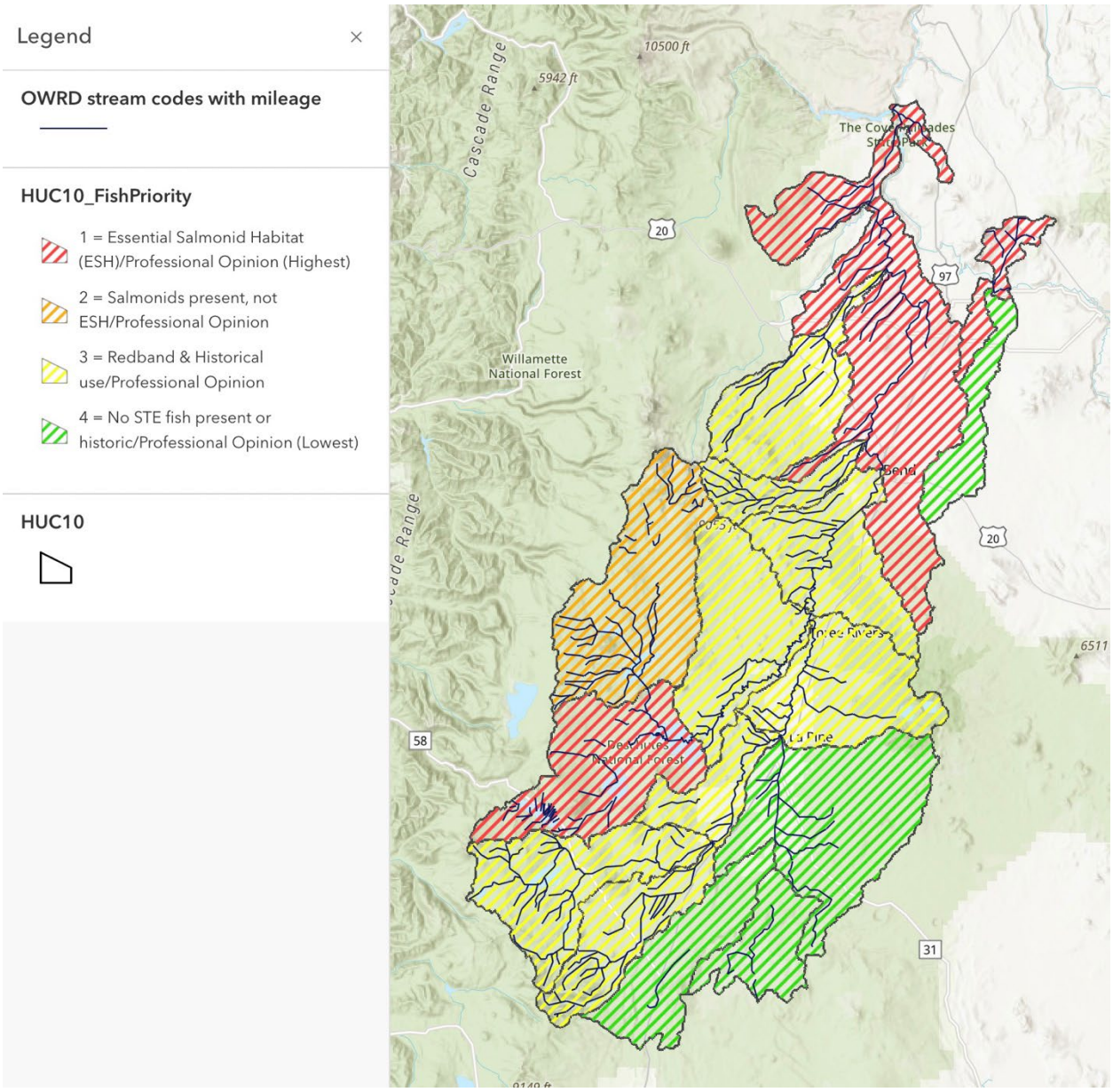
forests, floodplains, wetlands, and mountain meadows in addition to aquatic restoration. As discussed in Section 4.3.3, watershed restoration activities can enhance the natural storage capabilities of the Upper Deschutes Basin to benefit surface and groundwater supplies, ecological health, and flood risk reduction.

4.5.1 Improve/maintain ecological health

As part of this Plan, the DBWC will work with instream/ecological representatives and agencies to identify priority areas where habitat restoration can make the greatest impact on improving or maintaining ecological health. Section 3.5 discussed the relationship between habitat restoration and flow restoration efforts, the latter of which is benefitted by the pathways described in Sections 4.1 and 4.2. At the HUC10 subwatershed scale, restoration activities should be prioritized in the subwatersheds identified by ODFW as being the top priority for salmonid habitat (Figure 5). This includes the Browns Creek-Deschutes River subwatershed in the upper portion of the Basin, which provides critical bull trout habitat, and the McKenzie Canyon-Deschutes River subwatershed in the downstream portion of the Basin, which provides essential habitat for summer steelhead and spring chinook spawning, and redband and bull trout migration. Habitat priority areas for Oregon spotted frog are described in the USFWS' Recovery Implementation Strategy for the OSF Recovery Plan, anticipated for release in summer of 2024.

For the species covered under the Deschutes Basin Habitat Conservation Plan (bull trout, steelhead, and Chinook), the districts already have plans and priorities in place for habitat restoration activities that were agreed upon as conservation measures in the HCP. These are described further in the next section (4.5.2).

Figure 5. Fish habitat priority by HUC10 subwatershed in the Upper Deschutes Basin (from ODFW spatial tool).



