The Deschutes
PARTNERSHIP

2015-2021 Focused Investment Partnership

Progress Monitoring Plan

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1.0 INTRODUCTION

With the launch of the Oregon Watershed Enhancement Board's Focused Investment Program (the OWEB FIP) in 2015, the Deschutes Partnership embarked on a six-year effort to protect and restore stream habitat, improve stream flow and provide fish passage along 226 miles of rivers and streams throughout the Metolius River, Whychus Creek and Crooked River watersheds. This restoration effort, built on more than a decade of existing partnership history and detailed in *The Deschutes Partnership's Strategic Action Plan for Fish Habitat Restoration in the Upper Deschutes* (Deschutes Partnership, 2015) (SAP), is intended to achieve significant ecological outcomes that will support reintroduction of salmon and steelhead in the Upper Deschutes River subbasin.

While the SAP describes the Deschutes Partnership's proposed monitoring of outputs and outcomes in general, it does not provide specific details about the anticipated theories of change for the restoration programs and does not specify what type of monitoring is most important for tracking progress over time based on these theories of change. This plan provides this additional information by detailing specific theories of change, desired ecological outcomes and the proposed monitoring activities required to assess and measure progress over time. This provides the Deschutes Partnership, funders, collaborators and others with insight into what is being achieved through the six-year FIP investments and, to the extent possible within this timeframe, information to inform adaptive management of the Deschutes Partnership's restoration programs.

Because monitoring resources are limited, this plan represents only the suite of parameters required to efficiently track restoration progress. While many additional types of monitoring at different scales and for different purposes are possible and would add tremendous value (e.g., monitoring to evaluate specific restoration techniques at the project level, research to test hypotheses about fitness of reintroduced species, etc.), this plan focuses only on the core monitoring required to document progress of the FIP-focused investments. Even with this limited scope, the monitoring described in this plan exceeds the capacity of the Deschutes Partnership, making implementation dependent upon continued funding and the continued work of partners who generate the required monitoring data.

This plan replaces prior plans used by the Deschutes Partnership (e.g., the *Whychus Creek Restoration Monitoring Plan* [UDWC 2009]) and aligns with the progress monitoring framework OWEB has developed for FIP partnerships.

2.0 PROGRESS MONITORING FRAMEWORK

When OWEB launched the FIP program in 2015, it also initiated an effort to develop a uniform monitoring approach that would allow each of the six partnerships and OWEB to measure and communicate the ecological outcomes in a clear, consistent fashion. Beginning in 2016, OWEB partnered with the Bonneville Environmental Foundation and the Upper Deschutes Watershed Council to develop a Progress Monitoring Framework to meet this need.

The Progress Monitoring Framework describes a process for identifying key restoration outcomes, assigning monitoring indicators to those outcomes, and documenting the outcomes and indicators identified. This approach is adapted in part from the *Conservation Measures Partnership's Open*

Standards for the Practice of Conservation (CMP 2013) and *the Association of Fish and Wildlife Agencies' report on Measuring the Effectiveness of State Wildlife Grants* (AFWA 2011).

The Deschutes Partnership worked with the BEF-UDWC team to apply the Progress Monitoring Framework to the FIP. The Partnership developed a results chain and mapped the theory of change for how restoration strategies will reduce or eliminate limiting factors and restore the ecological processes interrupted by those limiting factors. The theory of change articulates the hypothesized relationships and underlying assumptions between strategy implementation, resulting intermediate ecological outcomes, and long-term ecological goals (OWEB 2018; Conservation International 2013). Results chain elements include:

- **Restoration strategies**, each a group of related actions that are intended to reduce or eliminate limiting factors to restore critical ecological processes or functions associated with ecological priorities;
- **Implementation outputs** representing the immediate, measurable, on-the-ground results of implementing an action or series of related actions;
- **Limiting factor reduction**, describing how the outputs of restoration actions reduce or eliminate limiting factors; and
- **Intermediate ecological outcomes** representing the specific physical and biological conditions or processes that develop as a direct result of the outputs on a timeframe from several years to decades after implementation of restoration strategies.
- Ecological outcomes cumulatively result in the achievement of an **ecological priority.**

From the ecological outcomes described in the theory of change and results chain, we identified key outputs and outcomes for monitoring. Key outcomes include those that provide information about critical elements of ecosystem response and may also add to understanding and/or reduce uncertainty about the linkages between strategies, outputs, outcomes and long-term ecological goals; outcomes for which monitoring in the short term can provide information about trend; and outcomes for which information from monitoring is likely to be valuable for communicating about restoration and restoration progress to stakeholders, funders, and the public.

