Upper Deschutes Watershed Council

Technical Report

Whychus Creek Watershed Restoration Plan Update

Upper Deschutes Model Watershed Program
Deschutes River Basin, Oregon

Prepared by:

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Whychus Creek Watershed Restoration Plan Update

In late 2011 the Upper Deschutes Watershed Council, the Deschutes River Conservancy, and the Bonneville Environmental Foundation (BEF) engaged in a collaborative process to review and update the Whychus Creek Watershed Restoration Plan. The update was completed as part of the Upper Deschutes Watershed Council's participation in BEF's Model Watershed Program. The Upper Deschutes Model Watershed Project is now in its 6th year of implementation.

The purpose of this update was to account for changes in the project's circumstances, integrate new information, and test the usefulness of applying elements of The Nature Conservancy's Conservation Action Planning framework and the Miradi adaptive management software.

This update was not intended to recreate or extensively alter the existing restoration approach, but rather it was done in the spirit of adaptive management and continual inquiry into the validation of the plan's theories and underlying assumptions. The context of community-based restoration is dynamic and therefore restoration plans should be sufficiently flexible to evolve with changing circumstances.

Approach

A combination of tools and methods outlined in the Conservation Measures Partnership's **Open Standards for the Practice of Conservation** and The Nature Conservancy's **Conservation Action Planning** process were used as a general framework to inventory and assess components of the Whychus Creek restoration plan. The **Miradi** adaptive management software was used to manage planning information and facilitate the creation of a conceptual model, threat rating matrix, and results chains. Additionally, all viability assessment and strategy information was input into Miradi to provide the partners with the opportunity to continue managing their work using this tool if desired.

The planning process included review of existing planning documents and other relevant materials, two day and a half work sessions, offline development of planning products to support work sessions, peer review of the viability assessment, and preparation of the final plan update.

Planning Workgroup

The planning update workgroup included the following participants:

- Ryan Houston, Executive Director, Upper Deschutes Watershed Council
- Lauren Mork, Monitoring Coordinator, Upper Deschutes Watershed Council
- Mathias Perle, Project Manager, Upper Deschutes Watershed Council
- Scott McCaulou, Program Director, Deschutes River Conservancy
- Brett Golden, Program Manager for Planning, Monitoring & Evaluation, Deschutes River Conservancy

- Robert Warren, Model Watershed Program Director, Bonneville Environmental Foundation

Peer Review

Peer review of the viability assessment was designed to access the expertise of professionals with detailed and specialized knowledge of the basin to ensure that elements of the assessment were consistent with their knowledge and understanding. (note: consider adding the guidance or results as an appendix – depending on what comes back). Experts contributing to the peer review included:

- Mike Riehle, Fish Biologist, USFS - Sisters Ranger District
- Bonnie Lamb, Deschutes Basin Coordinator, Oregon Department of Environmental Quality
- Brett Hodgson, Deschutes District Fish Biologist, Oregon Department of Fish and Wildlife
- Mike Harrington, Assistant District Fish Biologist, Oregon Department of Fish and Wildlife
- Peggy Kavanagh, Project Biologist, Oregon Department of Fish and Wildlife
- Celeste Mazzacano, Aquatic Program Director, Xerces Society for Invertebrate Conservation

Plan Elements

Scope and Vision

The geographic scope of this plan is the Whychus Creek watershed.

The vision defined by the planning group is to achieve a "*system that has physical and biological conditions necessary to support self-sustaining populations of native resident and anadromous fishes*."

Conservation Targets (or Values)

Species Targets

The planning workgroup identified ***anadromous salmonids*** (reintroduced spring Chinook salmon and summer steelhead trout) and ***resident redband trout*** as species targets.

The team considered including bull trout as a focal species but elected not to because the primary driver of ongoing restoration and fish related monitoring in the watershed has been the reintroduction of steelhead trout and spring Chinook salmon. Data on bull trout are incomplete and there are fewer resources to fill data gaps and better understand the importance of Whychus Creek for upper Deschutes River bull trout populations. While this situation is not desirable the workgroup believed that restoration actions designed to restore ecological function would benefit all native species including bull trout. The disadvantage was that any response by bull trout to restoration and the introduction would not be detected.

Ecological System Targets

Floodplain and stream channel systems was selected as the only ecological system target. However, it encompasses a broad range of attributes related to aquatic habitats, riparian areas, and the 100-year floodplain.

Target Viability Assessment

The status of each target was determined by selecting a suite of key ecological attributes, each with one or more measurable indicator (Table 1), estimating ranges of acceptable variability for each indicator, and then evaluating available data to establish where each indicator fell within those estimated ranges (Appendix 1).

Table 1. Conservation Targets and associated KEAs and indicators

Target	Key Ecological Attribute	Indicator
Anadromous salmonids (Spring Chinook salmon and steelhead trout) and resident redband trout	Abundance	• Naturally produced juvenile population size (O. mykiss parr) • Number of adult spawners (steelhead escapement) • Number of spawning redds (Chinook) • Smolt production or estimated number of outmigrants (Steelhead and Chinook)
Floodplain and stream channel systems	Macro-invertebrates	• Macroinvertebrate community composition and diversity • Multimetric Index of biological integrity • Weighted average inference models (temperature and sediment)
	Water Quality	• Temperature: rearing and migration (7-day moving average maximum) • Temperature: salmonid fish spawning January 1 – May 15 • Dissolved oxygen: cold and cool water (concentration and/or % saturation) • Dissolved oxygen: resident trout spawning and emergence Jan 1 – May 15 (daily minimum DO concentration) • pH
	Hydrology	• May median stream flow • July 15 – August 15 median stream flow
	Stream connectivity	• Miles of stream accessible to anadromous fish
	Entrainment Potential	• Flow volume diverted through unscreened diversions
	Habitat quality	• Percent of surveyed stream miles rated good or fair • Channel dimension, pattern, and profile

The current status for anadromous salmonids and resident redband trout is unknown since the reintroduction effort is still too early in its implementation to produce naturally spawning adults.

The status of the floodplain and stream channel systems was designated as **Fair**.

Threats Rating

Direct threats (defined principally as human activities that impair the viability of targets) were identified and rated by the work group (Table 2). Threat rating was accomplished by estimating the scope, severity, and irreversibility of each threat relative to the targets they impacted. Factors that contribute to those threats were also identified as part of the development of the conceptual model (see below).

Table 2. Direct threats

	Conservation Targets Values		
Threats	**Anadromous salmonids and resident redband trout**	**Floodplain and stream channel system**	**Summary Threat Rating**
Unscreened diversions	Low		**Low**
Diversion dams	Low	Low	**Low**
Climate change		High	**Medium**
Stormwater runoff		Low	**Low**
Invasive terrestrial plant species		Medium	**Low**
Invasive aquatic species		Medium	**Low**
Groundwater pumping		High	**Medium**
Non-native brown trout	Low		**Low**
Riparian and channel migration zone development		Medium	**Low**
Artificial bank armoring		Low	**Low**
Historic and ongoing removal of large woody debris		Medium	**Low**
Removal of riparian vegetation		Low	**Low**
Water diversion		High	**Medium**
Channel confining bridges		Medium	**Low**
Over utilization of grazing in riparian		Low	**Low**
Channelization and berm construction		High	**Medium**
Summary Target Ratings:	**Low**	**High**	**Medium**

Situation Analysis/Conceptual Model

The workgroup collaboratively constructed a conceptual model to visually depict their perception of the larger context of the restoration effort (Figure 1). The model includes the selected conservation targets, direct threats, factors contributing to those threats (root causes), and linkages between these elements to help better understand and discuss the interrelationship. This step encouraged deeper and clearer thinking about how existing strategies are expected to intervene to reduce threats and/or directly improve the status of conservation targets. The conceptual model was also necessary for the development of the results chains. Results chains (also called theories of change) help to reveal assumptions related to each strategy and define hypotheses for how strategies are expected to lead to desired outcomes. Results chains also provided an opportunity to identify intermediate objectives to validate or invalidate assumptions and therefore adaptively manage the work.

Strategies

As described above, ongoing strategies were evaluated in this planning update process and no new strategies were identified or developed. However, objectives associated with each existing strategy were updated as a way to build the structure for ongoing accountability, adaptive management, annual reporting, and annual work plan development.