4.5.2 Utilize existing plans/efforts (e.g., Oregon Plan, Deschutes Basin HCP)

In response to the listings of salmon species under the federal Endangered Species Act, Oregon lawmakers joined landowners in 1997 to create the Oregon Plan for Salmon and Watersheds. The Oregon Plan seeks to restore salmon runs, improve water quality, and achieve healthy watersheds through the joint efforts of government, landowners, and volunteers. In 1998, Oregonians passed a ballot measure to direct a portion of lottery funding for parks, watersheds, and salmon. This support was made permanent through a ballot measure passed in 2010. During the 2021-2023 biennium, the Oregon Watershed Enhancement Board (OWEB) awarded about $112.2 million for watershed enhancement projects in Oregon, about $8.4 million of which was

invested in the Deschutes Basin (Oregon Watershed Enhancement Board 2023). This funding can continue to be leveraged by partners in the Upper Deschutes Basin to support watershed and habitat restoration priorities identified by this Plan.

The districts and the City of Prineville have already been implementing conservation measures that were agreed upon as part of the Deschutes Basin Habitat Conservation Plan (HCP) in 2020. The conservation measures in the HCP focused on reservoir operations and instream flow restoration (see Section 2.2.2 for full description), which provide benefits to fish species and their instream habitats. The districts have already been implementing these conservation measures and will continue to utilize the pathways described in Sections 4.1 and 4.2 to help achieve compliance with HCP flow targets. In addition, the HCP also included a conservation measure focused on restoring habitat for OSF and other aquatic species in the Upper Deschutes River. Habitat restoration activities are supported by annual contributions from HCP permittees (i.e., the eight districts of the DBBC and the City of Prineville) to the Upper Deschutes Basin Conservation Fund. The fund "shall be used to improve or enhance habitat in the Upper Deschutes Basin for the OSF and other aquatic species, or otherwise address conditions in the Upper Deschutes Basin that affect the conservation and recovery of the OSF in the wild" ("Deschutes River Basin Habitat Conservation Plan" 2020). The HCP prescribed initial contributions of a combined total of $150,000 per year (adjusted for inflation to $174,000) from permittees to the fund.

4.5.3 Fish passage barriers/screening

Removal of fish passage barriers improves migratory salmonid species' ability to access historic spawning and rearing habitat in the rivers and creeks of the Upper Deschutes Basin. Fish passage into the Upper Deschutes Basin was cut off in the 1960s by the construction of the Pelton-Round Butte (PRB) Dam which forms Lake Billy Chinook at the downstream end of the planning area. The Federal Energy Regulatory Committee (FERC) issued a license to the owners of the PRB project, Portland General Electric (PGE) and the Confederated Tribes of the Warm Springs (CTWS), for the operation of the dam in compliance with various conditions under Section 401 of the Clean Water Act Section. One of the conditions is to prepare and implement a Fish Passage Plan to establish self-sustaining harvestable anadromous fish runs of Chinook, steelhead, and sockeye above the project at target self-sustaining population sizes and harvestable runs of each species (Hydropower Reform Coalition and River Management Society 2015). The license requires the licensees to follow a three-phase fish passage program:

- an Experimental Passage Phase;
- an Interim Passage Phase, which shall include investigations of fish passage methods and construction of selective water withdrawal facilities and temporary and permanent downstream passage facilities at Round Butte Dam; and
- a Final Passage Phase, which shall include actions and adaptive management studies for feasibility determination, development and construction of permanent upstream fish passage facilities, contingent on the achievement of successful downstream passage at the Project.

Hundreds of millions of dollars have been invested in the reintroduction of anadromous fish (steelhead and salmon) above Lake Billy Chinook by providing fish passage around the PRB

dam complex (Native Fish Society 2010). For the first time since the 1960s, adult salmon and steelhead returned to the Upper Deschutes basin in late 2011. However, returning fish numbers have been considered by many to be disappointing, highlighting the continued need for habitat restoration, protection, and additional fish passage through removal of upstream barriers.

Structures which divert surface water from the Deschutes River into irrigation canals or municipal intake systems also pose a challenge to fish passage, as fish may unintentionally migrate up those channels if there are no screens in place to prevent them from doing so. All canals and municipal intakes have fish screens installed; however, some may need to be improved or replaced. The City of Bend's municipal intake on Tumalo Creek was recently upgraded with a fish screen as part of the Bridge Creek Pipeline Replacement Project, which was completed in 2016. In order to complete the upgrade, the City was required to apply for two USFS special use permits – one to access Deschutes National Forest lands for construction of the new pipeline and upgraded intake facility, and another to operate the new system (US Forest Service 2013).

4.6 Infrastructure (irrigation)

Efforts to modernize irrigation infrastructure in the Upper Deschutes Basin have already been underway and will continue to be utilized as a strategy to reduce transmission losses and make water available for instream flow or for junior district supply reliability. In addition to the water conservation and district supply benefits described in Sections 4.1.1and 4.1.2, irrigation infrastructure modernization can also come with other safety and energy efficiency benefits.

4.6.1 Energy efficiencies

Ongoing efforts to modernize irrigation conveyance infrastructure in the Upper Deschutes Basin can also provide energy savings in addition to water savings. Instead of relying on electric pumps, updated designs take advantage of gravity to pressurize and move water through the system. A fully piped system provides pressurized water, which allows irrigators currently using sprinkler application systems to remove holding ponds and water pumps. The removal of pond and pumps provides benefits by eliminating the need for maintenance on these items and eliminate pond seepage losses and pumping costs. Farmers and ranchers can also use the pressure to reduce their pump costs from pumping diverted water from their on-farm bulges to their sprinklers, ultimately increasing efficiency and reducing energy expenditure. Based on the current energy usage of water pumps in COID of 33,287,460 kWh and assuming an energy cost of $0.10/kWh, the elimination of pumps alone will provide an estimated cost savings of $3,328,746 annually (Black Rock Consulting and Farmers Conservation Alliance 2017). Additionally, a pressurized District system may help incentivize flood irrigators to upgrade to more efficient on-farm application systems because installation and operation costs will be reduced since ponds and pumps are no longer required.