For each key outcome we stated the hypothesis for the ecological response to the restoration action, identified monitoring indicators that will provide information about the ecological response, selected a method for collecting data, and, where available, cited a protocol for implementing the specified method. We additionally identified a lead monitoring entity, the type of report used to communicate monitoring results, and the frequency of reporting. We have presented these outcomes, indicators, and associated information in tables for each restoration strategy in Section 3.0, Theory of Change.

The resulting key outcomes and monitoring indicators represent the minimum, essential set of parameters that will 1) apply to each strategy across most projects, 2) collectively describe the desired ecological condition, and 3) allow partners to understand whether the desired ecological outcomes of restoration actions are being realized. Given differing restoration needs and site considerations, not all projects will address all outcomes. Consistently measuring and reporting on these same outcomes and indicators throughout the reintroduction geography will allow restoration practitioners and partners to better understand how conditions for these species are changing at the project, watershed and basin scale.

3.0 THEORY OF CHANGE

The Deschutes Partnership's restoration strategies address key limiting factors in the Metolius River, Whychus Creek and the Crooked River. These limiting factors are described in the *Deschutes Subbasin Plan* (NPCC 2004), *Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment* (Carmichael and Taylor 2010) (*Mid-C Recovery Plan*), and a variety of others (please see SAP for complete discussion). Limiting factors include:

- <u>Degraded riparian communities:</u> Riparian structure, diversity, canopy cover, and function have been lost as a result of land conversion, grazing, development, altered hydrology and road building.

- <u>Degraded floodplain connectivity and function:</u> Floodplain connectivity has been lost through channelization, agricultural practices, road building, and other historic disturbance.

- <u>Degraded channel structure and complexity:</u> Channel complexity has been lost through historic wood removal, channelization, riparian loss and other changes.

- <u>Degraded water quality (temperature):</u> Over-appropriation of water rights has greatly reduced instream flow during the summer months, resulting in high water temperatures and associated water quality degradation.

- <u>Altered hydrologic processes:</u> Watershed changes resulting from grazing, road building, fire, forest management, development, grazing, and other activities have altered the watersheds' ability to capture, store, and slowly release water in a manner that supports natural stream dynamics and ecosystem requirements.

- <u>Altered sediment routing:</u> Sedimentation and excessive erosion resulting from channel modification, grazing, road building, fire, and other land management activities have altered the availability and quality of habitat.

- <u>Impaired fish passage:</u> Diversion dams block up- and downstream migration for resident and anadromous fish. Small dams are present in many locations across all three watersheds, and the Opal Springs dam located on the lower Crooked River blocks volitional passage for 128 miles of the Crooked River watershed.

For each restoration strategy described below, we summarize the strategy and theory of change to describe the mechanisms by which we hypothesize the strategy will reduce or eliminate the limiting factor and restore ecological processes and values per the progress monitoring framework. Anticipated results and ecological outcomes are cross-referenced numerically between results chains, the narrative descriptions below and the monitoring summaries provided in Tables 1 through 5. Results chains are provided in Figures 1 and 2.

Figure 1 includes a results chain that describes the anticipated results and outcomes from the Deschutes Partnership's restoration activities under the FIP as a whole. This results chain is general enough to apply to the Metolius River, Whychus Creek and Crooked River watersheds because the anticipated results from any given restoration strategy are fundamentally similar in each watershed, even if the project-level details are unique. In the case of the McKay Creek Water Rights Switch (Figure 2), we have developed a results chain specific to this project because the project is operating at a watershed scale, the project is unique among all of the streamflow restoration efforts within the Deschutes Partnership, the McKay Creek watershed has unique hydrologic conditions, and the Deschutes Partnership is interested in establishing specific monitoring to evaluate this project over time. While this project is currently the only Deschutes Partnership project that is distinct enough to warrant its own results chain, other projects may be treated in the same way if the need arises and additional results chains can be added over time.

There are two restoration strategies, Land Conservation and Outreach, which have no direct ecological outputs or outcomes but, instead, create specific land conservation, land management and/or social conditions that are prerequisite for the other restoration strategies to be implemented (e.g., prevention of floodplain development, restoration of natural floodplain conditions, recovery of riparian habitat by removing intensive grazing, etc.). We include these strategies here to account for the theory of change but, because these strategies are not expected to directly result in ecological outcomes, we do not include objectives, hypotheses or monitoring indicators for these strategies.