Land Conservation Strategies

Strategy C1: *Acquire fee title and conservation easements.* The Deschutes Land Trust (DLT) will acquire fee title or conservation easements on large floodplain properties along Whychus Creek downstream of Sisters.

> Objective C1.1: Protect nine miles of Whychus Creek through fee title or conservation easement acquisition by 2020.

Habitat Restoration Strategies

Strategy H1: *Reconnect the stream with the floodplain.* Where historic activities have reduced or eliminated floodplain connectivity, the Upper Deschutes Watershed Council (UDWC) will implement (or actively support the implementation of) stream restoration projects that reconnect the historic floodplain in all of the channelized reaches on Deschutes National Forest land upstream of Sisters and DLT properties downstream of Sisters.

> Objective H1.1: Restore floodplain connectivity along nine miles of the channelized reaches by 2020.

Strategy H2: *Revegetate riparian areas.* Where riparian areas are not well vegetated and the underlying causes of riparian area degradation have been addressed (e.g., historic grazing, loss of floodplain, etc.), the UDWC will work with partners to implement riparian area revegetation projects.

<u>Objective H2.1</u>: The UDWC will revegetate ___ miles of riparian area by 2020 [Note: total amount of area to be revegetated yet to be determined].

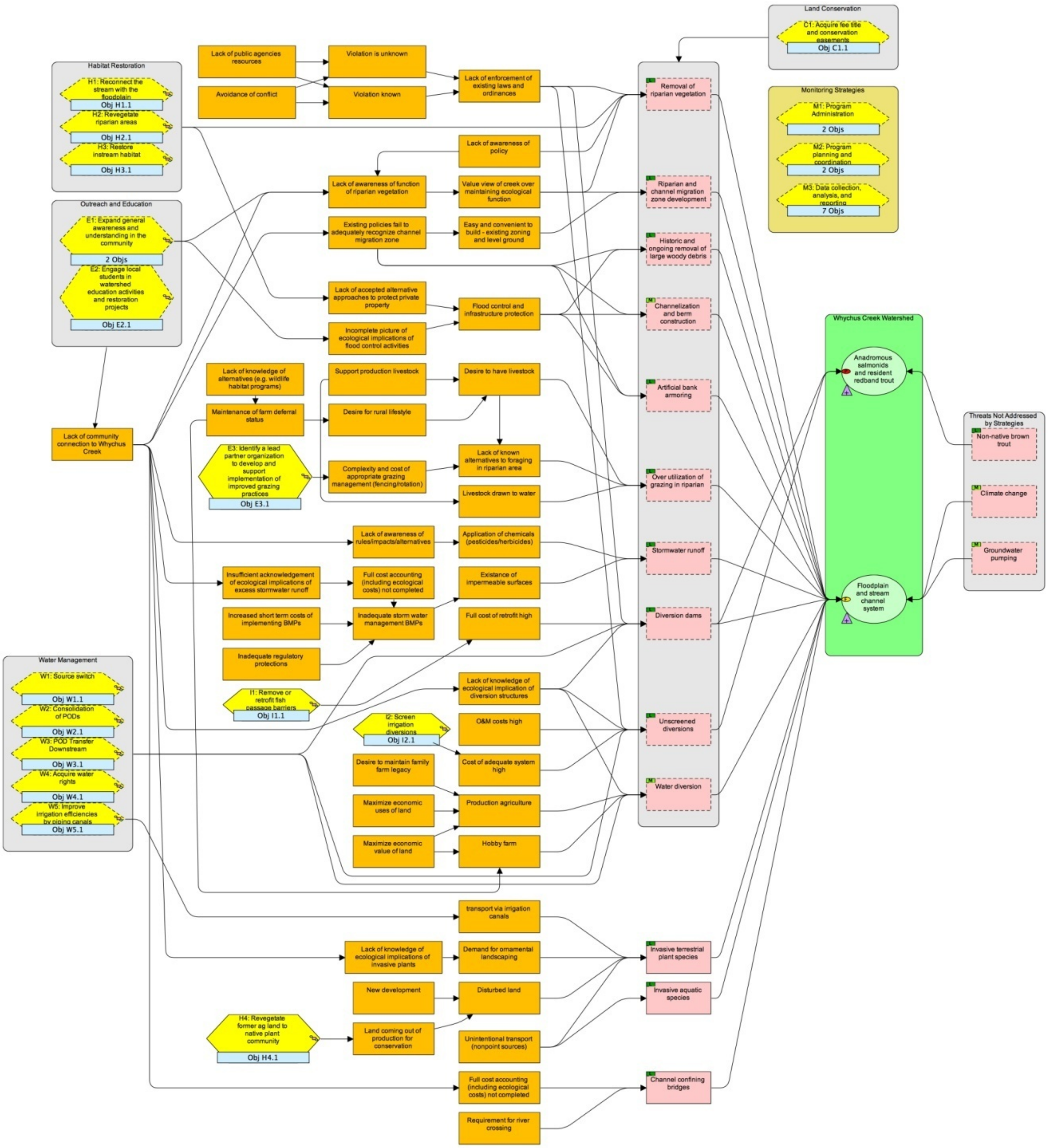

Figure 1. Conceptual model depicting the project's context. Symbols represent the following: green box = scope, green ovals = conservation targets, pink boxes = direct threats, orange boxes = contributing factors, yellow polygons = strategies.

Strategy H3: *Restore instream habitat.* Where instream habitat has been lost and the underlying causes of instream habitat loss have been addressed (e.g., channelization, wood removal, etc.), the UDWC will work with partners to implement instream habitat restoration projects.

> Objective H3.1: The UDWC will restore instream habitat as necessary to achieve a "Good" HabRate rating for all reaches of Whychus Creek from Whychus Falls to the Deschutes River.

Strategy H4: *Revegetate former agricultural land to native plant community.* Where irrigation water rights are retired or transferred away from a property, the Deschutes River Conservancy (DRC) will work with the landowners to revegetate former agricultural land with a native plant assemblage.

> Objective H4.1: Revegetate all former agricultural properties where water rights have been transferred within three years of the completion of the water transfer.

Habitat Restoration Results Chain

Most habitat restoration strategies are expected to directly reduce threats. Intermediate results (short or medium term outcomes shown as blue boxes in Figure 2) that eventually lead to desired ecological outcomes (improved status of conservation targets) were identified.

Irrigation Infrastructure Improvement Strategies

Strategy I1: *Remove or retrofit fish passage barriers.* The UDWC will work with the owners/operators of fish passage barriers to implement removal and/or retrofit projects to provide unimpeded up- and down-stream passage between Whychus Falls and the Deschutes River.

> Objective I1.1: All barriers to fish passage have been removed by 2020.

Strategy I2: *Screen irrigation diversions.* The UDWC will *w*ork with the owners/operators of unscreened diversions to implement removal and/or retrofit projects that bring diversions into compliance with state and federal screening criteria.

> Objective I2.1: All diversions have been screened by 2015.

Water Management Strategies

DRC Whychus Creek Flow Objective: 33 cfs by 2020

Strategy W.1: *Source switch.* Seek opportunities for existing surface water users to replace their surface water diversions with new or existing ground water sources.

> Objective W1.1: Up to three private diversions are eliminated by a combination of source switches and acquisitions.

