The Okanogan Subbasin

Management Plan

November 2004

Prepared for the Northwest Power and Conservation Council

Executive Summary

Background

The integration of scientific knowledge into management decision-making is a challenging task for scientists, public officials, planners, and environmental lawmakers. This integration is central to adaptive management, a concept that provides a framework for managers to launch the implementation of policies despite some level of uncertainty, variability, and potential risks. At the core of this subbasin plan is a deliberate design to learn from decisions and progressively fill the knowledge gaps that exist in the Okanogan subbasin. This way, management actions, whether successful or not, provide valuable information to improve our understanding of program effectiveness and influence future management decisions in subsequent iterations of the planning, implementation and monitoring cycle.

Many things are self evident in the Okanogan. Over the past century, ecosystem processes have been severely impacted, creating a fragmented mixture of altered or barren fish and wildlife habitats. Disruptions to the riverine and rangeland systems, in turn, have resulted in widespread loss of migratory pathways and access to essential habitats. Species in the Okanogan have become extinct, extirpated, endangered, or at the very least, are severely depressed. Moreover, the loss of key ecological function has resulted in alteration of the forage base, reduced overwintering ranges, elevated stream temperature and channel simplification, sedimentation problems, and in insufficient or nonexistent stream flows in many formally perennial streams.

It is important to note here the transboundary nature of the Okanogan. Unlike any other subbasin in the Upper Columbia, or most watersheds in the Columbia Basin, the ecology of these fish and wildlife populations are subject to, and dependent upon, multi-jurisdictional nuances and international management distinctions. Fortunately, both technical and policy-level coordination is taking place among and between management entities from the United States and Canada, and notable collaboration on the assessment and strategies outlined in this plan has occurred. Moreover, this has been accomplished while allowing each entity to retain their sovereign authorities, reserve management discretion, and maintain final sanction for actions as they are proposed. This is especially important since some Canadian authorities have not yet formally responded to the plan nor has the plan been reviewed by Canadian stakeholders or the Canadian public.

The citizens of the state, Okanogan County and the members of the Colville Confederated Tribes have significant interest in conservation, recovery and restoration of fish and wildlife populations, habitats and ecosystems in the Okanogan subbasin. All parties have worked together to fashion this Management Plan, and all parties have vested interests in seeing it implemented in an effective and timely manner. Tribal governments, state and federal agencies, key stakeholders and local governments have committed to work together to ensure that adequate resources are brought to bear on the factors identified in this plan. Moreover, these entities have affirmed to monitor the progress (or lack thereof) of this plan and to adaptively manage the plan elements for maximum effect and benefit at the minimum cost to the region.

The Colville Tribes have reserved rights to salmon and steelhead fishing as well as the harvest of game species and the gathering of plant material that was established with formation of their reservation. Such rights are "not to be abridged in any way." *Antoine v. Washington, 420 U.S. 194 (1975)*. Similar legislation exists for securing the Rights of Aboriginal People in Canada, such as the seven bands of the Okanagan Nation Alliance. However, largely through U.S. federal construction or licensing of 11 mainstem dams and development of irrigation projects, the salmon and steelhead runs the Tribes relied upon for ceremonial and subsistence purposes have been substantially impaired if not extirpated. This situation has been further exacerbated by the location of *all* federal hatchery mitigation *downstream* of waters accessible for fishing by tribal members.

The Colville Tribes have in excess of 8,000 enrolled members and current fishing opportunities (primarily a rod-and-reel snag fishery for summer Chinook below Chief Joseph Dam) provide a limited harvest of less than 1,000 fish annually on average. Consequently, there exists a substantial unmet demand for salmon to restore even an historic base level of tribal ceremonial and subsistence fisheries as well as ongoing need to maintain and expand traditional hunting and gathering activities.

The natural resources on the present 1.4 million acre Colville Reservation are managed for the cultural benefit of the Tribal membership consistent with the goals and objectives developed within the Tribe's Plan for Integrated Resource Management. The rights to fish, hunt and gather on the historic "North-half Reservation" also remain in place as affirmed in the 1872 Executive Order that ceded tribal lands to the U.S. government. Today, many Colville tribal members continue to pursue their cultural freedom in the hunting of big game and the gathering of roots and berries, albeit at reduced levels.

Habitat perturbations have greatly limited the recreational angling opportunity in Okanogan County communities along the Okanogan River. With spring Chinook extinct, steelhead listed as an endangered species, and summer Chinook populations limited in other than high survival years, recreational angling opportunities in the subbasin have been closed or restricted in most years. The significant economic contribution of recreational fisheries to the local economy has been nearly altogether lost in this equation.

In sum, the subbasin plan findings conclude that restoration of viable fish and wildlife populations in the Okanogan will require considerable effort and resources on both sides of the geopolitical border. Consequently, this plan stipulates and provides a biological roadmap based on ecosystem principles and focal species' ecology to guide actions. The assessments have confirmed the biological immediacy and necessity for recovery of fish and wildlife populations in the Okanogan, while substantiating their significance to the overall ecology and economy of the region. To support implementation of the subbasin plan, a regional support system is now in place where the mitigation, recovery and protection mandates of law are more clearly understood by all parties and with the initial stages of a coordinated public process and technical infrastructure well underway within the subbasin.

Scope

The following management plan is designed to identify the most prevalent and persistent factors limiting production, abundance and spatial diversity for fish and wildlife species and outline actions that can reverse and/or eliminate those limitations. This plan delineates limiting factors by the focal species affected and by the spatial extent of impact, such that strategic actions can be implemented over the life of this plan and its future iterations. Finally, specific objectives and strategies are identified so that project proposals can be developed in a collaborative forum, submitted to funding and management entities as prioritized actions, implemented, and ultimately, monitored and adaptively managed.