Irrigation modernization projects can provide further energy efficiency benefits by generating hydropower through the installation of in-pipe turbines or solar panels on open canals. Once canals have been replaced with pipes, pressurization in those pipes can be used to power a turbine and generate renewable electricity. In some cases, farmers and ranchers can use that pressure to install their own small hydroelectric projects, further reducing their energy costs (Farmers Conservation Alliance 2021). Irrigation modernization projects in the Deschutes Basin

have been led by the districts, with investments from NRCS, the Energy Trust of Oregon, and other state and federal sources. The Energy Trust of Oregon "offers key early-stage funding and strategic support to help irrigation districts and farmers update irrigation infrastructure and explore hydroelectric technology to generate clean energy, both along irrigation lines and on farms." They have partnered with Farmers Conservation Alliance to fund irrigation modernization projects in 25 districts across the state of Oregon (Farmers Conservation Alliance 2021). They also offer incentives for the generation of hydropower using pressure in irrigation pipes.

For irrigation modernization projects which seek to line canals rather than pipe them, like the NUID main canal, solar panels can be installed over the open-air canal to generate renewable electricity and reduce evaporative water losses from the canal.

4.6.2 Safety (e.g., seismic, flood risk)

Piped irrigation canals also provide various safety benefits compared to open-air canals. Earthquakes can potentially cause open-air canal banks to collapse, causing flooding and irrigation supply disruption (if during the irrigation season). Depending on the severity and location of seismic activity, a pipeline may have a higher likelihood of surviving without catastrophe. A problem that open-air canals have encountered in the past is that rodents can burrow into canal banks during the non-irrigation season, weakening them and causing potential breaches once water starts flowing through them in the irrigation season. In addition, piping canals will eliminate the risk to humans and wildlife who can have potentially fallen into open-air canals. Once the system has been fully piped and pressurized, the opportunity can exist in certain areas to provide pressurized water for fire hydrants to help mitigate fires.

4.6.3 Regional partnerships

As discussed in Chapter 2, the Deschutes Basin Board of Controls (DBBC) represents a regional partnership between the eight irrigation districts in the Deschutes Basin (including two that are outside the Phase I Planning Area – OID and TSID). The DBBC has developed an integrated piping strategy, which it has been implementing and will continue to implement in collaboration with the DBWC, state and federal agencies, and other stakeholders in the basin.

4.6.4 Long-term maintenance strategies

Maintenance and capital improvement plans for piped systems developed as piping projects are implemented will outline the long-term strategies and protocols for maintaining piped water distribution systems.

4.7 Infrastructure (non-irrigation)

While many of the strategies in this Chapter are focused on irrigation infrastructure (canal and lateral piping), there is other, non-irrigation infrastructure used to collect, deliver, and store water for other uses. This section will primarily focus on municipal infrastructure, which includes water treatment facilities, delivery systems, sewer systems, wastewater treatment and disposal (or reuse) facilities, and stormwater management infrastructure.

4.7.1 Aging water and wastewater systems

Much of the municipal water and wastewater infrastructure in the Upper Deschutes Basin was originally constructed about 100 years ago and has deteriorated over that time. Aging water delivery infrastructure can result in leaks or breaks which can reduce conveyance efficiency of or entirely disrupt the City's water supply. Wastewater collection and treatment facilities were constructed in the 1980s and have required upgrades to keep up with increasing demands from a growing population and changing regulations on treatment. The cities of Bend and Redmond have recognized these needs for upgrading or replacing their aging infrastructure and have implemented projects within the past 20 years to address these needs. The City of La Pine is currently upgrading and expanding its water and sewer infrastructure as well.

The pipelines that provide water supply for the City of Bend were constructed in the 1920s and 1950s and have experienced breaks in some of the older lines. To address this issue, the City of Bend completed its Bridge Creek Pipeline Replacement Project in 2016. The project replaced two existing parallel pipelines that carry water 10 miles from the Bridge Creek source to the City's Water Filtration Facility. It also upgraded the intake facility, which had not been updated since it was built in 1926, to include screens that protect fish passage (as discussed in Section 4.5.3) and control the rate that water is diverted, allowing the City to keep more water in Bridge Creek and Tumalo Creek.

The City of Bend's Water Reclamation Facility (WRF) was constructed in 1981 to collect and treat municipal wastewater and discharge the treated effluent into seepage ponds. Citing projected increases in population, and thus wastewater influent, the City developed a WRF Plan in 2008 to improve efficiencies and expand capacity of the facility (Carollo Engineers 2008). Construction of the WRF Secondary Expansion and Efficiency Project was completed in 2016 [**confirm**], allowing the plant to treat an additional 2 million gallons of wastewater per day, bringing its total treatment capacity to 9 million gallons per day [**confirm**].

For 45 years, the City of Redmond utilized an Effluent and Biosolids Complex and Water Pollution Control Facility to treat, repurpose, and discharge all treated wastewater. The City of Redmond has developed plans to transition the Effluent and Biosolids Complex operation into a more sustainable and environmentally-friendly treatment alternative utilizing ponds and wetlands designed to treat wastewater. Final design of the Redmond Wetlands Complex was completed in March 2024 and those plans are currently under review. Construction on their upgraded wastewater treatment plant is likely to begin in 2025.