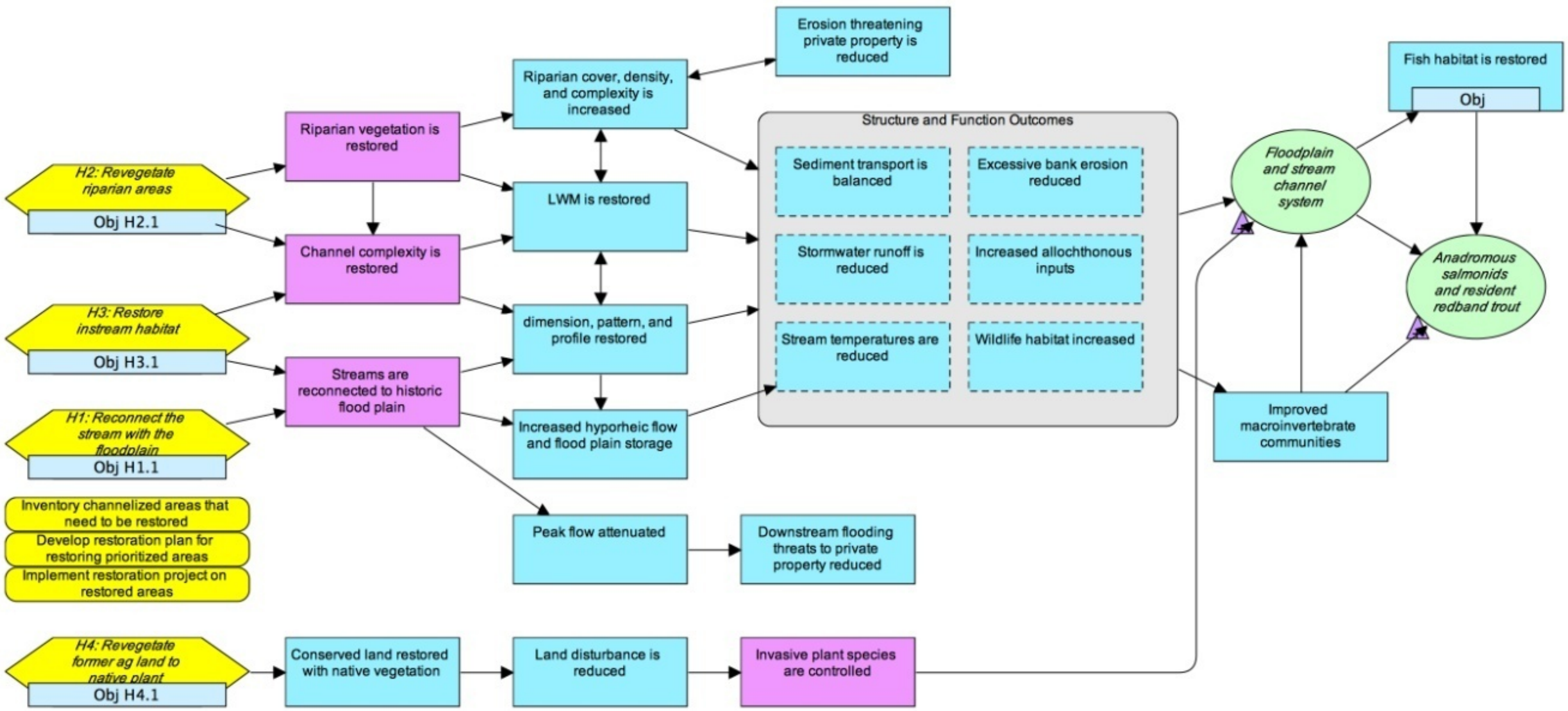

Figure 2. Results chain for Habitat Restoration Strategies. Symbols represent the following: green ovals = conservation targets, blue boxes = intermediate results, purple boxes = reduced threats, yellow polygons = strategies.

Strategy W.2: *Consolidation of PODs.* Where appropriate, engage existing surface water users in opportunities to consolidate their Points of Diversion to downstream points along Whychus Creek.

Objective W2.1: Consolidate the Uncle John and TSID Main points of diversion

Strategy W.3: *POD transfer.* Seek opportunities to provide environmental benefits by transferring existing surface water points of diversion to new, downstream locations on Whychus Creek.

Objective W3.1: As opportunities arise, the DRC will conduct POD transfers on Whychus Creek.

Strategy W.4: *Secure instream water rights.* Engage landowners inside and outside Three Sisters Irrigation District in opportunities to lease their water rights instream. Engage landowners outside of Three Sisters Irrigation District in opportunities to transfer their water rights instream.

Objective W4.1: Acquire up to 200 acres of water rights from willing sellers.

Strategy W.5: *Improve irrigation efficiencies by piping canals.* Engage surface water users to develop, finance, and implement projects that conserve water by piping irrigation canals, then transfer a portion of the conserved water instream.

Objective W5.1: Conserve an additional 10 cfs of water through water conservation projects.

Water Management Results Chain

Water management strategies directly reduce the threats posed by passage barriers and unscreened diversions. Intermediate results achieved through these strategies ultimately reduce the total volume of water diverted and prevent establishment of invasive plant populations.

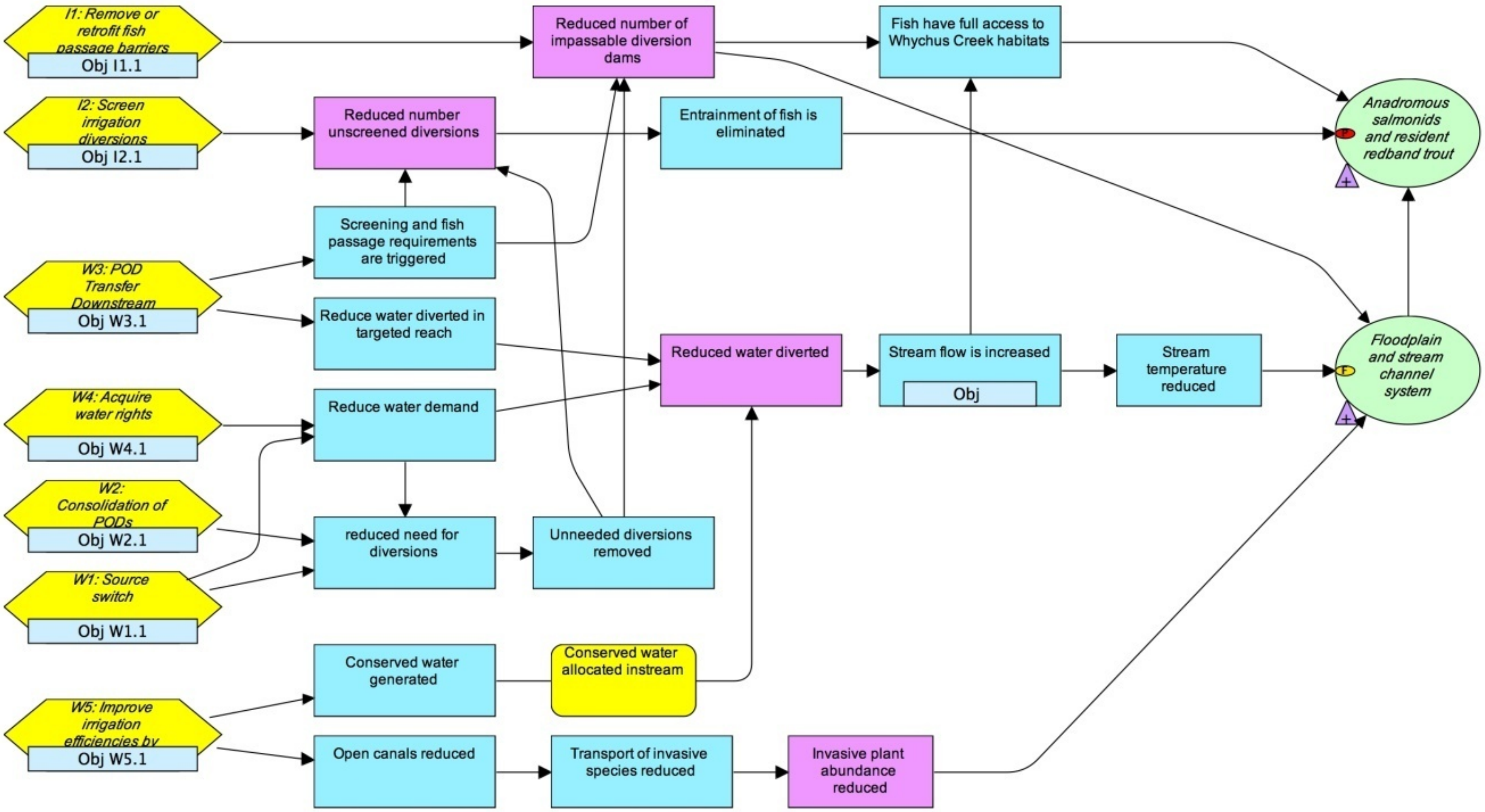

Figure 3. Results chain for Water Management Strategies. Symbols represent the following: green ovals = conservation targets, blue boxes = intermediate results, purple boxes = reduced threats, yellow polygons = strategies.