To achieve this, the subbasin planners have identified habitat and biological objectives that will advance the goals for each habitat type and have linked them to the assessment findings. Objectives describe the types of changes within the subbasin needed to achieve the goals, and prioritized themes and specific strategies are proposed that will provide the best chance to realize the subbasin vision described in this plan. Finally, when data are unavailable, the objectives describe the research necessary to make future decisions.

This subbasin plan embodies a restoration *and* preventative approach of protecting the viability of all affected species to preclude additional listings under the ESA and meet other conservation and protection mandates such as the Northwest Power and Clean Water Acts. This approach is less expensive in the long term and is more likely to protect existing fish and wildlife while recovering what has been lost. This plan must strike a balance between these two approaches, even while moving beyond the status quo. From a policy perspective, the planners have an interest in emphasizing not only what can be done at the subbasin level (in basin) but also what must be done *out of basin* to meet the plan goals.

Further, the Northwest Power Act establishes Bonneville's obligation to mitigate for fish and wildlife impacts from the development and operation of the federal hydropower system. This subbasin plan recognizes its obligation, in turn, to assist the Northwest Power and Conservation Council in developing a program to guide Bonneville's mitigation efforts and stage actions to accommodate budget limitations.

Ultimately, these initiatives (both within and outside the subbasin) must combine to amend events acting negatively upon the environment and host populations, and, they must, in the end, provide suitable habitat within the Okanogan subbasin in amounts and of sufficient quality to support sustainable fish and wildlife populations for the long term. This imperative is reflected in the Vision statement and in numerous other public, agency and government doctrines, Executive Orders, international treaties, and importantly, in existing statutory and case law.

In sum, this subbasin is an area where significant fish and wildlife production potential has been interrupted by indiscriminate human activities and thus, an area requiring important recovery, conservation and mitigation focus. In addition, future projects may necessarily go beyond strategies identified in this plan as new or improved information becomes available.

Vision

The management plan is designed to be consistent with, and guided by the subbasin *Vision*. The Vision for the Okanogan subbasin is consistent with the 2000 Columbia Basin Fish and Wildlife Program Vision, yet tailored specifically to the geographic region of the Okanogan subbasin and its citizenry. Within 15 years, it is envisioned that:

> *The Okanogan subbasin will support self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, which in turn, supports the economies, customs, cultures, subsistence, and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats, and ecological functions are made using open and cooperative processes that respect different points of view and statutory responsibilities, and are made for the benefit of current and future generations.*

Linkages and the Logic Path

Providing a strong linkage (see figure 1.) between the assessment, objectives and strategies, and between the Vision, monitoring plan and Foundation Principles, requires planners to associate each strategy with the limiting factors and causal mechanisms identified in the assessment. To achieve this, a logic path was developed using the following steps:

1. Collect pertinent data;
2. Conduct an assessment and analysis;
3. Identify limiting factors;
4. Develop working hypotheses;
5. Identify objectives;
6. Formulate strategies;
7. Compose *Priority Themes*;
8. Design an M&E program to test hypotheses and track plan progress, (or lack thereof), and
9. Apply an interactive path for adaptive management for tracking and updating the science and adapting the management plan goals.

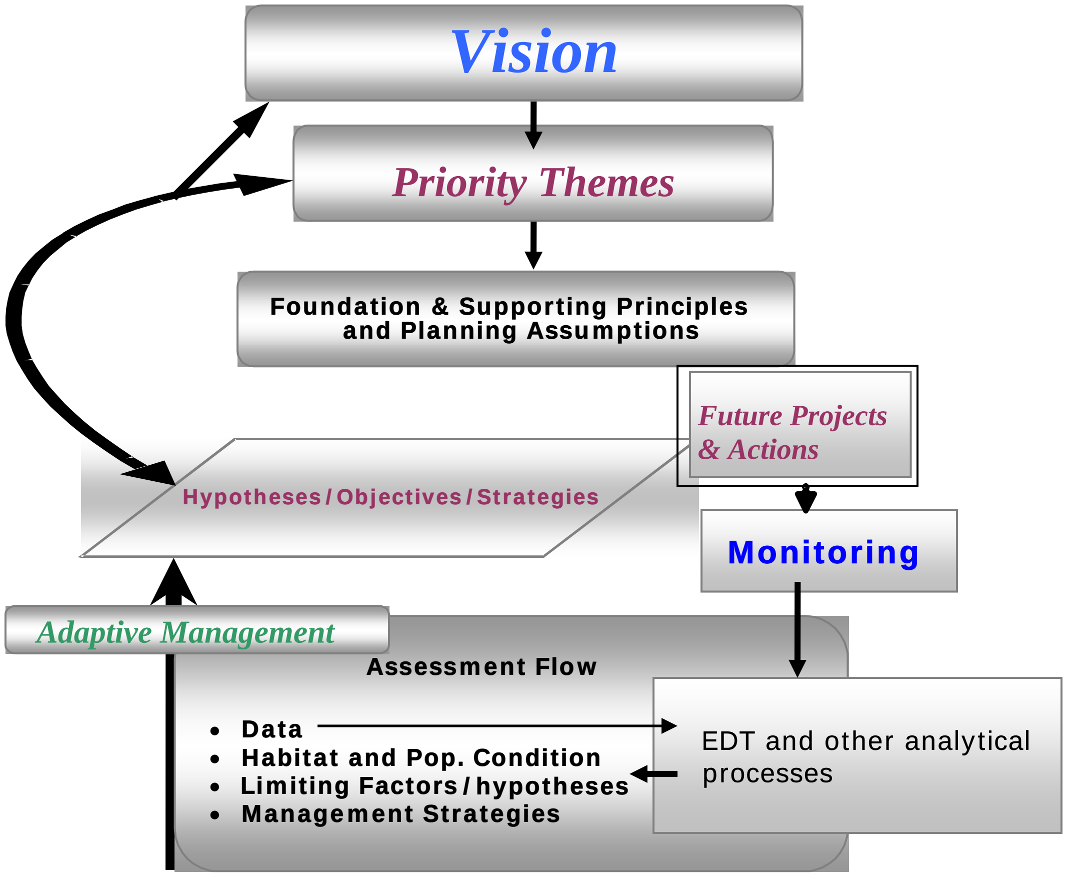


Figure 1. Logic Path for developing objectives, hypotheses and strategies (eventual actions) through the assessment process, and, the procedure for monitoring the degree of specific action(s) or theme(s) effectiveness. Adaptive management is designed to confirm or deny scientific assumptions and for tracking and informing the plan goals.