The City of La Pine has been expanding its water and sewer infrastructure to meet the needs of a growing population. This project allows the City to connect water and sewer lines to areas within its Urban Growth Boundary (UGB) which were not previously served by the City's water system. However, there is still a need for the City of La Pine to connect areas outside of its UGB on its expanded sewer system to prevent or reduce the contamination of groundwater from septic systems leaking into the high water table in those areas. In 2022, Oregon Senators Wyden and Merkley announced that La Pine will receive $17.7 million in loans and grants from the USDA for municipal water improvements to transition away from septic systems contaminating groundwater for residents and small businesses.

4.7.2 Energy efficiencies

The City of Bend originally considered constructing a hydropower generation facility as part of its Bridge Creek Pipeline Replacement Project. The facility will generate renewable energy for approximately 1,000 homes by taking advantage of the gravity-fed surface water already in the drinking water system, without requiring any additional surface water to be diverted. Bend residents will benefit from the revenues generated by the hydroelectric facility, which will lessen water rate impacts over the long-term. In 2011, the City had begun engineering and applying for permits for the hydroelectric project, but in 2012 decided to suspend that work to allow for an independent review of the facility's potential benefits. The facility can be added at a later date if the review results in a decision to not pursue it further.

4.7.3 Recycled or reclaimed water projects

Per ODEQ's definition, water reuse is "the recycling of treated wastewater derived from domestic and industrial sources for beneficial purposes". Treated wastewater can be reused for irrigation as well as for commercial and residential applications as a way to manage wastewater and conserve potable surface water and groundwater supplies. Under OAR 340-055-0007, "it is the policy of the Environmental Quality Commission to encourage the use of recycled water for domestic, agricultural, industrial, recreational, and other beneficial purposes in a manner which protects public health and the environment of the state." In addition, the 2024 IWRS Recommended Action 12C encourages additional water reuse projects for domestic and industrial wastewater (Oregon Water Resources Department 2024).

Most of the treated effluent from the City of Bend's upgraded Water Reclamation Facility (WRF) is discharged into seepage ponds, but previously some of that was reclaimed and used to irrigate a nearby golf course. The City of Bend plans to restart its previous water reclamation program by delivering recycled water to Juniper Preserve (formerly Pronghorn golf course) in summer 2024. The biosolids produced during the treatment process are beneficially reused with land application to local agricultural sites (Carollo Engineers 2008). Similarly, the City of Redmond's existing complex reuses treated wastewater to produce high-quality Orchard Grass Hay and produces biosolids that are used as fertilizer on agricultural lands.

The expansion of the capacity of municipal wastewater treatment facilities in the Upper Deschutes Basin provides an opportunity to increase the amount of treated wastewater that is reused for beneficial purposes. This includes the potential for reused water to be directly integrated into irrigation canals or pipelines to help meet agricultural demands, although there are some difficulties with this reuse of treated wastewater. OAR 340-055 authorizes the reuse of treated wastewater for various types of agriculture, including:

- any agricultural or horticultural use;
- orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil;
- processed food crops;
- pasture for animals;
- sod;
- firewood, ornamental nursery stock and Christmas trees; and
- commercial timber; and fodder, fiber and seed crops not intended for human ingestion.

The City of Bend's WRF produces Class A treated wastewater, which is the highest level of treatment and thus is allowed to be used for any of the above types of agriculture. Under OAR 340-055, any recycled water use in Oregon requires, at minimum, a National Pollutant Discharge Elimination System (NPDES) permit or a Water Pollution Control Facilities (WPCF) permit and a "Recycled Water Use Plan". In addition to agricultural reuse, treated wastewater can also be recycled for municipal uses, including irrigation of city parks or golf courses.

There are some additional conditions on the reuse of treated wastewater that must be considered. One consideration is that, if the water being reused is originally sourced from mitigated groundwater permits, then the mitigation obligation will increase. Another consideration is that there are standards that any reuse of reclaimed water for other uses cannot harm instream flows for fish. In addition, the direct integration of reclaimed water into district irrigation canals poses many difficult issues. One difficulty is that an NPDES permit is likely required for wastewater recycled effluent to be discharged into an irrigation canal. Other issues include [XXX].

4.7.4 Graywater, rainwater, stormwater

Graywater, rainwater, and stormwater are other potential sources of water which, if managed appropriately, can be used for the beneficial purposes of reducing municipal demand for water or increasing groundwater recharge.

Under Oregon law (ORS 454.605), graywater includes wastewater discharged from showers and bathtubs, bathroom sinks, kitchen sinks and laundry machines. Graywater does not include toilet discharge, garbage wastes (kitchen sinks with garbage disposal units) or wastewater contaminated by soiled diapers. If appropriately collected and handled, graywater can be safely reused for flushing toilets and urinals as well as irrigating certain trees and plants. Reuse of graywater reduces the demand on other sources of water, such as potable water, surface water and groundwater (OAR 340-053-0090). However, graywater is rather unique in the Upper Deschutes Basin – due to the high permeability of its soils, graywater can be treated and discharged back into the ground to replenish the regional aquifer. For this reason, there has not been much conversation around trying to use graywater for other purposes.

Rainwater harvesting is the capture, diversion, and storage of rainwater for a number of different purposes. Although water is publicly owned in Oregon, state law allows residents to collect runoff from rooftops and store it in reservoirs, rain barrels, water tanks, or other containers. For those with less than an acre of property, harvested and stored rainwater can reduce municipal water demand by providing an alternative source for irrigating landscapes, vegetables, or small fruit gardens.