Monitoring Strategies

Strategy M.1: *Program administration.* Administer and develop program funding and systems to efficiently organize and access data.

> Objective M1.1: Develop and administer annual budget and funding plan for monitoring program.
>
> Objective M1.2: Develop, maintain and refine systems for storing and organizing information.

Strategy M.2: *Program planning and coordination.* Maintain, develop and evaluate program planning documents, and communicate and incorporate monitoring results.

> Objective M2.1: Finalize Whychus Conservation Action Planning materials.
>
> Objective M2.2: Communicate results to partners, provide recommendations to integrate findings into restoration and monitoring, and collaborate on opportunities for future work.

Strategy M.3: *Data collection, analysis, and reporting.* Coordinate data collection, analysis, and reporting for seven biological and physical indicators.

> Objective M3.1: Coordinate with DRC to monitor and report on streamflow.
>
> Objective M3.2: Coordinate with Oregon Department of Fish and Wildlife (ODFW) to identify habitat quality data needs, conduct analysis, and report on habitat quality.
>
> Objective M3.3: Coordinate water quality data collection, conduct analyses, and produce report.
>
> Objective M3.4: Maintain and update GIS and tabular records of passage barriers, miles of accessible habitat, unscreened diversions, and unscreened diverted flows, and report on progress.
>
> Objective M3.5: Coordinate macroinvertebrate monitoring and contract with Xerces Society to process and identify samples, conduct data analysis, and report on findings.
>
> Objective M3.6: Track and report on status of steelhead, redband and Chinook salmon in Whychus Creek.
>
> Objective M3.7: Integrate project- and watershed-scale monitoring to increase capacity to use data and inform restoration and monitoring across scales.

Outreach and Education Strategies

Note: Outreach and education strategies focus protecting long-term investments in restoration and creating the social conditions necessary to restore Whychus Creek more than they actually restore Whychus Creek. As such, these strategies likely connect to the entire assemblage of results chains rather than to any specific results chain.

Strategy E1: *Expand general awareness and understanding in the community.* The UDWC, DRC and DLT will work to inform the community about watershed restoration efforts, needs and opportunities with the goal of improving general community acceptance and support for restoration efforts. The focus of this strategy is on general awareness and availability of information through media, websites, presentations, community meetings, etc.

> Objective E1.1: Connect with 250 Whychus Creek watershed residents per year.
>
> Objective E1.2: Make critical restoration information easily available via DLT, UDWC and DRC websites.

Strategy E2: *Engage local students in watershed education activities and restoration projects.* The UDWC will work with schools, teachers and other educational groups to provide hands on educational experiences that foster a connection to Whychus Creek and develop knowledge and understanding of watershed restoration.

> Objective E2.1: Engage 2,000 students each year in watershed education activities.

Strategy E3: *Identify a lead partner organization to develop and support implementation of improved grazing practices.* We will solicit new partnerships in the non-profit and agricultural sectors (e.g. NRCS, SWCD, local ranchers organizations) to develop agricultural Best Management Practices for the Whychus Creek Watershed and identify a lead organization and the appropriate policy avenues to effect implementation of agricultural BMPs.

> Objective E3.1: Identify and recruit a lead partner to implement this strategy.

Outreach and Education Results Chain

Hypotheses that describe how outreach and education strategies lead to ecological outcomes are probably the most difficult to construct and measure. The conceptual model suggests that one of the most critical factors that contribute to past and ongoing threats is a "lack of community connection to Whychus Creek" and so it is evident that this issue should be addressed if sufficient restoration gains are to be made – and, more importantly, if those gains are to be sustained into the future.

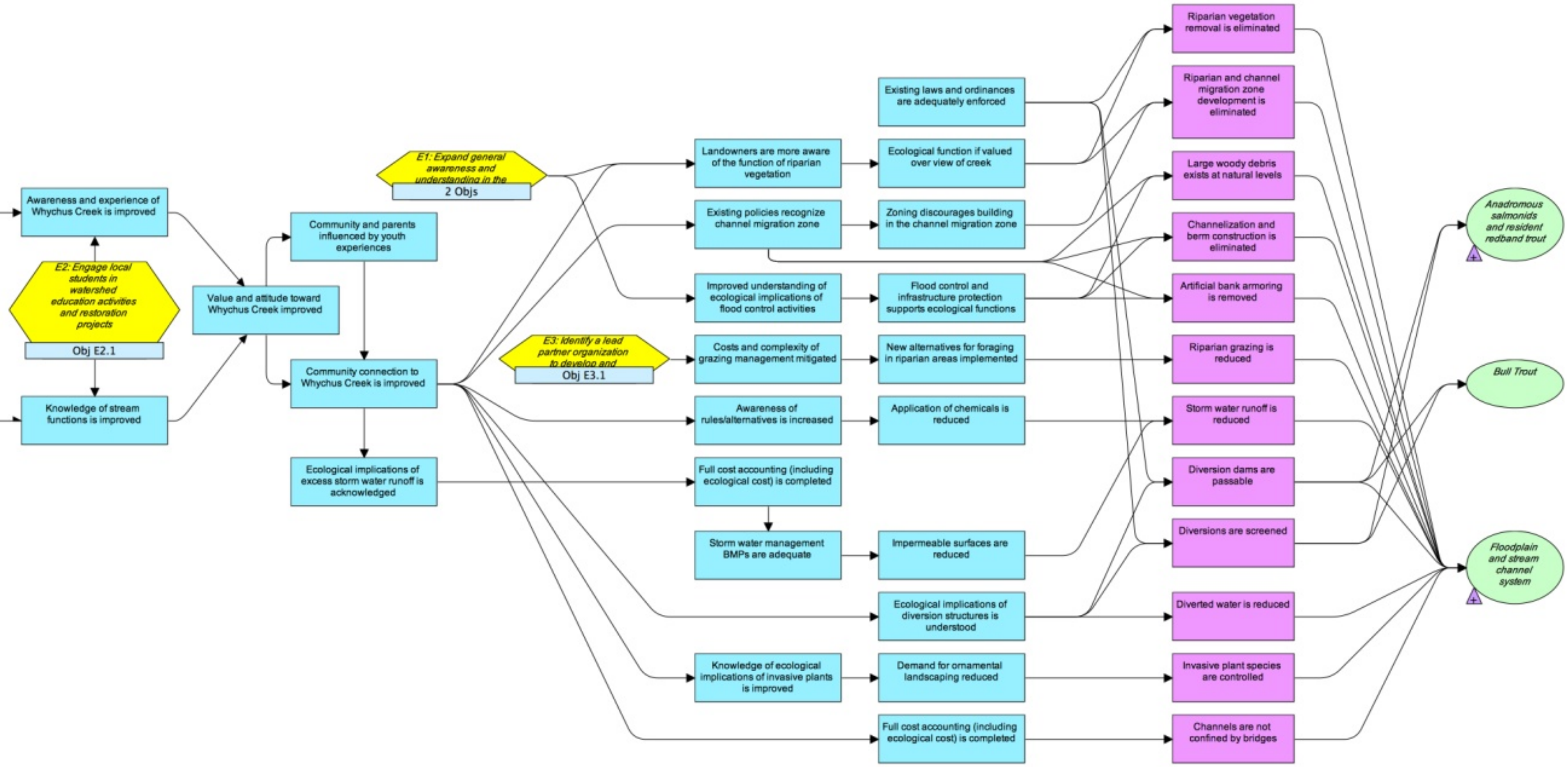

Figure 3. Results chain for Outreach and Education Strategies. Symbols represent the following: green ovals = conservation targets, blue boxes = intermediate results, purple boxes = reduced threats, yellow polygons = strategies.