A working hypothesis is a statement that summarizes the subbasin planners understanding of the subbasin at the time of development of this plan, based on assessment data and analysis. Working hypotheses provide the rationale for the objectives and management strategies, and form the framework for monitoring and evaluation.

Strategies are sets of actions to accomplish objectives. Thus, the progression from assessment to strategy involved a step-wise analysis, peer group discussion and broad review by all subbasin planning partners, and ultimately, from the public, ISRP, NOAA, BPA and Council staff. Strategies provide the basis for prioritized actions and future projects and program proposals in the subbasin for fish and wildlife.

To address the ecological situation outlined in the assessment, a substantial and integrated collection of technical actions and policy initiatives will be required. The purpose of this Management Plan is to identify those specific actions necessary to mitigate stressors on these populations and their ecosystems *within* the Okanogan subbasin. Important and effective actions *outside* the subbasin will also be necessary to conserve fish and wildlife populations and to mitigate for human caused effects. General *out-of-basin* objectives and strategies for fish and wildlife are also listed in this Plan for context and for staging in-basin actions.

Subbasin priorities for fish and wildlife

The following prioritized “themes” summarize the overall approach for habitat protection and restoration activities in the Okanogan subbasin. They are derived from the assessment findings and designed to be consistent with the subbasin plan *Foundation Principles and Vision.* Consequently, this plan sets forth a course for implementation that recognizes the interrelated nature of these themes and the unambiguous linkages to the specific objectives and strategies they support.

1. **Actions Implemented at the Local Level.** This plan cannot succeed unless grass-roots conservation organizations, local governments, state and federal agency local units, local Native American Tribes, and watershed groups understand the identification of system-level needs and legal obligations. Further, under this implementation theme, planners will work to identify how local contributions can help meet those needs and how existing obligations contribute to responsible mitigation and recovery actions. This subbasin plan is intended to provide useful and credentialed information—as well as new tools—for use by conservation practitioners. The information and tools would be best disseminated if there were a continuing commitment to sponsoring local dialogue and refining this plan.

2. **Remove Barriers**. Wildlife, Salmon, steelhead, bull trout and other focal species have been cut off from some of the highest quality habitat in the Okanogan Basin. Getting elk and deer to winter forage, adult fish above dams and other barriers, and juveniles outmigrants out of the subbasin (and safely through the hydropower systems, estuary, and harvest regimen) represents one of the clearest opportunities in the next 10-15 years. Success in this theme will increase the abundance of fish, wildlife and improve the capacity, and diversity of listed and non-listed salmonids. For example, roads, and rail lines especially in lowlands, poses significant impediments to the migration of fish and wildlife to suitable habitat. The database of known stream crossings has recently been improved, allowing more readily accessible information on their location and ownership, the severity of the problems they cause, and their relation to upstream habitats. This, coupled with state and tribal programs to promote fish screening for diversions, represents a near-term opportunity for conservation and restoration success.

3. **Restore/Reconnect Low-Cost, High-Return Areas of the Floodplain.** Natural flow regimes, periodic flooding, complex channels, and functioning riparian areas are required to create and maintain the habitat features and dynamics that make floodplains especially productive and biologically diverse. Low gradient rivers, such as the Okanogan, require floodplains to purge sediments laterally because velocities are often insufficient to carry these sediments downstream (such as occurs in higher gradient streams). Reconnecting floodplains within the Okanogan valley is not only critical to processing sediments in main-stem areas, this natural cycle also increases nutrients available for terrestrial vegetation and agriculture. The best areas of the river and its floodplain to restore are those that have the highest potential for recovery of complex, biologically diverse habitats and those areas where local interests are likely to be supportive. The Okanogan Basin has abundant opportunities for this type of activity but this will require an active citizenry, international cooperation, and outreach efforts to make feasible.

4. **Reduce Water Temperatures Using Natural Processes.** When the river flows through gravel and sinuosity increases, important chemical and physical changes take place and the water temperature drops. Encouraging the river to flow more freely through floodplain gravels, islands complexes, alcoves and gravel bars will both increase habitat for aquatic species and improve water quality. Additionally, by reconnecting side channels and dispersing the water into more channels allows riparian shading to have a greater cooling effect. This sets the stage for what could be a powerful interaction between developed areas that are being required to meet new water standards and the ecosystem benefits that can be gained in less developed areas through enhanced stewardship of the working landscape. While this theme is related to No. 3 above, its importance to Okanogan focal species warrants distinctive attention and actions. Use of current EDT assessment findings in concert with infrared thermal and LiDAR data in the Okanagan will help planners strategically identify priority areas for restoration and conservation actions.