Figure 1. Deschutes Partnership FIP Initiative Results Chain for Whychus Creek, the Metolius River including Lake Creek, and the lower Crooked River including Ochoco Creek

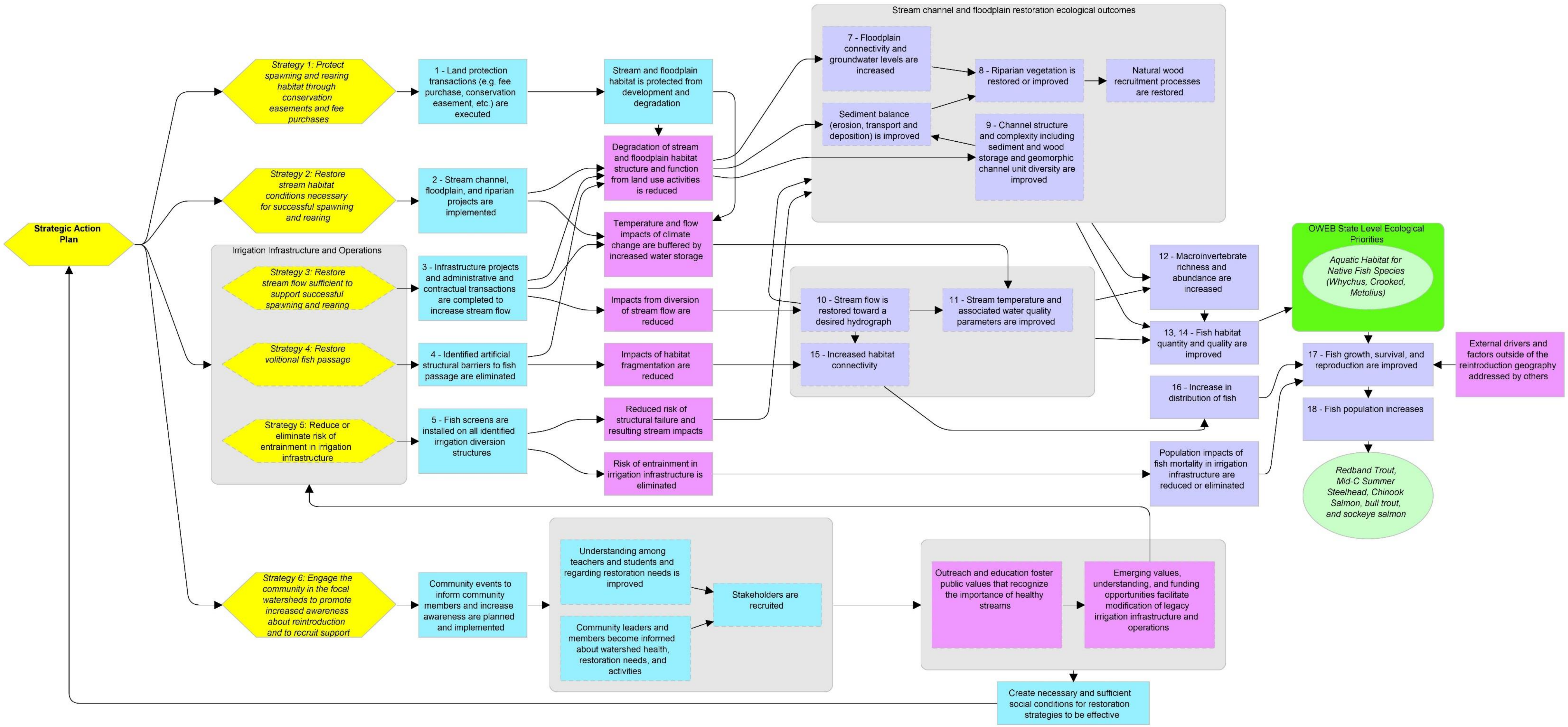
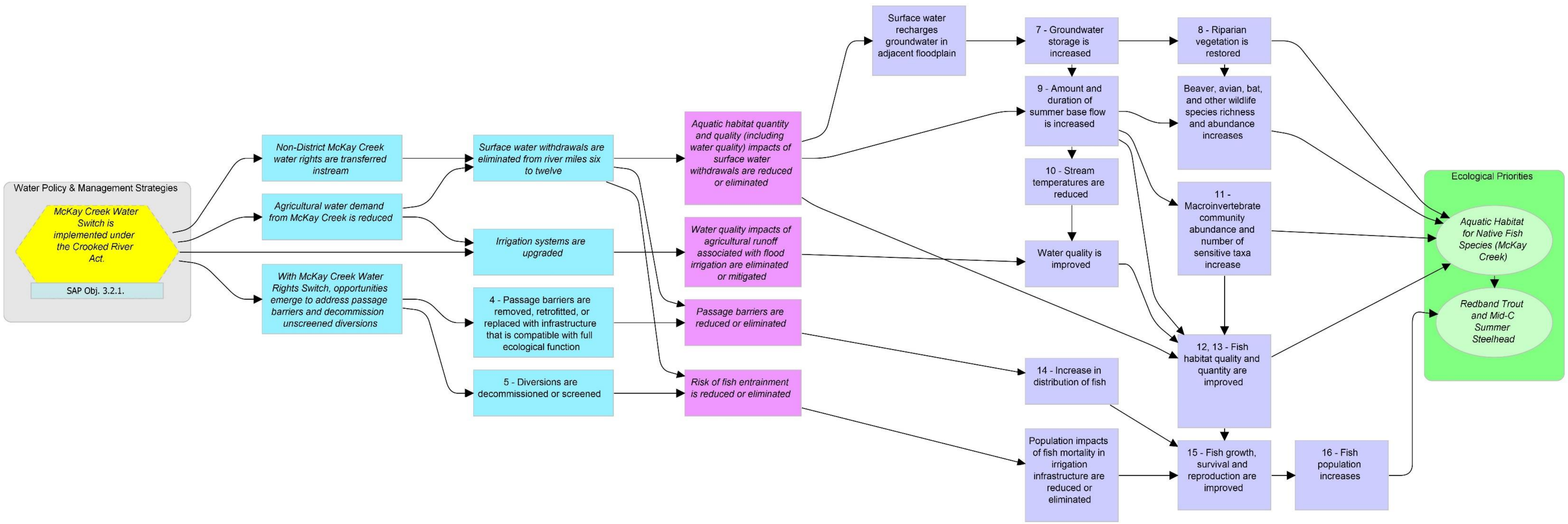