Stormwater is any precipitation that collects on and runs off the land. Stormwater runoff collects and transports pollutants and debris from both urban and rural landscapes as it moves across the land surface. As such, permits are required for municipalities to manage the stormwater drainage within their cities and annual reports are required to keep the permits. The City of Bend Stormwater Utility has two ODEQ permits for discharging stormwater through the storm sewer system – one for discharges to the river, and the other for discharges to groundwater. These permits are required by the Federal Clean Water Act and the Federal Safe Drinking Water Act.

The City's Integrated Stormwater Management Program (ISWMP) describes a framework for the City of Bend's planned activities to minimize pollutants from reaching surface and groundwater sources (City of Bend 2023).

4.7.5 Cloud Seeding

Cloud seeding is a weather modification technique that improves a cloud's ability to produce snow or rain by introducing a salt (silver iodide) into existing clouds to aid in the formation of ice crystals. It has recently been gaining interest as a way to increase precipitation in many arid regions around the world, including Central Oregon. In April 2024, NUID received a $76,000 award from Reclamation through its Applied Science Grants program to study the practicality of using cloud seeding to balance climate variability and water management. The project will "create a model that would produce 3-D clouds, temperature, and wind data which will be used to quantify the number of seedable hours and cloud altitudes over the mountain areas". Cloud seeding can increase the production of precipitation during the winter therefore increasing the snowpack and water supply (U.S. Bureau of Reclamation 2024).

4.7.6 Long-term maintenance strategies

For any strategies that upgrade, expand, or develop new water delivery or wastewater management infrastructure, a maintenance plan will be completed to outline strategies and protocol for long-term maintenance of such infrastructure.

4.8 Instream Flow Protections

To ensure that the implementation of the approaches/tools described in this Chapter will have a lasting benefit to instream/ecological flow, this Plan will identify ways to protect those flows against potential future appropriations of surface water. Existing protections for instream flow are discussed in detail in Section 2.2.2 include instream water rights, Allocation of Conserved Water, State Scenic Waterways flows, and more.

4.8.1 New instream water rights

Through the existing mechanisms established by the Instream Water Rights Act and Allocation of Conserved Water (ACW) statutes, new instream water rights can be obtained to protect flows in the Upper Deschutes Basin. One of the mechanisms created by the Instream Water Rights Act allows for temporary leases, time-limited transfers, or permanent transfers of existing water rights for other uses to be voluntarily converted from out-of-stream use to instream use (OAR 537.348). In addition, there are protested water rights which were applied for by agencies through another of the mechanisms established by the Act and which may get resolved in the future and become new ISWRs. In the Upper Deschutes, one ISWR was protested for the reach of the mainstem Deschutes River from North Canal Dam to Round Butte Reservoir.

The expansion of water marketing pathways described in Section 4.2 can lead to new temporary and permanent instream water rights. To date, most of the water dedicated instream from market-based activities has come through the DRC's Annual Water Leasing Program (AWLP) and has been temporary in nature. That is expected to continue in the near-term, although permanent acquisitions of instream water rights can be pursued further in the future and provide long-term instream flow protection. Water savings can also be dedicated through OWRD's ACW program

to an instream water right on the Middle Deschutes River from Bend down into Lake Billy Chinook.

4.8.2 Streamflow restoration priorities

Section 3.1 describes the overall needs for instream and ecological flow restoration across the Upper Deschutes Basin. On a broad scale, streamflow restoration efforts are generally for the purpose of attempting to return the Deschutes River to a more natural hydrograph – by increasing winter flows in the Upper Deschutes (below Wickiup), which are unnaturally low due to impoundment of water in upstream reservoirs, and by increasing summer flows in the Middle Deschutes (below Bend), which are lowered by surface water diversions during the irrigation season. The pathways outlined in Sections 4.1 and 4.2 dedicate water to these reaches at these times of year, in addition to providing benefits to the other legs of the stool.

4.9 Water Quality Protections

The waterways of the Upper Deschutes Basin which are impaired for certain water quality parameters are described in Chapters 2 and 3 of this Plan. As was discussed in Section 2.2.6, a Total Maximum Daily Load (TMDL) must be developed for waterbodies listed on the 303(d) list as having Category 5 impairment, as several reaches of the Upper Deschutes Basin do. The Upper Deschutes and Little Deschutes subbasins are on ODEQ's medium priority list for TMDL development and are estimated to be submitted for EPA approval in April of 2030. The forthcoming TMDL documents will describe the sources of pollutants which cause water quality impairments and will identify potential solutions for reducing pollutant loading into waterways from point and nonpoint sources. The Water Quality Management Plan (WQMP) is developed and issued as part of the TMDL. The plan provides the framework of management strategies and identifies responsible parties who will implement actions to achieve and maintain water quality standards. Once completed, findings from the TMDL process may influence strategies and priorities around the streamflow issues discussed in this Plan as they pertain to water quality protections.

4.9.1 Pollution reduction strategies

Pollution discharged directly into waterbodies of the United States is regulated through the issuance of National Pollutant Discharge Elimination System (NDPES). Permits which may discharge for land application or percolation to groundwater require Water Pollution Control Facility (WPCF) permits if not in hydraulic connection to surface water. These permits set limits on what can be discharged from a point source (or a group of point sources in the case of general stormwater permits) and requires monitoring and reporting to ensure that the discharge does not negatively impact water quality. Specific permits issued for dischargers in the Upper Deschutes Basin are described in Section 2.2.7 of this Plan. ODEQ regional permitting staff issue and administer NPDES and WPCF permits and will continue to do so.