5. **Focus on Ponderosa Pine and Shrubsteppe Upland Habitats for Wildlife.** Wildlife and upland terrestrial restoration should focus on Ponderosa pine habitats to benefit species such as white-headed woodpecker, Pygmy nuthatch, Gray flycatcher and Flammulated owl or shrubsteppe habitat for species such as sharp-tailed grouse, mule deer, Brewer's sparrow, and grasshopper sparrow. Many threatened and endangered, unique, and rare species of plants and animals live in these habitats. The information and approaches developed in this plan should identify and provide a new capacity in the management and sustainability of these highly impacted, low elevation habitat types and associated species.

6. **Restore Instream Flow in Tributaries.** All fish and wildlife require water to survive. Many tributaries within the Okanogan subbasin that historically represented important habitats, especially for steelhead and spring Chinook, no longer have sufficient flow to support anadromous fish or wildlife needs. Developing creative solutions for restoring instream flows to levels that provide adult and outmigrant fish passage to high quality habitats, or expand the currently available habitat for spawning and rearing, are essential elements to salmon, steelhead and wildlife recovery in the Okanogan subbasin. Collaboration with water users, irrigation districts, regulatory agencies, and fish and wildlife managers to solve multiple use issues in an arid environment will be difficult, but the ecosystem benefits and restoration potential make this a valuable theme. Ecosystem benefits would produce both direct and indirect benefits such as quicker likelihood of regulatory assurances, delisting, and ultimately, conserving and/or recovering fish and wildlife species in the Upper Columbia ESU. Benefits include increased cold-water refugia, expanded riparian habitat, greater access to water for humans and animals, naturalized flow regimes, and increased bank stability.

7. **Restore Riparian and Wetland Areas.** Riparian vegetation along lowland streams, in-channel islands, and rivers in agricultural and urban areas needs to be reestablished. Riparian areas are important for both wildlife and aquatic species. Planting native vegetation along streams is a cost-effective way to improve habitat for both focal aquatic and terrestrial species (i.e. Red-eyed Vireo, Yellow-breasted chat, and beaver) in all settings: forested, agricultural, and rural. A restored level of natural vegetation is sought under this theme, with a mature and functional riparian complex within 5-10 years as the

goal. Forested riparian areas are best for shading and recruiting wood of the minimum size class necessary for pool and channel forming processes, and deep-rooted native plants acting as key elements to stabilize banks while adding important nutrients to the stream. Vegetation nearest the stream has the greatest influence, so it is most important to plant the long lengths of the stream. One contiguous zone is more useful than several shorter, disconnected zones.

8. **Continue Research, Monitoring, and Evaluation.** To put into practice effective adaptive management and make informed decisions, an on-going and disciplined commitment to research, monitoring and evaluation is a required theme. Because of the considerable lack of knowledge in the Okanogan, continued research monitoring and evaluation efforts are needed to answer even the most basic questions about fish and wildlife population status, trends, habitat conditions and life history assumptions. Evaluation of new and existing monitoring data, remote sensing data, and information from areas outside the Okanogan subbasin (e.g., mainstem, ocean and estuary) will also provide a mechanism to determine if progress is being made toward achieving the priority themes and objectives contained in this management plan. To track progress and inaugurate an adaptive management process, the management plan will rely upon a sound monitoring framework and plan outlined under the Okanogan Basin Monitoring and Evaluation Program (OBMEP). This program, in its first year of implementation, has been developed concurrently with Bonneville's pilot studies in the Wenatchee, John Day and Salmon River systems with guidance provided by the Pacific Northwest Aquatic Monitoring Partnership, the Coordinated Systemwide Monitoring and Evaluation Projects, and the federal Research Monitoring and Evaluation Program. The program is being developed in consultation with Canadian officials, and various federal, state and tribal monitoring programs and experts at the local level. Finally, this monitoring plan will continue to evolve as the region continues toward a fully integrated regional monitoring approach, but has at its core, the ability to track status and trend for fish and wildlife populations, and serve as a model for the province and region. Specific monitoring elements targeting hatchery and wild fish performance, disease, ecological interactions and other parameters are anticipated and described in this plan, and will be added as additional production programs come on line.

9. **Judicious Use of Artificial Production and Supplementation.** Hatchery production has a long history within the Columbia River basin and although not all hatchery actions have benefited fish populations, it is indisputable that without the important contributions of production programs, few viable anadromous fish stocks would exist in the Upper Columbia. It is also evident that *without* the judicious use of artificial production as a strategy in this subbasin plan, many other populations of fish could be forced to extinction. This theme, however, is strongly compelled by the transboundary nature of the Okanogan subbasin plan and the individual management policies and prerogatives of the respective co-managers. Authorities in the United States and Canada will make individual decisions on where, how and/or whether artificial production is an appropriate management strategy for the Okanogan. Fortunately, however, the collaborative scientific and policy processes that currently exist in the Okanogan/Okanagan are providing an effective forum to host in-depth discussions and form joint resolutions on this theme.

Moreover, without this theme, long-standing mitigation requirements will continue to be unmet.

Note on the Nine Subbasin Plan Themes: The abovementioned are functionally equal in priority. They are intended to be implemented in the near term to meet the Vision of this plan. Finally, they are designed specifically to recover and conserve species and meet the basic fish and wildlife mitigation obligations in the Okanogan.

Artificial Production Species Summary

Three types of production programs are proposed (U.S. only at this time):

1. Integrated recovery – hatchery-origin fish are used to increase the abundance and viability of the naturally spawning population, but can also be harvested under prescribed conditions,

2. Integrated harvest – hatchery-origin fish are produced primarily for harvest, but can also contribute to naturally-spawning populations under prescribed conditions, and

3. Isolated harvest – hatchery fish are produced solely for harvest and are not to spawn in the wild to any significant degree.

Summer/Fall Chinook: Summer Chinook are artificially propagated and released into the Okanogan subbasin as an integrated recovery program to support the conservation of the natural population and consider surplus fish for recreational and tribal ceremonial and subsistence fisheries. The Colville Tribes have proposed to expand the conservation aspects of this program to increase the abundance, productivity, and diversity of summer/fall Chinook in the subbasin.