Reference Materials

Planning Guidance

Conservation Action Planning – Overview of Basic Practice (The Nature Conservancy)

http://conserveonline.org/workspaces/cbdgateway/cap/resources/1/TNC_CAP_Basic_Practices.pdf/download

Using Conceptual Models to Document a Situation Analysis (Foundations of Success)

http://www.fosonline.org/wordpress/wp-content/uploads/2010/09/FOS_Conceputal_Model_Guide_April2009.pdf

Using Results Chains to Improve Strategy Effectiveness (Foundations of Success)

http://www.fosonline.org/wordpress/wp-content/uploads/2010/09/FOS_Results_Chain_Guide_2007-05.pdf

Miradi – Adaptive management software for conservation projects

https://miradi.org/

Existing Plans and Relevant Documents

Whychus Creek Restoration Monitoring Plan. 2009. Upper Deschutes Watershed Council, Bend, Oregon. 40 p.

Reintroduction and Conservation Plan for Anadromous Fish in the Upper Deschutes River Sub-basin, Oregon, Edition 1: Spring Chinook Salmon and Summer Steelhead. 2008. Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Reservation of Oregon. 79 p.

Golden B, Houston R, Editors. 2010. 2009 Whychus Creek Monitoring Report. Upper Deschutes Watershed Council, Bend, Oregon. 134 p.

Mork L., Houston R., Editors. 2012. 2010 Whychus Creek Monitoring Report. Upper Deschutes Watershed Council, Bend, Oregon. 72 p.

Mork L., Houston R., Editors. 2013. 2011 Whychus Creek Monitoring Report. Upper Deschutes Watershed Council, Bend, Oregon. 121 p.

Appendices

Appendix 1: Viability Assessment

Target	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good	2012 Status	Desired Future Condition
Steelhead	Abundance	Number of adult spawners (escapement)	0-200	201-450	451-700	701-1,000	**Poor** No adult spawners in 2010	Very Good
		Number of spawning redds	0-100	101-225	226-350	351-500	**Poor** No adult spawners in 2010	
		Juvenile population size (parr)	0-8,200	8,201-17,900	17,901-30,650	>30.650	**Very Good** 47,340 parr	Very Good
		Smolt production Estimated from number of outmigrants	0-4,100	4,101-8,950	8,951-15,300	>15,300	**Unknown** No smolt production estimates for the Upper Deschutes Subbasin as of March 2011 PGE Fisheries reports	Very Good
	Diversity	Age class and life history diversity	No spawning and emergence	All: Spawning and emergence, 0+ summer, 0+ winter, 1+ summer, 1+ winter			**Poor** Now spawning and emergence. 0+ summer and winter rearing, 1+ summer and winter rearing assumed, but no size at age estimate available	Very Good
Redband trout	Abundance	Number of adult spawners (Escapement)	0-50	51-200	201-500	≥500	**Fair** 65 redds in 2010	Very Good
		Number of spawning redds	0-25	26-100	101-250	250	**Fair** 65 redds in 2012	Very Good
		Juvenile population size	>1,852	1,853-7,408	7,409-18,482	>18,556	**Very Good** 47,340 parr estimated in 2010	Very Good
		Smolt production	926	927-3,704	3,705-9,241	9,278	**Unknown**	Very Good

Target	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good	2012 Status	Desired Future Condition
Spring Chinook salmon	Abundance	Number of adult spawners (escapement)	0-100	101-450	451-650	>650	**Poor** No adult spawners in 2010	Very Good
		Number of spawning redds	0-50	51-225	226-325	>326	**Poor** No adult spawners in 2010	
		Juvenile (parr) salmon population size (winter)	<2,860	2,860-40,014	40,015-45,143	>45,143	**Fair** 4,306 parr (low estimate) in 2012	Very Good
		Smolt production	0-1,000	1,001-14,005	14,005-15,774	15,775-29,250	**Unknown** No smolt production estimate for the Upper Deschutes Subbasin as of March 2011 PGE Fisheries reports	Very Good
	Diversity	Age class and life history diversity	No spawning and emergence	All: Spawning and emergence, 0+ summer, 0+ winter.			**Poor** No spawning and emergence. 0+ summer, 0+ winter assumed present although no size at age estimate	Very Good
Floodplain and stream channel systems	Macroinvertebrates	Macroinvertebrate community composition and diversity	most disturbed rating in any reach (O/E ≤ 0.78)	minimum rating of moderately disturbed in all reaches (O/E = 0.79 - 0.92)	minimum rating of least disturbed in all reaches (O/E = 0.93-1.23)	1:1 or greater observed to expected ratio in all reaches O/E ≥ 1.0 (least disturbed to enriched)	**Poor** Most disturbed rating at ten of fourteen sites in 2011	Very Good
		Multimetric Index of biological integrity	severe impairment rating in any reach	minimum rating of moderate impairment in all reaches	minimum rating of slight impairment in all reaches	minimal impairment in all reaches	**Fair** Moderate impairment at four of fourteen sites in 2011	Very Good
	Water quality	Temperature (7 day moving average maximum temperature)	>23 degrees C for > 5% of data days	≤ 23 degrees C for ≥ 95 % of data days and <	≤19.5 degrees C for ≥ 95% of data days and ≤18	≤ 18 degrees C for ≥ 95% of data days	**Fair** >18 degrees C at any site for 25%	Very Good

Target	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good	2012 Status	Desired Future Condition
				19.5 degrees C for ≥ 80% of data days	degrees C for < 80% of data days		of data days in 2010. > 19.5 at any site for 18% of data days in 2010.	
		Temperature: Salmonid fish spawning September 1-June 30	>15 degrees C for >5% of data days	≤12.8° for ≥40% of data days and <15° for ≥95% of data days	≤12.8° for ≥80% of data days and <15° for ≥100% of data days	≤12.8 for ≥80% of data days and ≤ 14 degrees C for 100% of data days	**Poor** >15 degrees C for 14% of data days at any site from Jan 1 to May 15 2010. ≤ 13 degrees C for 57% of 2010 data days	Very Good
		Dissolved Oxygen: Daily minimum dissolved oxygen concentration and % saturation)	<6.5 mg/L / 90% saturation for > 20% of all data days	≥ 6.5 mg/L / 90% saturation for ≥ 80% of data days and < 8 mg/L for >20% of all data days	≥8 mg/L / 90% saturation for ≥ 80% of data days	≥8 mg/L / 90% saturation for 100% of data days	**Very Good** ≥8 mg/L / 90% saturation for 100% of data days from 2006 to 2008 (Jones 2010)	Very Good
		Dissolved Oxygen: Resident trout spawning and emergence (daily minimum dissolved oxygen concentration)	<5 mg/L for > 5% of data days Jan 1 - May 15	≥5 mg/L and 90% saturation for ≥95% of data days Jan 1 - May 15 and <8 mg/L for > 20% of data days Jan 1 - May 15	≥8 mg/L and 90% saturation for ≥ 80% of data days Jan 1 - May 15 and ≤ 11 mg/L and 95% saturation for > 20% of spawning data days	≥ 11 mg/L 95% saturation for ≥ 80% data days January 1 - May 15	**Very Good** ≥ 11 mg/L 95% saturation for 84% of data days from 2006 to 2008 (Jones 2010)	Very Good
		pH	<5 or > 9 for > 5% of data days	> 5 and < 9 for ≥95% of data days and ≥ 6.5 and ≤ 8.5 for ≥ 80% of data days	6.5 - 8.5 for ≥ 80% of data days	6.5 - 8.5 for 100% of data days	**Good** <6.5 and >8.5 at any site for 10% of data days from 2006-2008 (UDWC, unpublished data)	Very Good
	Hydrology							
	Streamflow	May median stream flow	<20 cfs April - October	20 - 44 cfs April - Oct	45-65 cfs April-October	≥66 cfs April-October	**Fair** 2011 May median streamflow: 23 cfs	Very Good
		August median stream flow	<20 cfs April - October	20 - 44 cfs April - Oct	45-65 cfs April-October	≥66 cfs April-October	**Fair** 2011 August	Very Good