Under the federal NPDES permit program, permits are issued for a five-year term. However, as of December 2023, 58 percent of the NPDES permits in Oregon have not been renewed on time. These out-of-date permits remain in effect but may not contain conditions that reflect updated standards and water quality conditions. Oregon DEQ is committed to improving the NPDES individual permit backlog through continuous improvement. DEQ will continue to implement permit development process improvement efforts designed to reduce the time to develop and

issue permits that meet state and federal requirements and are protective of water quality. During Federal Fiscal Year 2023 (October 1 through September 30), DEQ successfully accomplished a number of program improvements, including:

- Published significant updates to NPDES Domestic Major and Minor NPDES individual permit templates, and to its Domestic Fact Sheet template
- Published NPDES individual permit issuance plan for FFY 2024
- Published NPDES five-year individual permit issuance plan for 2023-2027
- Added new processes for engagement with stormwater subject matter experts
- Refined process for subject matter experts and deliverables for permit development
- Planned and prepared for state-wide implementation of the "Your DEQ Online" system in 2024 for individual and general WPCF and NPDES permits
- Continued standardized regular training and collaboration for the NPDES individual permit writing team
- Continued to improve quality assurance reviews on all individual NPDES permit modifications, renewals, and initial issuance
- Continued data gap analysis process to ensure future permits have necessary data to prevent delays
- Added four new NPDES permit writers and additional support staff for permitting and program development"

Additional strategies for reducing pollutant discharges into waterways of the Upper Deschutes Basin may be identified as part of the forthcoming TMDL development process.

4.9.2 Nonpoint source projects

Many resource-related implementation and restoration activities have been completed in the Deschutes Basin to address nonpoint sources of pollution into waterways. The Deschutes Basin Water Quality Status and Action Plan identified the strategies being implemented to address nonpoint source pollution from agricultural, forest, urban, and recreational land uses (Oregon Department of Environmental Quality 2011). Improved grazing, cropping and water management practices have been combined with approved best management practices to reduce pollutant loading from agricultural lands to surface waters within the Basin. The forest management practices outlined in the Forest Practices Act actively reduce the impact of logging and other use practices in riparian corridors and similarly sensitive areas. Stormwater management plans that target specific projects and practices to reduce stormwater-based pollutant loads are in place in the cities of Bend, Madras, Prineville, and other municipalities. Recreational facilities (i.e., restrooms and dumping facilities) have been upgraded or are planned for upgrades in several areas of the Upper Deschutes River to reduce their impact.

The strategies described in this Chapter to restore streamflows also provide some benefit to water quality, as increased flows may help to dilute the concentration of pollutants that make their way into streams from nonpoint sources. Additional strategies for reducing nonpoint source pollution into waterways of the Upper Deschutes Basin may be identified as part of the forthcoming TMDL development process.

4.9.3 Source water protection

The Oregon Health Authority (OHA) is the agency that ensures the customers of public water systems receive drinking water that meets the Safe Drinking Water Act regulatory standards. Safe drinking water is not only dependent upon good treatment and distribution systems, but also upon high quality sources of water. ODEQ's role is to implement the Clean Water Act to protect the sources of drinking water across the state. Source water protection is accomplished by effective state public health programs, environmental protection, land use policies, pro-active land stewardship, and by implementation of local drinking water protection efforts by communities and public water suppliers. The City of Bend's primary drinking water supply is protected within the Bend Municipal Watershed, but much of the rest of the drinking water in the Upper Deschutes Basin is sourced from groundwater. ODEQ has regulatory authority and works in partnership with other local and state agencies and tribal governments for groundwater protection.

In South Deschutes County, extensive field research and study has shown that groundwater quality is threatened by continued use of traditional onsite wastewater treatment (i.e., septic) systems. As discussed in Section 2.3.6, USGS has documented increases in nitrate levels in the shallow aquifer underlying the city of La Pine and surrounding areas, which can be attributed to contamination from residential septic systems (USGS 2007). The La Pine Demonstration Project sought to identify ways to protect the La Pine subbasin's water quality, while allowing planned development to occur through a holistic approach using new pollution-reducing onsite wastewater systems. Examples of onsite wastewater systems include a sand filter or pressure distribution system, which use a sand pit or pipe system to treat effluent from a septic tank and distribute it into a drainfield. More recently, in 2022, Oregon Senators Wyden and Merkley announced that La Pine will receive $17.7 million in loans and grants from the USDA for municipal water improvements to transition away from septic systems contaminating groundwater for residents and small businesses.

4.9.4 Toxics (e.g., nutrients reduction)

ODEQ's Pesticide Stewardship Partnerships (PSPs) identify potential concerns and improve water quality affected by pesticide use. The partnerships combine local expertise and water quality sampling results to encourage voluntary changes in pesticide use and management practices for urban, agricultural, and/or commercial forestry land uses. One of the nine PSPs in Oregon is located in the Middle Deschutes Basin near Madras. While this PSP is located downstream of the Phase I Planning Area, it is possible in the future that a similar partnership can be developed to address water quality issues related to pesticide use in the Upper Deschutes Basin as well.