Spring Chinook: Spring Chinook are artificially propagated and released in the Okanogan subbasin as an interim, isolated harvest program to support tribal ceremonial and subsistence fishing and provide information for a proposed, long-term integrated recovery program.

Steelhead: Steelhead are artificially propagated and released in the Okanogan subbasin as an integrated harvest program. The Colville Tribes have initiated a local broodstock program and will initiate a kelt reconditioning program to create a comprehensive integrated recovery program.

Coho and Sockeye: There has never been an artificial propagation program for coho salmon in the Okanogan subbasin. Sockeye salmon were to be propagated in the subbasin as part of the authorized mitigation program for Grand Coulee Dam. However, the sockeye hatchery was not constructed. A short-term sockeye propagation program was initiated in the 1990's at Cassimer Bar Hatchery, but suspended after only a few years as success was questionable and the direction of mitigation was shifted to habitat improvement in Canadian waters. Artificial propagation of sockeye has been initiated in Canada to reintroduce sockeye in Skaha Lake and monitor the program over time.

Additional goals for other focal species such as Pacific Lamprey, Bull Trout, Wildlife, and West Slope Cutthroat, are provided in the Management Plan sections that follow this summary.

Ecosystem-based Management Principles Adopted in the Canadian Subwatershed

The Canadian Okanagan Basin Technical Working Group (COBTWG) has adopted an ecosystem approach to the management of fisheries to guide the implementation of fisheries actions in the Canadian reaches of the Okanagan subbasin. The COBTWG meets regularly with the US Co-managers and other interested agencies in an ad-hoc forum.

The Canadian approach is guided by agreements that include principles (paraphrased from the COBTWG Terms of Reference, January 2003) related to conservation and protection of indigenous fish stocks considered at imminent risk, and rehabilitation or restoration of highly valued indigenous fish populations and their habitats to satisfy requirements for sustainable use patterns. In addition, management efforts are directed at maintenance or restoration of normative ecosystem processes considered essential to ecosystem health, and are to reflect a balance of multi-species ecosystem concerns.

Management actions are further directed by a precautionary approach, including application of an adaptive management framework for implementation of any project considered to involve moderate-to-high levels of risk or uncertainty to long-term sustainability of indigenous species within a healthy aquatic ecosystem. The adaptive management approach (consistent with figure 1.) includes:

- Adoption of a 'stepwise' approach to project implementation;
- A commitment to assessment and monitoring prior to, during, and after completion of the project; and
- A cyclical review of incoming assessment information to support a stepwise decision-making process that includes the option of project termination or reversal at any point where information clearly indicates the costs are likely to outweigh the benefits.

In addition to the elements noted under the first two bullets above, the COBTWG acknowledges support for adherence to the set of general ecosystem principles and operational guidelines adopted in May 2000 by Canada as one of the Parties to the United Nations 1992 Convention on Biodiversity.

Limiting Factors

The Ecosystem Diagnosis and Treatment process was used to identify limiting factors for anadromous fish while the Qualitative Habitat Assessment model was used for resident fish species. Finally, the Habitat Evaluation Procedure analysis was used for wildlife.

To address these limiting factors in a strategic and comprehensive manner, this Management Plan identifies strategies for each of twenty-one aquatic Assessment Units (AU's) and several key management units for terrestrial species that will effectively address key process and the disruptions and the environmental symptoms they produce. Because the identified strategies are ecosystem-based, they tend to be mutually beneficial to both fish and wildlife species, especially in riparian areas. It is also clear to that these strategies require locally supported processes that employ common analytical frameworks, outreach efforts and adequate resources for implementation of the specific actions called for in this plan.

Simply put, the assessment findings clearly point out that to conserve and reestablish populations of fish and wildlife species in the basin, many things will have to be done simultaneously. Moreover, this plan provides a detailed framework and outlines the actions necessary to modify and adapt based on the results of the monitoring and evaluation program.

Table 1. Linkages between Key Limiting Factors limiting fish populations and the objectives in the Okanogan subbasin plan. Specific strategies for fish and wildlife (actions) are presented in the Management Plan and in the individual AU summaries. See section 1.3 for a map of the Assessment Units and their location within the Okanogan Basin

Key Limiting Factor or Problem	Management Objectives	Applicable AU's
Barriers to Chinook, steelhead and sockeye migration/spawn/rearing	Plan and implement fish passage; inventory barriers. Assess passage conditions. Address thermal blocks and low flow barriers. Remover barriers or improve passage at existing barriers.	2, 3, 9, 15- Mainstem Okanagan River at McIntyre Dam. Many tributaries. McIntyre/Vaseux, Omak Creek, Salmon Creek., Vertical drop structures in Canada
Fish losses in unscreened irrigation canals	Prepare and implement screening plan. Complete survey where lacking information. Assess fish entrainment.	16 – Mainstem Okanagan River at McIntyre Dam 13 – Inkaneep Creek
Water Temperature & Dissolved Oxygen	Investigate extent of problem. Prepare plan for remedies (e.g. instream flow, flushing flows, hypolimnetic aeration, etc.) Analyze TIR and LiDAR data.	2, 3, 9, 15, 11 & 12 North, South and Central Basins of Osoyoos Lake
Predation	Investigate extent of consumption losses. Prepare plan for control	01 – 04 Lower reaches of Okanogan River 11 - Osoyoos Lake
Unknown loss of 50% returning adult sockeye between Wells Dam and spawning grounds	Use video and/or radio tagging to determine where and why losses are taking place.	1 – 12 Migratory route between Wells Dam and spawning grounds. Zosel and McIntyre Dams.
Undetermined numbers and types of Chinook and steelhead in Canadian waters	Inventory Chinook and steelhead and develop a management plan	11 - 15 Osoyoos Lake, Inkaneep, Parkrill, Shuttleworth, McIntryre/Vaseux Creek and Okanagan River. Applies to Ninemile (US) also.
Habitat Diversity	Increase LWD, Reconnect to floodplain areas. Increase side channel habitat. Install habitat boulders and artificial log-jams. Improve riparian habitats with the potential to contribute to future LWD recruitment. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.	1-8, 13-17, and 19. Lower Salmon, portions of Omak Creek, Small tributary systems. Inkaneep, McIntyre, Shingle, Ellis, Trout et al.