Target	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good	2012 Status	Desired Future Condition
							median streamflow: 32 cfs	
		Minimum 30-day moving average stream flow	<20 cfs April - October	20 - 44 cfs April - Oct	45-65 cfs April-October	≥66 cfs April-October	**Fair** 22.13 minimum 30-day moving average 1/1 - 12/13/11	Very Good
	Riparian Vegetation	Riparian Vegetation: Extent and width of native riparian vegetation	DEQ is developing TMDLs for Whychus Creek which should indicate the role of riparian vegetation in influencing stream temperature.					
		Riparian Vegetation: Native riparian species richness and diversity						
	Stream Connectivity (Habitat Access)	Miles of stream accessible to anadromous fish	Year-round access to14 miles from the mouth of Whychus Creek. (Barrier 1 and upstream barriers present)	Year-round access to 20 miles from the mouth of Whychus Creek. (Barrier 2 and upstream barriers present)	Year-round access to 22 miles from the mouth of Whychus Creek. (Barrier 4 and upstream barriers present)	Year-round access to 36.5 miles. Barriers 1-6 removed: 100% river miles accessible to Lower Whychus Falls (rm 36.5)	**Fair** Barrier 2 and upstream barriers present	Very Good
		Entrainment Potential						
		Flow volume (cfs) diverted through unscreened diversions	>20% irrigation flows diverted through unscreened diversions (>39 cfs)	<20% irrigation flows diverted through unscreened diversions (<39 cfs)	<5% irrigation flows diverted through unscreened diversions (<10 cfs)	0 cfs diverted through unscreened diversions	**Fair** 19% of flows diverted for irrigation / 37 cfs remain unscreened.	Very Good
	Habitat Quality (Physical)	Miles of habitat rated Good, Fair, or Poor for selected life stages	<70% of surveyed miles rated "Fair" or "Good" for all life stages	≥70% of surveyed miles rated "Fair" or "Good" for all life stages	100% surveyed miles rated "Fair" or "Good" for all life stages	100% of surveyed miles rated "Good" for all life stages	**Fair** 73% and 76% of surveyed miles rated fair or good for Steelhead and Chinook spawning life stages respectively; 100% of miles surveyed rated fair or good for all other life stages.	Very Good

Target	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good	2012 Status	Desired Future Condition
		Channel dimension, pattern, and profile	0-3 river miles restored	4-6 river miles restored	7-9 river miles restored.	10-12 river miles restored. Dimension, pattern and profile supports full geomorphic and hydrologic function.	**Poor** With Camp Polk channel restoration, two river miles have been restored. 25% of river miles or 10/40 remain channelized	Very Good

Appendix 2: Whychus Creek Viability Assessment Peer Review Summary

Peer Review Process

Peer review of the viability assessment was designed to access the expertise of professionals with detailed and specialized knowledge of the basin to ensure that elements of the assessment were consistent with their knowledge and understanding. Experts contributing to the peer review included:

- Mike Riehle, Fish Biologist, **USFS - Sisters Ranger District**
- Bonnie Lamb, Deschutes Basin Coordinator, **Oregon Department of Environmental Quality**
- Brett Hodgson, Deschutes District Fish Biologist, **Oregon Department of Fish and Wildlife**
- Mike Harrington, Assistant District Fish Biologist, **Oregon Department of Fish and Wildlife**
- Peggy Kavanagh, Project Biologist, **Oregon Department of Fish and Wildlife**
- Celeste Mazzacano, Aquatic Program Director, **Xerces Society for Invertebrate Conservation**

Peer review was conducted through meetings and correspondence between UDWC staff and individual reviewers or pairs of reviewers. The viability assessment was revised according to reviewer insights, comments, and expert opinion. The final Key Ecological Attributes and Indicators reflect the scientific advice of peer reviewers. Reviewer comments and UDWC responses are summarized below.

Indicator Quality

As the peer review process progressed, we realized that some indicators were much more informative and salient than others. To provide a measure of the quality of information provided by each indicator, we assigned a qualitative rating to each indicator:

- **Very Good**: Information provided by the indicator is among the best available. Indicator is relatively straightforward and easy to measure, and the ability to measure the indicator is minimally affected by adverse environmental conditions such as high flows. Data available for the indicator are precise and accurate, and the relationship between the indicator metric and stream conditions is well developed. The indicator directly reflects on desired habitat conditions.
- **Good**: Information provided by the indicator is generally well-founded in empirical data, scientific literature, or expert opinion, but may not be as precise or accurate as “Very Good” indicators. “Good” indicators may less directly address desired habitat conditions than “Very Good” indicators.

- **Fair**: Fair indicators are characterized by metrics that represent an indirect measure of ecosystem function or habitat conditions and are attended by less certainty about the relationship between the metric and ecosystem function/habitat conditions.
- **To Be Determined**: Indicators rated as "To Be Determined" (TBD) have yet to be tested or proven. All Whychus TBD indicators describe the status of fish populations in Whychus Creek. Either these data have yet to become available for Whychus Creek or the specific life stage measured is not yet occurring in Whychus.

Anadromous salmonids and resident redband trout

O. mykiss abundance

Naturally produced juvenile population size (parr)

M. Riehle
- Estimate and rate steelhead and redband parr together as O. mykiss, given the inability to differentiate the two life histories as juveniles in the field and the absence of any future plan or funding to be able to differentiate between the two on a regular basis.
- Evaluate the assumptions of the Ackerman (2007) UCM parr capacity model - this estimate may be higher than real conditions may support.

B. Hodgson
No additional comments.

M. Harrington
No additional comments.

UDWC
We grouped steelhead and redband trout abundance (KEA) for the purpose of quantifying juvenile population size (indicator) according to Mike Riehle's recommendation. Because annual releases of O. mykiss will continue for the forseeable future, we qualified the indicator as "Naturally produced" juvenile population size to clarify that we intend viability assessment ratings for this indicator to reflect the juvenile population conditions in the absence of management actions that maintain the population.

We back-calculated rating values for Poor and Fair categories and the lower boundary value for the Good category from smolt production numbers using a 50% parr to smolt survival rate for Deschutes Basin summer steelhead (Cramer and Beamesderfer 2006). We calculated smolt production numbers from steelhead adult spawner numbers as described below.

We rounded the upper boundary for the Good category and lower boundary for the Very Good category presented to reviewers from the UCM parr capacity estimate by

Ackerman et al. (2007). On Mike Riehle's suggestion, we revisited the model assumptions of this estimate. Habitat survey data used in the model were collected by ODFW and USFS in 1990 and 1997, and temperature data, provided by PGE, were from 2004. Because these data were collected under relatively impaired conditions and prior to extensive streamflow and habitat restoration, the Ackerman (2007) parr capacity estimate may actually reflect an impaired condition rather than good to very good stream conditions restoration partners aim to restore in Whychus. Subsequent to peer review we revised this number to reflect the same 50% parr to smolt survival rate used for the Poor and Fair categories. The new calculation increased the Good/Very Good category boundary value from 30,650 to 35,900 parr. Values for the Good category thus encompass the Ackerman (2007) estimate, but the minimum value for the Very Good category ultimately reflects the number of spawning adults that would characterize a Very Good status for the Whychus O. mykiss population.

Steelhead abundance

Number of adult spawners (escapement)

M. Riehle:
- Escapement can be measured and plans are in place to measure escapement (to Whychus and the Deschutes River above Lake Billy Chinook), but this metric is a marginal indicator of steelhead population status because it is affected by too many variables external to the stream system, such as the effects of harvest and ocean productivity on the population, to be used to represent conditions within the watershed.
- The Very Good category upper value of 1000 adult spawners is not a "pie in the sky" number; a very good population condition would be characterized by spawner numbers greater than 1000. Escapement was already reduced by the 1950's when Montgomery and ODFW were making estimates, including the estimate of 1000 adult steelhead spawning in Whychus, in part due to intensive fishing on the Columbia (Nehlsen 1995).
- The Middle Deschutes and Whychus steelhead/O. mykiss populations are likely the same population.
- One way to identify escapement values for Whychus and the Middle Deschutes would be to back-calculate from escapement goals for the Warm Springs River and Shitike Creek (the two components of the Deschutes Westside population of adult spawning steelhead in addition to Whychus; Carmichael and Taylor, Appendix B, p. B-33).

B. Hodgson
- Values identified for adult spawners by category are "in the ballpark".
- Be careful about interpretation: Relatively low spawner numbers that represent real gains but receive a "Poor" rating may be interpreted as a lack of progress or indicative of an unsuccessful reintroduction effort.
- The range of 200-450 adult spawners in Whychus identified as a "Fair" condition is a realistic ten-year recovery target (2022).