Figure 2. Results Chain for McKay Water Rights Switch



3.1. Land Conservation

The Deschutes Land Trust works cooperatively with willing landowners to purchase land or enter into conservation easements in areas that currently through restoration will provide floodplain and riparian ecosystems and high-quality fish habitat. Projects may also protect associated conservation values including wetlands and upland habitat. Restoration actions are planned and implemented on acquired or easement properties as needed.

Protection of spawning and rearing habitat through land purchases or conservation easements[1] will prevent development and further degradation of stream and floodplain habitat in areas of the watersheds that are critical for supporting fish. Once protected, lands are managed to reduce legacy habitat degradation from invasive weed populations, and become available for stream channel, floodplain and riparian restoration where it is needed. For many of the large-scale restoration projects implemented under the FIP, Deschutes Land Trust ownership or easements are necessary because they create the opportunities for a scale of restoration not typically possible on land in private ownership.

3.2 Outreach

The Deschutes Partnership conducts a series of outreach and engagement activities annually, including community presentations, stewardship projects for students, watershed education activities for elementary schools, stewardship hikes, and restoration tours. The Deschutes Partnership expects this delivery of information[6] via a diverse array of approaches will improve the level of understanding and competence of the community regarding the need for and approach to stream and river restoration. In turn, an increased level of understanding about stream restoration will increase engagement and participation in restoration activities on private lands.

3.3 Stream Habitat Restoration

Stream habitat restoration responds to the following limiting factors identified in the *Mid-C Recovery Plan*:

- Degraded riparian communities and large wood recruitment, damaged by past grazing, channel alterations and development;

- Degraded floodplain connectivity and function including loss of off-channel habitat and reduced groundwater discharge, the latter attributed with contributing to problems of low flow and high water temperature;

- Degraded channel structure and complexity including reduced channel stability, sinuosity, and stream length.

- Altered sediment routing (high fine sediment) resulting from channelization, unstable streambanks or livestock grazing.

To the greatest extent possible, restoration projects focus on employing a process-based approach to stream habitat restoration. This approach aims to restore the "physical, chemical, and biological processes that create and sustain river and floodplain ecosystems" (Beechie et al 2010) to set the stream channel and floodplain system on a trajectory toward self-sustaining function. These projects interrupt degradation of stream and floodplain habitat structure and function and create the necessary conditions for physical, chemical and biological processes to resume. These processes include primary responses such as sediment erosion, transport, and deposition; floodplain inundation and groundwater storage[7]; and wood and organic material recruitment and storage[9]; secondary response habitat characteristics such as diversity of substrate size classes, flow velocities, and geomorphic channel units[9, 13, 14]; and tertiary, biological responses including plant community[8], macroinvertebrate community[12], and native fish[17]. As such, our ecological objectives, hypotheses, and indicators for stream habitat restoration address restoration of those processes and their resulting structures.