Key Limiting Factor or Problem	Management Objectives	Applicable AU's
Sediment	Establish baseline for M&E of sediments. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed.	1-9, 13-17 and 19. All Mainstem, especially prevalent in Similkameen and those units just below Similkameen/Okanogan Confluence. Also, Tonasket, Bonaparte, Shingle, Ellis, McIntyre and select other small tributary systems. Sources include AG and lateral erosion
Salmon Carcasses (low abundance of salmon/steelhead and their nutrients in general)	Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings. Program intended to address mortality associated with degreased growth rates etc.	All tributaries with present or historic anadromous use.
Loss of Floodplain Connectivity	Reestablish back channels, re-slope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years. Conduct a channel migration corridor analysis using existing LiDAR) data and monitor trends. Protect and re-establish groundwater sources. Protect and re-establish all ground-water sources.	1-9, 13-17 and 19. All Mainstem, especially prevalent in Similkameen and those units just below Similkameen/Okanogan Confluence. Also, Tonasket, Bonaparte, Shingle, Ellis, McIntyre and select other small tributary systems.
Mining and Other Water Quality Issues besides temperature	BMP, enforcement, clean-up of existing land-fill, pesticide dumps etc. Clean up mine tailings	Down stream effects in Similkameen, 2 and some tributary systems.

The general limiting factor prioritization approach was to:

- Estimate status of habitat processes historically and currently;
- Evaluate current and historic fish and wildlife population use of these habitats;
- Characterize actions and strategies through working hypothesis statements; and,
- Identify a list of measurable objectives, testable hypotheses, (link to M&E), and identify strategies to guide the development of projects, programs and actions for the next 15 years or more.

Table 2. Integrated priority assessment units and survival factors in the Okanogan. Priorities were determined using the EDT model for steelhead and Chinook, and the QHA method for bull trout and cutthroat trout. For survival factors, 1=primary limiting factor, 2= secondary limiting factor. Specific strategies for each AU are found in the summaries themselves.

Geographic Area / Assessment Unit	Integrated Priority Restoration Category	Habitat Diversity	Key habitat quantity	Sediment load	Obstructions	Temperature	Channel Stability	Flow	Predation	Chemicals	Pathogens	Harassment/ Poaching	Oxygen	Food	Competition (other species)	Competition (hatchery fish)	Withdrawals
Lower Salmon	A	1	1	2	1	2	1	1					2				
Similkameen River	A	1		1	2	2	2	2	2	1	1	2					
Omak Creek	A	1	2	1	1		1	2	2					2			
Okanogan Middle	B	1		1		1	2		2	2							
Okanogan Lower	B	1	1	1		1			2	2		2					
Okanogan Upper	B	1		1		1			2	2							
Vaseux/McIntyre	B	1					2	1									
Canada mainstem to Okanogan Lake	B	1	1		1		2		2			2		2			
Skaha Lake	B				1						2				2		
Inkaneep Ck	B	2	1	1	1	1	2										
Canada mainstem middle	B	1	1		1			2	2		2	2					
Vaseux Lake and Mainstem Reaches	C	1	1			2	2		1		2		2		2		
Canada mainstem Lower	B	1	1			1	1				2	1					
Osoyoos Lake South Central	B					1			2		2		1				
Small Tribs (Middle and Upper Basin)	C	1	1	1	1	2	1	1	2	2		2		2			
Loup Loup	C	1	1		1			1									
Upper Salmon	C	1	1	2		2		2		2							

Examples of the linkage process from this plan take the general form (e.g., *Middle Okanogan* Assessment Unit):

For fish:

Example Limiting Factor: loss of habitat diversity

- Hypothesis 3: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead and sockeye in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye plus increase spawning distribution for summer/fall Chinook.
- Objective 3-1. Protect and enhance rearing and prespawn holding and rearing habitat by 5% for steelhead, sockeye, and Chinook using in-stream structures.
- Strategy 3-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for prespawn migrant holding areas.
- Strategy 3-1B. Improve riparian habitats with the potential to contribute to future LWD recruitment.
- Strategy 3-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

For wildlife:

Example Limiting Factor: loss of habitat type

- Goal: Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3 (Inventory and Assessment).
- Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitat to sustain focal species populations.
- Identify and distinguish ecologically functioning and non-functioning ponderosa pine habitats, corridors, and linkages.
- Identify sites that are currently not in ponderosa pine habitat that have the potential to be of high ecological value, if restored.
- Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.
- Strategies:
- Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
- Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).

In this plan, working hypotheses provide the "testable" part of the management plan; objectives can be thought of as the mileposts or Plan performance standards; while the strategies act as the precursors to planned actions or future project proposals.

The relevant processes that have been subject to the most disruptive change for terrestrial species in the Okanogan are habitat loss, fragmentation and range land degradation.

For aquatic species, loss of instream flow, simplification of channel form and loss of floodplain connectivity have combined to limit/eliminate habitat productivity altogether.