4.10 Education and outreach

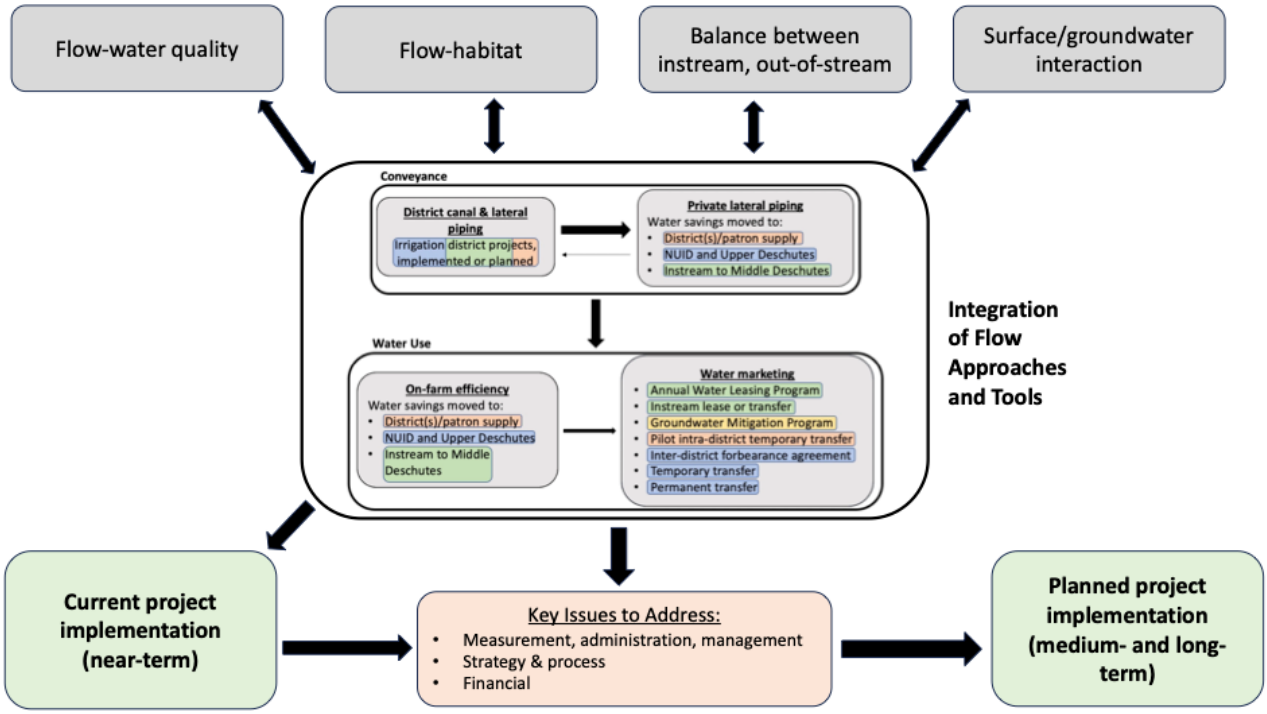
Many of the strategies described in this Chapter, particularly market-based approaches or best management practices for water quality, are voluntary. As such, outreach and education will be needed to ensure that the public and potential implementation partners understand the Basin's water needs and the costs and benefits of the programs that can be implemented to address those needs. The DRC's Raise the Deschutes seminar series is an example of an ongoing program to educate the general public on all things water in the Deschutes Basin. Raise the Deschutes seminars can be one means of informing the public and other stakeholders about the strategies

identified in this Plan to meet water needs. Following the adoption of this Plan, the DBWC will continue to work collaboratively to engage stakeholders and implementation partners in any implementation programs which result from this Plan.

4.11 Integration

As illustrated in Figure 6, the integration of flow restoration approaches/tools is at the heart of the DBWC's work on the Plan. Through the integration of these tools, there emerges a set of key issues to address in order to successfully advance Plan integration and implementation. Project implementation resulting from this integration will both inform and be informed by stakeholder efforts to address key present and future management issues. Issue resolution is needed to maximize the employed strategies and expected outcomes, particularly those related to use of on-farm/private laterals and water marketing strategies and tools that build upon DBBC canal piping efforts. And lastly, the flow restoration approaches/tools at the heart of this Plan will include consideration and recognition of their relationships across and integration with a variety of other basin planning priorities, which include habitat and water quality restoration, meeting both in-stream and out-of-stream needs and recognizing surface water/groundwater interactions.

Figure 6. DBWC integration and implementation flow diagram.



4.11.1 Vision and principles

The overall vision for Plan integration is to prioritize investment portfolios that benefit all legs of the stool. Plan integration will be guided by a set of principles for effectively aligning each of the tools/strategies described in Chapter 4 and workshopped with the DBWC Working Group.

The principles are as follows:

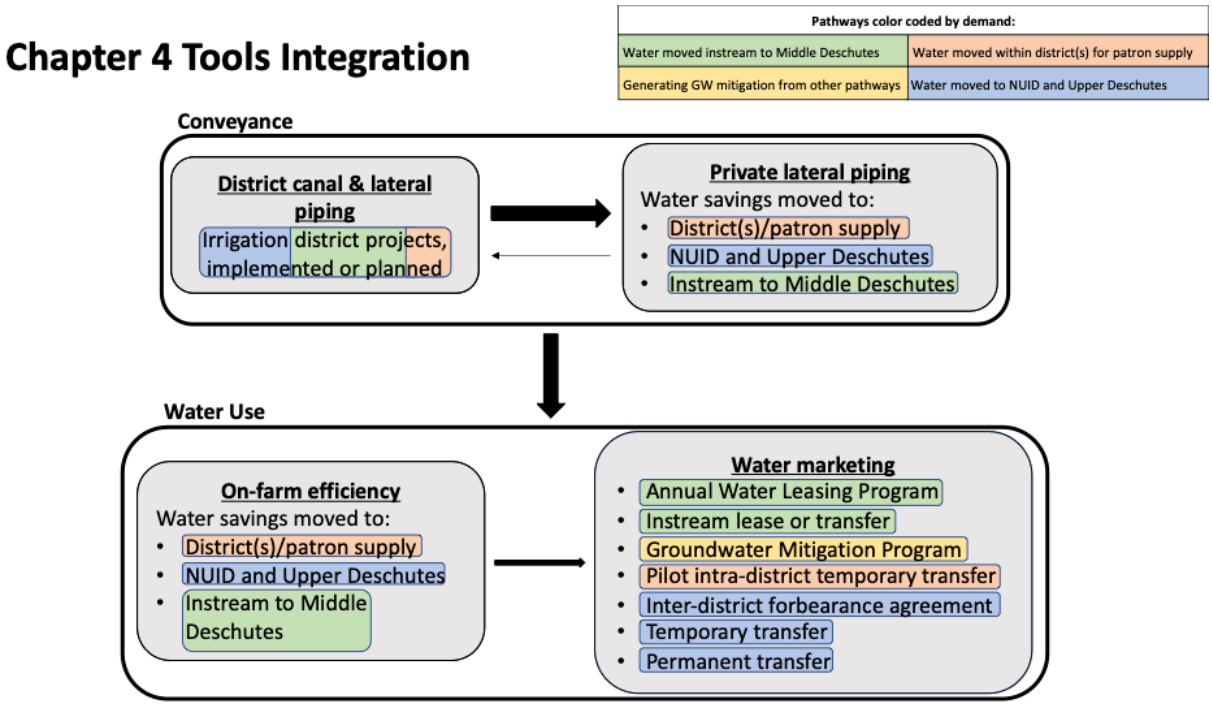
- Aspirational and functional

- Maximizes outcomes
- Balances outcomes between needs
- Cost-effective
- Recognizes complexity and addresses necessary barriers
- Supportive of partners

4.11.2 Integration of tools/strategies

At the heart of the DBWC Plan integration piece, is an effort to determine proper alignment of the various tools/strategies described in Chapter 4 and the associated interdependencies, benefits, challenges, and outstanding issues (Figure 7). This will be considered through case studies that illustrate successful integration of at least two strategies. The goal of tools integration is to find cost-effective solutions for meeting all three legs of the stool which minimize/avoid operational issues and provide a balance of benefits for the partners.

Figure 7. Integration of flow tools and approaches diagram.



Tool integration is evaluated through the lens of forward progress, which seeks to answer the following two questions when prioritizing actions:

1. Are cost-effective timely outcomes resulting from tool integration?
2. Are barriers being addressed to enable integrations?

Case studies: [NEEDS DEVELOPMENT]

1. Smith Rock-King Way
    a. J Lateral and/or G-4 Lateral
    b. On-farm improvements
    c. Water leasing, both full and split-season

2. Others?

Outstanding questions: "Issues flagged for discussion" and "suggestions for potential refinement" from tables

Flow restoration approaches/tools at the heart of this Plan will be considered with a variety of other basin planning priorities, which include habitat and water quality restoration, meeting both in-stream and out-of-stream needs and recognizing surface water/groundwater interactions. Market-based tools should also be integrated with current efforts to pipe the district's canals and laterals (including private laterals), complete with installation of measurement devices, to address and manage the challenges with distributing and accounting for water to meet both instream and irrigation uses.

4.11.3 Balance between instream, out-of-stream needs and geographies

Flow restoration tools must be integrated such that they balance the needs of various instream and out-of-stream uses in the Upper Deschutes Basin. Flow approaches also must be integrated across various reaches within the Upper Deschutes and not be detrimental to planning efforts in areas outside of this Plan's geographic scope (e.g., the Crooked River and Lower Deschutes River Basin). The questions which guide this effort are:

1. Are outcomes being balanced between instream, agricultural, and municipal needs in the planning area?
2. Are outcomes being balanced between reaches (Upper Deschutes; Middle Deschutes; Tumalo Creek) in the planning area?
3. Are outcomes neutral or positive for planning efforts in other areas of the Deschutes Basin?

[MORE FORTHCOMING?]

4.11.4 Surface water-groundwater integration

Surface water and groundwater interactions play an important role in the Upper Deschutes Basin. As such, the implementation of flow restoration tools/approaches must assess and understand potential impacts on and tradeoffs between surface water and groundwater. An example of a relevant data gap is to develop a tool to help understand the impacts of various basin-scale water management scenarios on surface water and groundwater interactions. Surface water-groundwater integration is also useful to evaluate potential groundwater mitigation pathways and to balance surface water restoration with aquifer protection.

[GROUNDWATER PIECE FORTHCOMING]

4.11.5 Flow-habitat integration

It is also important to consider whether flow restoration approaches integrate well with habitat restoration goals in the Upper Deschutes Basin. Funding for both flow and habitat restoration actions can be prioritized concurrently – for example, when restoring channel geomorphology and hydrologic function. Flow-habitat integration is also pivotal to addressing habitat concerns

for the Oregon spotted frog, which cannot be done through flow restoration activities alone (as described previously in Chapter 3).

[MORE FORTHCOMING]

4.11.6 Flow-water quality integration

Flow restoration efforts should also help meet water quality goals in the Upper Deschutes. An example of this is when increasing flows can be used as a strategy for decreasing stream temperature to benefit fish and wildlife or meet TMDL requirements. For example, Tumalo Creek flow restoration efforts can also help improve temperatures there and in the Middle Deschutes River.

[MORE FORTHCOMING]

4.11.7 Other lenses through which flow approaches should be evaluated

In addition to the various evaluation lenses described in the previous sections, the implementation of flow restoration approaches should also be considered through the following lenses and help answer these questions:

- Barriers Lens – are existing barriers to implementation being addressed to enable scaling of actions outcomes?
- Partner Lens - does the Plan set implementation partners up for success?
    - Ex: Does the Plan give irrigation districts the tools it needs to meet its water delivery goals with project and transaction implementation?
    - Ex: Does the Plan articulate clear pathways for cities to ensure future water supplies while also satisfying mitigation requirements?
- Outcomes Lens - does the Plan meet water needs of all three legs of the stool?

4.12 References

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