Table 1. Stream Habitat Restoration Monitoring

Results Chain Number	Ecological Outcome	Hypothesis	Indicator	Method, Frequency and Duration	Lead Entity	Protocol Citation or Monitoring Plan	Reporting
	Primary response: Runoff/Flow						
7	Increase floodplain connectivity and groundwater levels	Frequency, duration, and extent of floodplain inundation will increase, and stream bed elevations will be similar to floodplain elevations, resulting in an increase in groundwater levels	Average growing season depth to groundwater	Continuous groundwater well data loggers or Solinst water level depth measurements on appropriate projects through 2021.	Project lead (UDWC, DLT or CRWC)	Whychus Creek Restoration Project at Camp Polk Preserve 2017 Groundwater Monitoring Report (UDWC 2017)	Project monitoring report
13, 14	Increase aquatic habitat quantity	Total channel length at base flow will increase Wetted area at base flow will increase Ratio of secondary to primary channels will increase	Total channel length Total wetted area Ratio of secondary to primary channels	Channel length and total wetted area from ODFW AIP Stream Habitat Surveys or aerial photos. Frequency and duration dependent upon specific project.	PGE, ODFW or project lead (UDWC, DLT or CRWC)	Aquatic Inventories Project Methods for Stream Habitat and Snorkel Surveys (Moore et al. 2017)	Project monitoring report
	Primary response: Wood/Detritus						
9	Increase amount of wood	Total amount of wood will increase	Pieces of large wood and wood complexes	Project as-built and/or ODFW AIP Stream Habitat Surveys. Frequency and duration dependent upon specific project.	PGE, ODFW or project lead (UDWC, DLT or CRWC)	Aquatic Inventories Project Methods for Stream Habitat and Snorkel Surveys (Moore et al. 2017)	Project monitoring report
	Secondary response: Physical Habitat						
9	Increase richness and abundance of habitat types	Richness (number) and abundance of habitat units will increase	Richness (number) and abundance of habitat units	ODFW AIP Stream Habitat Surveys. Frequency and duration dependent upon specific project.	PGE or ODFW	Aquatic Inventories Project Methods for Stream Habitat and Snorkel Surveys (Moore et al. 2017)	Project monitoring report
9	Reduce proportion of riffle habitat / increase proportion of pool habitat	The proportion of habitat units that are riffles will decrease and the proportion that are pools will increase	Proportion of habitat units that are riffles vs. pools	ODFW AIP Stream Habitat Surveys. Frequency and duration dependent upon specific project.	PGE or ODFW	Aquatic Inventories Project Methods for Stream Habitat and Snorkel Surveys (Moore et al. 2017)	Project monitoring report
	Tertiary response: Biological						
8	Increase native riparian vegetation	Extent of native riparian vegetation will increase	Extent of native riparian vegetation	Riparian vegetation mapping from aerial imagery; Invasive species extent from on-the-ground weed mapping (DLT properties). Frequency and duration dependent upon specific project.	Project lead (UDWC, DLT or CRWC)	Whychus Creek aerial imagery cover classification (in prep., EDC 2018)	Project monitoring report
12	Increase macroinvertebrate richness and abundance	Higher diversity of habitats will result in higher taxa richness More aquatic habitat and higher instream organic material will result in higher macroinvertebrate productivity (number of organisms) EPT ratios will increase	Number of macroinvertebrate taxa Total number of organisms EPT ratios	Multi-habitat sampling protocol adapted from USEPA 2009 and Ode 2016. Annually through 2021.	Project lead (UDWC, DLT or CRWC)	Multi-habitat sampling protocol adapted from USEPA 2009 and Ode 2016.	Annual watershed-specific monitoring reports
13, 14	Increase number of juvenile O. mykiss in project	Density of juvenile O. mykiss will increase	Juvenile O. mykiss density	Fish population estimates. Frequency and duration dependent upon specific project.	PGE, ODFW or USFS	ODFW/USFS fish survey protocols	Project monitoring report
16	Increase distribution of fish (adult steelhead trout and Chinook salmon)	Volitional passage will allow adult fish to migrate and use habitat upstream of historic fish passage barriers	Movement of radio-tagged adult steelhead and Chinook salmon	Radio tracking	PGE	Pelton Round Butte Project (FERC 2030) Test and Verification Study: Adult Migration, Survival and Spawning Study Plan (PGE and CTWS 2009)	Whychus Creek watershed report; project monitoring report
17	Increase fish growth, survival, and reproduction	O. mykiss growth rates will increase;	O. mykiss growth rate	Electrofishing (will require multiple visits throughout the season to track changes in lengths/weights)	ODFW and USFS	ODFW/USFS fish survey protocols	Project monitoring report

3.4 Stream Flow Restoration

The Deschutes Partnership develops and implements infrastructure projects and transfers or leases water rights instream to restore stream flow to support spawning and rearing in Whychus Creek and McKay Creek.

High stream temperatures are identified as “particularly limiting fish production” from river miles 2 to 25 in Whychus Creek (NPCC 2004); decreased stream flow is also identified as a limiting factor, and is additionally noted as further degrading water quality. Fish production in McKay Creek, an intermittent stream in its upper and middle reaches, suffers from the same limiting factors even though the hydrology in unique.