The EDT model estimated the potential increase in salmon/steelhead performance because of restoration and protection actions in two ways; 1) unscaled % increase in life history diversity, productivity, and abundance 2) rank of each assessment unit based on the sum of potential increase in each of the categories. However, because of uncertainties of modeling results, ranks were converted to categories (A,B,C,D) which approximate high, moderate, and low priority assessment units for each species.

In summary, this plan identifies specific strategies to accomplish the plan goals and organizes them in a logical and balanced sequence; a sequence supported by the assessment findings and an identification of primary limiting factors.

Implementation of the subbasin plan

This subbasin plan will take years to implement fully. Its concepts and strategies will be continually tested, monitored and adaptively managed. The monitoring program described in this plan is designed to provide the information necessary to test, learn and adapt. Adequate resources and a consistent monitoring approach will also be required to form the foundation for an effective implementation strategy.

Patience and persistence are prerequisites for success, especially in the case of the Okanogan because much work needs to be done. It also will take years to detect the full benefits or failures of any one action or combination(s) of actions.

In practice, adaptive management is a process for implementation and for taking action where limited information is available. In the Okanogan subbasin plan, adaptive management provides a robust tool for ensuring that timely feedback from diverse activities informs the re-direction of future actions and that action effectiveness is steadily increased over time.

In their seminal work applying adaptive management in a hydropower context, Professor Kai Lee and the late Jody Lawrence wrote:

> *Adaptive management is learning by doing... Adaptive management is both a conceptual approach and a strategy for implementation. As a conceptual approach, it sets a scientifically sound course that does not make action dependent on extensive studies. As a strategy for implementation, adaptive management provides a framework within which measures can be evaluated systematically as they are carried out. Adaptive management encourages deliberate design of measures. This assures that both success and failures are detected early and interpreted properly as guidance for future action. Information from these evaluations should enable planners to estimate the effectiveness of protection and enhancement measures on a systemwide basis. Measures should be formulated as hypotheses. Measures should make an observable difference. Monitoring must be designed at the outset.* ***Biological confirmation is the fundamental measure of effectiveness*****.** (Emphasis added.)

1.1 Management Plan

This management plan provides detailed guidance on strategies to address limiting factors for fish and wildlife populations in the Okanogan subbasin. The plan is a derivative of the following subbasin plan elements (also see Figure 2.):

1. Vision, Goals, Principles and the Subbasin Plan Foundations;
2. A technical assessment of habitat conditions and inventory of past and ongoing activities;
3. A synthesis of key findings;
4. Identification of factors limiting viable fish and wildlife populations;
5. Development of hypothesis, objectives and strategies for each habitat assessment unit or population;
6. Identification of biological goals at the populations level, and
7. An adaptive management process

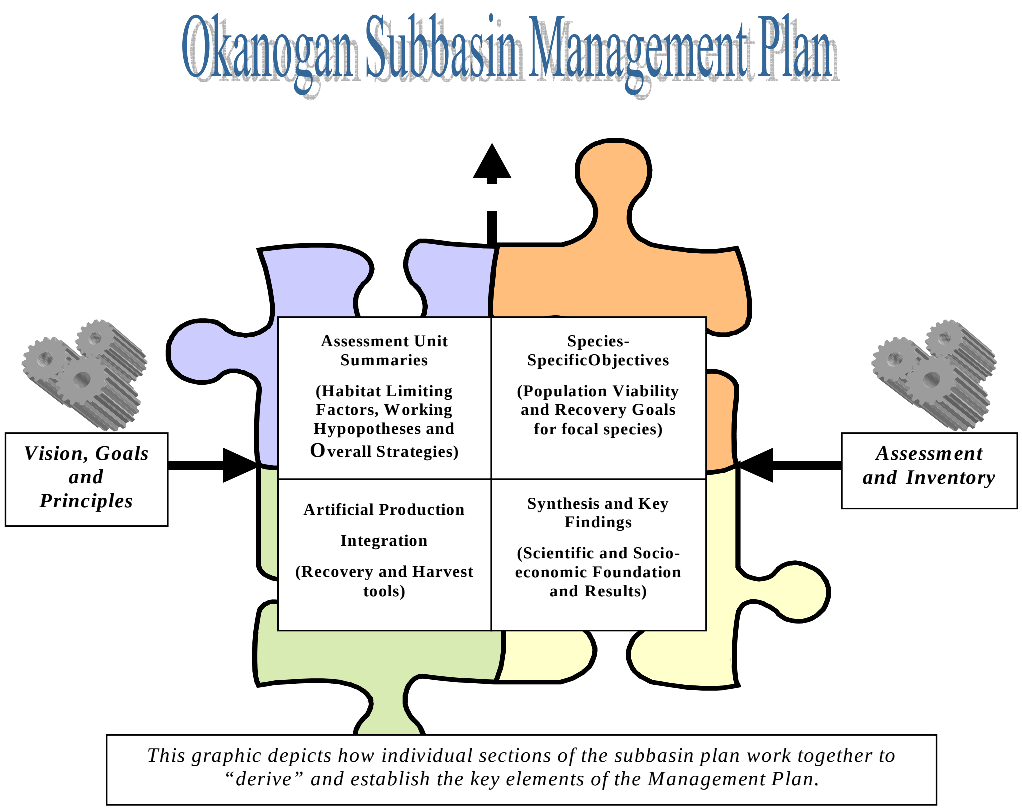


Figure 2. Schematic showing how planners derived the Management Plan from various and supporting subbasin plan elements. Integration between all parts of the subbasin plan and planning effort was necessary to construct an effective and consistent management plan.

1.2 Foundation Principles

A set of foundation principles have been developed that are reflected in the following framework of six key elements that include the natural and cultural systems upon which the subbasin plan is built.