- Use Warm Springs River and Shitike Creek redd and spawner data as a comparison from an extant population for Viability Assessment steelhead spawner and redd numbers.

M. Harrington
- Use Lower and Middle Deschutes historical (1952) spawning numbers as a reference for Whychus/Middle Deschutes spawning values.
- External factors such as changing ocean conditions resulting from climate change have unknown effects on steelhead and salmon populations and returning adult numbers, so even if we were able to make an estimate for escapement based on historical spawning numbers, conditions beyond the watershed are unlikely to support populations at historical levels.

UDWC
Brett Hodgson recommended we attempt to access redd and spawner data for the Warm Springs River and Shitike Creek, collected by the Confederated Tribes of Warm Springs, as a comparison from an extant population for the adult spawner values identified in the Whychus Creek Viability Assessment. We abandoned attempts to access these data following multiple inquiries to the Tribes.

ODFW reports from the 1950's for the Lower Deschutes did not report on spawning numbers (R. French personal communication, 10.26.2012). We were also unable to locate escapement goals for the Warm Springs River or Shitike Creek in either the ODFW Lower Deschutes Subbasin Plan or in the Middle Columbia Steelhead Recovery Plan from which to back-calculate escapement ratings for Whychus per Mike Riehle's suggestion. Given: a) the requirement for the Deschutes Westside population to meet the criteria of a "large" population consisting of a minimum of 1500 spawning adults for the Cascades Eastern Slope Major Population Group (MPG) to attain viability; b) Riehle's assumption that Deschutes above LBC and Whychus adult steelhead comprise the same population; c) his assessment of an Upper Deschutes upper value of 1000 spawning adults as modest; and d) the low 10-year geomean of natural origin spawners at 456 including spawners from the Warm Springs River, Shitike Creek, and the mainstem Deschutes between Trout Creek and Pelton Dam (Carmichael and Taylor 2008), we suggest that an estimate of 701-1000 adult spawners establishes a target "Very Good" condition that is neither unrealistically high nor inappropriately low.

Number of spawning redds

M. Riehle
- Estimate and rate steelhead escapement and redds as separate from redband, recognizing that the accuracy of both estimates given available data may be low, and many factors beyond Whychus Creek determine steelhead escapement and spawner numbers.
B. Hodgson

No additional comments.

M. Harrington
- Redds are not a good indicator. They are difficult to detect given the high flows and turbid conditions typical of spawning season, and are difficult to identify as belonging to redband or steelhead.

UDWC
In consideration of our conversations with peer reviewers we concluded that redds are fundamentally a poor indicator because of the low accuracy of redd counts resulting from the difficulties encountered in attempting to detect and differentiate redds. We have accordingly excluded redds as an indicator of steelhead abundance in the Whychus viability assessment.

Smolt production

M. Riehle
- Smolt production is the best tool and the best indicator (for measuring fish population response to restoration, conditions in the watershed), because smolts are a product of the watershed.
- Smolt production is difficult to measure because the water drops when fish are smolting.
- PGE is trapping smolts at the mouth of the Deschutes and it may be possible to derive an estimate of smolt production in Whychus from these numbers.
- Estimate and rate smolt production for steelhead as separate from redband, recognizing that the accuracy of smolt production estimates may be low given available data. (As of 2011 there is no steelhead smolt production estimate for Whychus.)

B. Hodgson
- Smolt to adult survival is lower for hatchery produced fish than for natural origin fish, and smolt to adult survival increases as the fitness of the population increases. Accordingly:
- Use the 3.9% 1985-2002 Deschutes Summer Hatchery smolt to adult survival rate to calculate smolt production values for the Fair and Good categories.
- Use the 5.4% smolt to adult survival rate “consistent with expected higher survival rates of wild smolts” (Beamesderfer 2002) for the Very Good category.
- Use a 3% smolt to adult survival rate for the Poor category.

M. Harrington
No additional comments

UDWC
Consistent with Brett Hodgson’s recommendation, we initially used a 3.9% 1985-2002 Deschutes Summer Hatchery smolt to adult survival rate to calculate smolt production

for the upper limits of the Fair and Good categories, and a 3% smolt to adult survival rate to calculate the upper limit of the Poor category. The resulting upper limit value for the Good category, and lower limit value for the Very Good category, of 17,950 smolts, was higher than the 17,346 smolt capacity estimate by Cramer (2001), the 15,325 smolt production estimate cited by ODFW and CTWS (2008) from Ackerman et al. (2007), and the 12,960 number back-calculated from 700 adults using a 5.4% smolt to adult survival rate. Brett Hodgson pointed out that figures cited by Beamesderfer are based on returns to the Pelton trap, and suggested that survival rates be adjusted down given the likelihood of lower adult return rates to spawning tributaries above the PRB project. We ultimately selected a 4.5% smolt to adult survival rate to calculate the lower limit of the Very Good category, resulting in a smolt production number of 15,560, as a middle ground between the 3.9% and 5.4% smolt to adult survival estimates, and to reflect the higher fitness of a well-established, wild population.

Redband abundance

M. Riehle
- Estimate and rate adult redband spawners from redd counts, recognizing that the accuracy of both estimates given available data may be low.

B. Hodgson
No additional comments.

M. Harrington
- Redds are not a good indicator. They are difficult to detect given the high flows and turbid conditions typical of spawning season, and are difficult to identify as belonging to redband or steelhead.

UDWC
As discussed for steelhead abundance, peer reviewers considered spawning redds a poor indicator because they are difficult to detect with an acceptable level of accuracy given flow and turbidity during spawning season. PGE conducts redd counts in Whychus Creek annually under their Native Fish Monitoring program, representing the only data available from which to calculate adult spawner numbers. Thus the ability to quantify redband spawners or spawning as a measure of redband abundance is limited to data for which the accuracy is questionable. Because of the low accuracy believed to characterize redd count data we have excluded measures of redband abundance, other than O. mykiss juvenile population size, from the viability assessment.

Spring Chinook abundance

Number of adult spawners (escapement)

M. Riehle

- Could see chinook in Camp Polk with higher, restored flows
- Assume Middle Deschutes and Whychus are same population
- Assume Whychus supports 15% of chinook production above PRB

B. Hodgson / M. Harrington
- Too many variables for adult spawners to be a good indicator

UDWC
As with steelhead, peer reviewers considered escapement a poor indicator of stream habitat recovery because of the number of factors external to the stream system that affect adult returns. PGE's Native Fish Monitoring Plan calls for monitoring of spring Chinook spawning escapement beginning two years after smolts first outmigrated downstream of the dam (PGE 2006). Chinook smolts first outmigrated in 2009; returning adult chinook were first passed upstream of the PRB project in June 2012. According to the monitoring plan, spawning surveys and redd counts will be conducted in lower Whychus Creek from August through October.

Because escapement has been identified as a poor indicator, we are not including it as such in the Whychus Viability Assessment. However, we identified values for adult spawners for each of the viability assessment categories as the basis to calculate the number of spawning redds and smolts for each category, and have retained the adult spawner field in the viability assessment for reference.

Number of spawning redds
Smolt production

M. Riehle
- Estimate and rate redd numbers and smolt production.
B. Hodgson / M. Harrington
No additional comments.

Although PGE technicians have encountered significant obstacles in counting O. mykiss redds in Whychus Creek, spring Chinook redd counts may be more successful because they take place concurrent with the lowest flows of the year. We have retained spring Chinook redd numbers as a viability assessment indicator on this premise.

Although no smolt production estimate currently exists for Whychus, smolt production was identified as an especially good indicator of population status and ecosystem condition. PGE will attempt to measure smolt production again in 2013.

Floodplain and stream channel

Macroinvertebrates

B. Lamb
- There are models that specifically address temperature and sediment – check 2005 macroinvertebrate report. Consider the utility of these – especially sediment – as an additional metric / indicator / way of analyzing data.