Stream flow restoration[3] responds to these limiting factors by increasing the amount of water left in the stream[10] rather than diverted for irrigation. More stream flow means more stream habitat: as flows increase, stream reaches formerly fragmented through dewatering are reconnected, and wetted width and depth increase. With more water, the stream stays cooler[11], bringing down the unnaturally high temperatures that result from diminished flows, and making stream habitat more suitable for fish[13, 14].

In McKay Creek, surface water has historically persisted only into early summer. The McKay Creek Switch will restore a minimum of 11.2 cfs instream. We hypothesize that increased springtime flows will recharge groundwater and increase groundwater levels[7], supporting riparian vegetation across a greater area[8]. Depending on substrate in the adjacent floodplain and stream bed, surface water may persist later into the summer[9], possibly long enough for emergence of swim-up fry. In reaches with perennial flow, increased flows resulting from the switch are expected to reduce stream temperatures[10], supporting more sensitive (EPT) macroinvertebrate taxa and taxa with lower temperature optima[11]. Persistence of surface water until fry emergence, increased macroinvertebrate abundance, cooler stream temperatures, and increased habitat quantity will collectively contribute to improved juvenile survival[15] and ultimately higher juvenile numbers[16].

Because flow conditions, the number of restoration strategies being implemented, and anticipated ecological outcomes differ between Whychus Creek and McKay Creek, monitoring will also differ as summarized in Table 2.

Table 2. Stream Flow Restoration Monitoring – Whychus Creek

Results Chain Number	Ecological Outcome	Hypothesis	Indicator	Method, Frequency and Duration	Lead Entity	Protocol Citation or Monitoring Plan	Reporting
10	Increase spring stream flow	Spring flows will increase	May median flow	Sisters City Park OWRD gauge. Continuous through 2021.	DRC	Whychus Creek Stream Flow Report (Golden and Wymore 2015)	Annual watershed-specific monitoring reports
10	Increase late summer stream flow	Late summer flows will increase	August median flow	Sisters City Park OWRD gauge. Continuous through 2021.	DRC	Whychus Creek Stream Flow Report (Golden and Wymore 2015)	Annual watershed-specific monitoring reports
10	Increase base flow	Annual minimum flow will increase	Annual 30-day minimum flow	Sisters City Park OWRD gauge. Continuous through 2021.	DRC	Whychus Creek Stream Flow Report (Golden and Wymore 2015)	Annual watershed-specific monitoring reports
11	Reduce summer stream temperature	Summer stream temperature will decrease	Percent of days (7DADM) exceeding 18° C	Continuous temperature monitoring through 2021 at key indicator sites.	UDWC	Whychus Creek Water Quality Status, Temperature Trends, and Stream Flow Restoration Targets (Mork 2016)	Annual watershed-specific monitoring reports

Table 3. Stream Flow Restoration Monitoring – McKay Creek

Results Chain Number	Ecological Outcome	Hypothesis	Indicator	Method, Frequency and Duration	Lead Entity	Protocol Citation or Monitoring Plan	Reporting schedule and title
	Primary response: Runoff/Flow						
7	Groundwater is sufficiently shallow to support riparian vegetation, ~2-3 ft mean depth throughout the growing season	Recharge from surface water will increase groundwater levels	Average growing season depth to groundwater adjacent to project reach	Continuous groundwater well data loggers or Solinst water level depth measurements on appropriate projects through 2021.	DRC (or DLT on preserves)	TBD	Annual watershed-specific monitoring reports
9	Surface water persists until emergence of swim-up fry and across a greater extent	Eliminating diversion of 11.2 cfs will result in surface water persisting longer and across a greater extent	Number of days and last date of surface water at key locations Persistence of surface water in relation to fry emergence	Stream flow loggers; Photo interpretation from aerial imagery (including PlanetLabs pre-2018); Redd counts; Stream temperature. Frequency and duration dependent upon project.	DRC or CRWC	TBD	Annual watershed-specific monitoring reports
	Secondary response: Water Quality						
10	Number of days when 7DADM exceeds 18°C is reduced	Eliminating diversion of 11.2 cfs will reduce summer stream temperatures in reaches with surface water pre-project	Number or percent of days when 7DADM exceeds 18° C	Continuous temperature monitoring through 2021.	DRC or CRWC	UDWC QAPP and SOP (UDWC 2008a, UDWC 2008b)	Annual watershed-specific monitoring reports
	Tertiary response: Biological						
8	Abundant riparian vegetation covers a greater extent of floodplain adjacent to the McKay Switch reach	Riparian vegetation becomes re-established and abundant where groundwater is recharged to sufficiently shallow depths	Total acreage/cover, species composition	Aerial imagery/ photo interpretation; Transects or plots for species composition. Through 2021.	DRC or CRWC	Whychus Creek aerial imagery cover classification (in prep., EDC 2018)	Reports as data are available.
11	Macroinvertebrate community is abundant and species-rich and community composition indicates healthy stream conditions	Number of EPT taxa will increase; macroinvertebrate community temperature optima and number of DEQ high temperature indicator taxa will decrease	Number of EPT taxa Community temperature optima Number of DEQ high temperature indicator taxa	Macroinvertebrate surveys every two years through 2021.	DRC	Multi-habitat sampling protocol adapted from USEPA 2009 and Ode 2016 ORDEQ protocols for Oregon's wadeable streams (OWEB 2003)	Reports as data are available.
12, 13	Fish habitat quality and quantity metrics indicate good fish habitat	Increasing amount and duration of stream flow and surface water	ODFW AIP survey metrics including residual pool depth – SELECT KEY METRICS that change	ODFW AIP Stream Habitat Surveys. UCM. Before / after implementation.	PGE or ODFW	Aquatic Inventories Project Methods for Stream Habitat and	Reports as data are available.

		will improve fish habitat quantity and quality	with stream flow and potentially with channel-forming flows UCM model outputs			Snorkel Surveys (Moore et al. 2017) Unit Characteristic Method (Cramer and Ackerman 2009)	
15	Fish growth, survival and reproduction are improved	Increased duration and extent of surface water and increased macroinvertebrate production will improve habitat and food availability for juvenile redband, resulting in improved condition and bigger fish	Length/weight numbers and distributions Smolt outmigration numbers Redd numbers	Electrofishing (will require multiple visits throughout the season to track changes in lengths/weights); Screwtrap; Redd surveys. Frequency and duration TBD.	PGE or ODFW	ODFW/USFS fish survey protocols	Reports as data are available.
16	Juvenile O. mykiss and Chinook salmon densities indicate a viable population size	Improved growth, survival and reproduction results in higher juvenile O. mykiss and Chinook salmon numbers	Juvenile fish density in McKay Switch	Fish population estimates. Before / after implementation.	PGE or ODFW	ODFW/USFS fish survey protocols; analysis TBD	Reports as data are available.

3.1.4. Fish Passage Restoration

The Deschutes Partnership works with irrigators and landowners to remove or retrofit dams that are impede the free upstream or downstream movement of redband and steelhead trout and salmon.

Removal of dams or installation of fish passage facilities[4] will increase habitat connectivity[15] and accessibility of spawning and rearing habitat to enhance the overall productivity and spatial distribution of trout and salmon. With dam removal or fish passage restoration, fish will access and use newly available spawning and rearing habitat; with increased access to spawning and rearing habitat, productivity and population size and resilience of trout and salmon will increase.

Table 4. Fish Passage Restoration Monitoring

Results Chain Number	Ecological Outcome	Hypothesis	Indicator	Method, Frequency and Duration	Lead Entity	Protocol Citation or Monitoring Plan	Reporting
15	Increase quantity of habitat accessible to resident and anadromous fish	Eliminating fish passage barriers will increase habitat connectivity	Presence of artificial passage barriers Number and length of fragmented reaches	Inventory of artificial passage barriers, number, and length of fragmented reaches	UDWC or CRWC	Fish passage criteria in OAR 635, Division 412 (ODFW 2009); Anadromous Salmonid Passage Facility Design (NMFS 2008).	Annual watershed-specific monitoring reports

3.1.5. Fish Screening

The Deschutes Partnership works with irrigators and landowners to screen active diversions or decommission defunct diversions that present a risk of entrainment into irrigation canals or other water diversion structures to juvenile trout and salmon.

Installation of fish screens on active diversion structures[5] will reduce entrainment of juvenile trout and salmon and decrease mortality rates. Reduction in mortality rates of juvenile trout and salmon from entrainment will increase fry/parr/smolt to adult survival. Increased adult survival will increase productivity of trout and salmon populations.

Table 5. Fish Screening

Results Chain Number	Ecological Outcome	Hypothesis	Indicator	Method, Frequency and Duration	Lead Entity	Protocol Citation or Monitoring Plan	Reporting
5	Eliminate risk of fish entrainment and mortality in irrigation diversions	Screening or decommissioning irrigation diversions will eliminate risk of fish entrainment and mortality in unscreened diversions	Number of unscreened diversions Percent of total irrigation flow diverted through unscreened diversions	Annual inventory of unscreened diversions and water rights associated with screened and unscreened diversions through 2021	UDWC or CRWC	Anadromous Salmonid Passage Facility Design (NMFS 2008).	Annual watershed-specific monitoring reports

4.0 IMPLEMENTATION

The Deschutes Partnership will implement this monitoring plan via the sequential completion of a series of discrete monitoring activities, each represented by a single row in each of the tables 1 through 5. Approximately half of the monitoring activities described will be led by core members of the Deschutes Partnership and half will be led by other collaborators that are part of the extended network of organizations, agencies and utilities working to support reintroduction in the Deschutes Basin.