C. Mazzacano
- It seems like [the Viability Assessment Indicator Rating] is another way of expressing the
health of the system, but stated in a way that focuses more on associated restoration challenges.
- I assume that each of those 4 overall ratings is comprised of multiple different biotic indicators?
- DEQ stressor models (developed in Huff et al) are what I've been using for Whychus in the analyses of the missing and replacement taxa temperature and sediment optima, to see if there is any correlation between those optima and taxa that are present or missing. It would certainly be appropriate to use them in a slightly different way (the way reported in Shannon's paper) and calculate the weighted average for the assemblage at each sampling site and see how they compare.

UDWC
Only the macroinvertebrate field of the Viability Assessment was presented to Celeste for review, hence her second comment about viability ratings being comprised of multiple different biotic indicators.

Celeste Mazzacano will calculate weighted averages in 2012 for all available macroinvertebrate data to evaluate whether weighted averages provide new or different information than PREDATOR model community composition and diversity or multimetric Index of Biological Integrity scores.

Water Quality

Temperature: Rearing and migration (7DMAX)

B. Lamb
- Use absolute values, e.g. Very Good = ≤18°C [rather than meeting a specified temperature for a percentage of data days]. [According to the DEQ] assessment methodology if there is any 7day temperature that exceeds 18*C, then that would result in a listing. So that would support the idea of NOT using 95% of data days as a way to evaluate good conditions.

- ODEQ 1995 – citation for lethal threshold for trout – may also be citation for comprehensive temp report, DO and pH.

UDWC
We reviewed the ODEQ Temperature Issue Paper (ODEQ 1995) to identify literature-based temperature thresholds for salmonids and assigned rating category values that incorporate fish requirements and state temperature standards for rearing and migration.

Temperature: Salmonid fish spawning Jan 1 - May 15

B. Lamb
- Season hasn't been defined. Look for when it will be / when it is, and until then use Jan 1 – May 15 season and cite source / location. (Lower D or John Day).
- I did talk to our standards person a little bit more about how we would apply the spawning criterion in the future. We will need to get with fish folks to help figure out what species and life stages need to be considered. If Chinook are expected to spawn there (which Brad Chalfant seemed to think might be true, based on a conversation he had with Mike Riehle), then that might mean the spawning season would start in the fall. If it is just steelhead, then it might stay more of a spring spawning season. It also sounded like Chinook spawning might trigger the summer criteria to be "core cold water" (16*C). But this is all hypothetical at this point. I would expect we would make changes when we next do a temperature standards review, which could be sooner than originally planned give the current temperature litigation.
- Is ODEQ beneficial use criterion 12.8°C or 13°C?.

UDWC
The DEQ standard for salmonid fish spawning is 12.8°C (ODEQ 2010 Integrated Report accessed online 6/14/12) Sept 1 - June 30th. This criteria is not applied to Whychus. Resident trout spawning season for DO criteria, which was applied to Whychus for 2010, is Jan 1 - May 15. We found enough evidence for a lower optimal spawning temperature than 12.8°C to support "Good" and "Very Good" rating thresholds less than the 12.8°C DEQ standard.

Dissolved Oxygen: Cold and cool water
Dissolved Oxygen: Resident trout spawning and emergence Jan 1 – May 15

B. Lamb
- Four categories (rows, indicators) total: Rearing and migration cold water; Rearing and migration cool water; resident trout spawning and emergence cold water; spawning and emergence cool water.
- The [cool water/cold water designation] break occurs around Sisters, although there is a little spot below Sisters where it pops back into cold. I asked our [DEQ] standards folks how we would apply that and they didn't exactly know because we have not done that

yet. They thought we would probably incorporate that whole area into the cool designation, unless there was a reason why it should stay as cold. And when I drilled into that area (map called Whychus_DO_Camp Polk") that is right around Camp Polk. . . which might be a reason why it should stay as cold there because of all the springs. So, I do not know what we will do as a state if/when we evaluate DO data for Whychus Creek. Our standards person also said that if we determined that lower Whychus Creek would have Chinook and be designated as "core cold water", then that would automatically mean that the cold water DO criterion would apply. So, again, not a really clear answer.

UDWC
We referenced DEQ standards and the DEQ Dissolved Oxygen Issue Paper (ODEQ 1995) to select dissolved oxygen values for cool and cold water and for resident trout spawning and emergence for each rating category. For cool and cold water, we selected the most rigorous criteria, 9 mg/l, identified as the "optimal dissolved oxygen level above 15°C" (Raleigh et al. 1984) as the upper limit for a "Good" rating and the lower limit for a "Very Good" rating. We set values for Good, Fair and Poor categories according to the dissolved oxygen requirements for cold water aquatic life. Although this standard is not applied to Whychus with the exception of a small, isolated area, there is some indication that a cold water standard is appropriate for Whychus. Similarly, for resident trout spawning and emergence, we selected values to correspond to thresholds identified in the literature and summarized in the ODEQ Dissolved Oxygen Issue Paper.

pH

B. Lamb
No comments

Hydrology

May median stream flow

B. Lamb
- What are the concerns? Not a temperature problem but a volume/physical habitat problem, i.e. non-temperature flow impacts. If it's not a temperature but a physical habitat issue, there might be a more appropriate metric, e.g. wetted width? Look at work from Lower Deschutes.

UDWC
We verified that there is in fact a spawning criteria temperature problem in May, assuming a January 1 – May 15 spawning season for resident trout. To use May median streamflow to address this problem we developed a temperature-flow relationship for May. The resulting May median flow viability rating values reflect flows required to

produce a 7DMAX temperature of 13.3°C at Road 6360, based on the Road 6360 temperature-flow relationship for May . Data were not available to calculate the flows needed to produce the resident trout spawning temperature requirement of 12.8°C.

We considered whether depth may be more important or limiting than temperature during the May low flow period, but no data were available to establish a depth-flow relationship beyond the surrogate measure for a minimum depth provided by ODFW requested flows and the state instream water right (ODFW requested flows are the same as the instream water right). Although ODFW requested flows provide a surrogate measure for a minimum depth, flows required to produce redband spawning temperatures remain higher than requested flows / the instream water right.

August median stream flow

B. Lamb
- If July 15 – Aug 15 is actual hottest “month”, use these dates for median streamflow (check if it’s a temp or phys. habitat issue)

UDWC
The majority of the hottest days on record between 2000 and 2011 have fallen between July 15th and August 15th, representing a clear temperature problem. We developed a temperature-flow relationship for Road 6360 between these dates as the basis for establishing rating category values for July 15 – August 15 median streamflow.

We eliminated minimum 30-day moving average flow as a viability assessment streamflow indicator. Because we don’t have the data to identify or address depth as a limiting factor, the minimum 30-day moving average values would be based on minimum flows needed to meet the applicable temperature requirements. These are different depending on when the minimum 30-day moving average stream flow occurs, i.e. in September v. in May. Additionally, using May median stream flow and July 15-August 15 median stream flow as indicators directly addresses temperature requirements at those two critical times.

Stream Connectivity
Entrainment Potential

UDWC
We did not seek peer review for Stream Connectivity or Entrainment Potential. Rating category threshold values for these Key Ecological Attributes are not ecologically based but instead are based on progress in modifying two sets of structures (fish passage barriers and irrigation diversions) to reduce instream hazards and make habitat conditions more suitable for fish.

Habitat Quality

Percent of surveyed stream miles rated Good or Fair

P. Kavanagh
- I think your ratings are reasonable and reflective. My only suggestion, and it is minor, would be to change the percent of surveyed habitat of good and very good. Realistically, the good and very good ratings both reflect little need for intervention and perhaps are more similar than not. You could combine them into 1 rating. If you want that fourth, 'gold standard' rating, perhaps make the percentage of surveyed miles rate 95-100%. A bit of range seems more likely to occur than a single 100% rating. Though, that may be your point that habitat rated very good is far and few between.

UDWC
We modified ratings for the Very Good category as suggested.

Channel dimension, pattern, and profile

UDWC
We did not seek peer review for the Channel dimension, pattern and profile indicator. UDWC and restoration partners are able to accomplish channel restoration projects when lands adjacent to historically channelized reaches are owned by Deschutes Land Trust, and following analysis of divergence from historical channel dimension, pattern, and profile conditions for reaches available for restoration. We established rating category values for channel dimension, pattern, and profile simply as a measurement of progress from 2009 baseline conditions toward a condition where all needed channel restoration that is possible given land ownership has been accomplished.