4.1 Collaborator-led Monitoring Activities

By leveraging the existing monitoring resources and capabilities of external collaborators, the Deschutes Partnership will build upon established monitoring programs rather than create new monitoring activities. This approach has been used by the Deschutes Partnership in the past and provides the benefit of reducing overlap, improving collaboration, and leveraging the specific expertise of outside collaborators. However, because there are several external collaborators, monitoring is technically complex, specific data collection methods affect the types of questions that can be answered, and each entity conducts monitoring to achieve their own objectives, mandates and funding requirements, there are several things the Deschutes Partnership must do to ensure that these collaborator-led monitoring activities address the FIP needs described in this plan.

Most importantly, the Deschutes Partnership needs to have a dedicated monitoring coordinator who focuses on connecting and integrating the work of external entities and the Deschutes Partnership. This coordinator needs to have an in-depth understanding of what monitoring is being conducted, by whom, when, where, over what timeframe, to answer what hypotheses or questions, and with what methods and protocols. Importantly, when outside collaborators are leading monitoring activities, they are typically investing in the monitoring because they are focused on meeting their own internal requirements (e.g., PGE conducts monitoring per the requirements of the 50-year FERC license, or USFS conducts monitoring to address forest plan compliance), which may or may not readily answer the hypotheses specific to the FIP and the Deschutes Partnership. In these cases, the monitoring coordinator may need to work with the collaborator to modify methods or analyses, reprocess data and/or conduct new analyses that are designed specifically to answer key questions for the purposes of the FIP and Deschutes Partnership. For all of these reasons, the monitoring coordinator needs to remain closely engaged in collaborator monitoring to ensure that it meets FIP and Deschutes Partnership objectives and, in cases where it does not, be able to adapt quickly by negotiating with external partners, adding additional capacity or conducting complementary monitoring activities. Based on past experience, the Deschutes Partnership anticipates that this level of coordination requires an approximately 50%-time monitoring coordinator.

4.2 Deschutes Partnership-led Monitoring Activities

For the monitoring activities where external collaborators are not conducting the work, a member of the Deschutes Partnership will take on the role of lead entity, responsible for developing, designing, implementing, and reporting on the monitoring described. This lead entity may be the Deschutes Partnership's monitoring coordinator or, when specialized expertise exists in one of the other organizations, the monitoring coordinator may work with another lead entity to conduct the work. In most cases, these partnership-led monitoring activities align with the monitoring that the Deschutes Partnership has implemented over the past decade because the partnership already possesses specific expertise in the fields of water quality, macroinvertebrates, stream flow and project-specific parameters (e.g., groundwater, vegetation, etc. as specific restoration sites).

For successful implementation of these monitoring activities, the Deschutes Partnership needs to secure the funding necessary to conduct the work on project-by-project or programmatic basis. Monitoring activities can be bundled together into cohesive funding packages based on location (e.g., McKay Creek focused monitoring) or by similar monitoring parameters (e.g., streamflow, temperature and macroinvertebrates are typically closely related to one another). These funding packages are ultimately what comprise the monitoring activities to be funded by the FIP program. The total staff time required to conduct this work will vary, from approximately 50% to 90% depending on the monitoring year.

4.3 Scheduling of Monitoring Activities

This plan avoids defining the specific timing of each monitoring activity because that level of detail will vary over time as projects are scheduled, funding is secured, partners adapt their strategies, capacity changes within organizations, and other factors change. Given all of these variables, it is impossible to anticipate exactly when each type of monitoring will occur in the future, for how long data will be collected, how many specific samples will need to be taken, or exactly what types of data analyses will be necessary. Instead, the Deschutes Partnership will plan monitoring needs on a rolling basis by forecasting three years into the future on an annual basis. This approach will allow forward-looking planning for funding and capacity needs while also accommodating adjustments based on real time changes in projects, collaborator activities or other factors. These forecasts will be developed in a simple spreadsheet of proposed activities.

Although the six-year duration of the FIP is relatively short to allow for some forms of adaptive management, the approach outlined in this plan will allow the Deschutes Partnership to adaptively manage its restoration and monitoring programs as more is learned about project results and the theory of change. In this context, adaptive management can operate at many scales and for many purposes, from the project-specific (e.g., the refinement of different restoration techniques in a given floodplain restoration project), to the programmatic (e.g., changing the allocation of investments in different restoration programs based on new information about each programs' ecological uplift), to the watershed scale (e.g., changing the allocation of investments among watersheds based on cost-benefit evaluations). While this kind of learning happens routinely as part of project and program implementation, the Deschutes Partnership seeks to develop a more formal adaptive management plan once guidance has been developed by OWEB, the BEF team and others.

5.0 REFERENCES

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