1. Economies, customs, cultures, subsistence, and recreational opportunities within the basin;
2. Regulation of land use;
3. Out of basin effects;
4. Long term sustainability;
5. Fish and wildlife habitat; and
6. Connectivity

Application of our principles

The Okanogan subbasin plan recognizes the following principles of general application. It is intended that all projects developed from the framework provided in this subbasin be consistent with these principles:

1. **Economies, customs, cultures, subsistence and recreational opportunities within the basin.** The people of the Okanogan subbasin are diverse and independent. They value a wide range of customs and cultures. Actions, strategies, programs, and projects for fish and wildlife and their habitats will be more successful if developed in context with the basin's economic needs, opportunities, and with an understanding of the impacts to the human environment in the basin

   a) Activities associated with the subbasin plan, undertaken to protect and/or restore fish and wildlife, have the potential to improve opportunities for cultural and recreational uses and, thus, the social and economic well being of the communities. Strategies and projects should be reviewed and evaluated based on the potential for such positive impacts and methods developed to measure and monitor the success of such efforts.

   b) The cost of actions to implement the Okanogan subbasin plan is estimated in relation to benefits. Within the context of priorities established to recover listed species, and mitigate the effects on others, alternatives that achieve the greatest benefits at the least costs are preferred.

2. **Consideration of social costs and likely benefits should include the effects of implementation on short- and long-term economic stability in the subbasin.** Consideration should include (but is not limited to) project feasibility, cost-share opportunities, longevity, economic opportunities and benefits, effects on electrical rates, development and regulatory costs, and public land ownership.

   a) Actions derived from the Okanogan subbasin plan are undertaken with the understanding that the natural environment, including its fish and wildlife resources, is the cultural heritage that is common to the diversity of human existence; and that such actions play a key role in the long-term sustainability of the common cultural heritage within the subbasin.

b) Acknowledgement, integration and balancing of human, fish and wildlife needs will be necessary to ensure the successful implementation of this plan. Okanogan subbasin stakeholders' values are clearly stated and reflected in this process.

c) Actions derived from the Okanogan subbasin plan will be consistent with Federal Tribal Trust responsibilities and obligations, and with exiting statuary and case law.

d) Recreational opportunities are provided for diverse user groups, consistent with conservation and enhancement of subbasin resources.

e) Programs and actions are monitored and evaluated for effect, and may be altered as necessary to achieve the intended results, recognizing that science, strategies, and the approach to restoring and protecting ecosystems is evolving.

3. **Regulation of land use.** The ability to implement protection or restoration strategies will require a close and cooperative relationship between federal, state, tribal, and local governments and a wide range of interest groups. Protection and/or restoration strategies that affect land use will require action (for both the adoption and implementation) by local, state, federal and/or tribal governments.

   a) No existing water right is affected by actions derived from Okanogan subbasin plan without the consent of the holder of that right.

   b) The processes of subbasin plan preparation, implementation (including project development and planning), and amendment are open, voluntary, and collaborative.

   c) Actions derived from the Okanogan subbasin plan acknowledge the statutory authority of local, state, federal and tribal governments and existing plans, programs, and processes.

   d) Future land use planning and activities that involve potential impacts to fish and wildlife and their habitats should be fully discussed with the agencies and tribes with management authority prior to implementation.

4. **Out of basin effects**. The Columbia River basin is characterized by natural environmental variability, fluctuation in production and established human urban and rural activities. Restoration and management of fish and wildlife and their habitats in the Okanogan subbasin must consider both in- and out-of-basin effects within the entire Columbia River basin ecosystem, natural and cultural, including freshwater, estuary, and ocean.

   a) Strategies for recovery or maintenance of self-sustaining populations need to be evaluated within the context of the entire life history of the populations, and not just within the life history stages within the subbasin geographic area.

b) Important environmental attributes that determine the distribution and productivity of fish and wildlife populations have been influenced by natural and cultural activities in and outside the subbasin.

5. **Long-term sustainability**. Life history, genetic diversity, and metapopulation organization are ways that fish and wildlife adapt to their habitat. Diversity and population structure are how fish and wildlife species adapt to spatial and temporal environmental variations. Such diversity promotes production and long-term persistence at the species level.

    a) In addition to fish and wildlife populations that support the custom, culture, subsistence, and recreational opportunities in the subbasin, indigenous fish and wildlife species should be enhanced and restored to be self-sustaining.

    b) For aquatic- and fish-related interests, selection of a broad range of focal species provides a basis for development holistic management strategies. For terrestrial- and wildlife-related interests, the selection of focal habitats and related focal species provide a basis for developing holistic management strategies.

    c) Biological inter- and intra-specific interactions shape fish and wildlife populations. Restoration of individual populations may not be possible without restoring other fish and wildlife populations with which they co-evolved.

    d) Most native fish and wildlife populations are linked across large areas and do not consider political borders, thus reducing the possibilities for extinctions or extirpations. An important component for recovery of depressed populations is to work within this framework and maintain or recreate large-scale spatial diversity.

    e) Populations with the least amount of change from their historic spatial diversity are the easiest to protect and restore, and will have the best response to restoration actions.

    f) Small populations are at greater risk of extinction than are large populations, primarily because they are more vulnerable to environmental changes such as catastrophic events.

6. **Fish and wildlife habitats.** Fish and wildlife productivity requires a network of complex, interconnected habitats that are created, altered, and maintained by both natural and human processes in terrestrial, freshwater, estuary, and ocean areas.

    a) The habitat in the Okanogan subbasin should be capable, of supporting self-sustaining, harvestable, and diverse populations of fish and wildlife just as they did historically.

    b) Physical characteristics of the alluvial valley and floodplains of the Okanogan River have changed ecosystem attributes, and restoring watershed processes, where possible, will require a long-term collaborative commitment to fish and wildlife recovery.

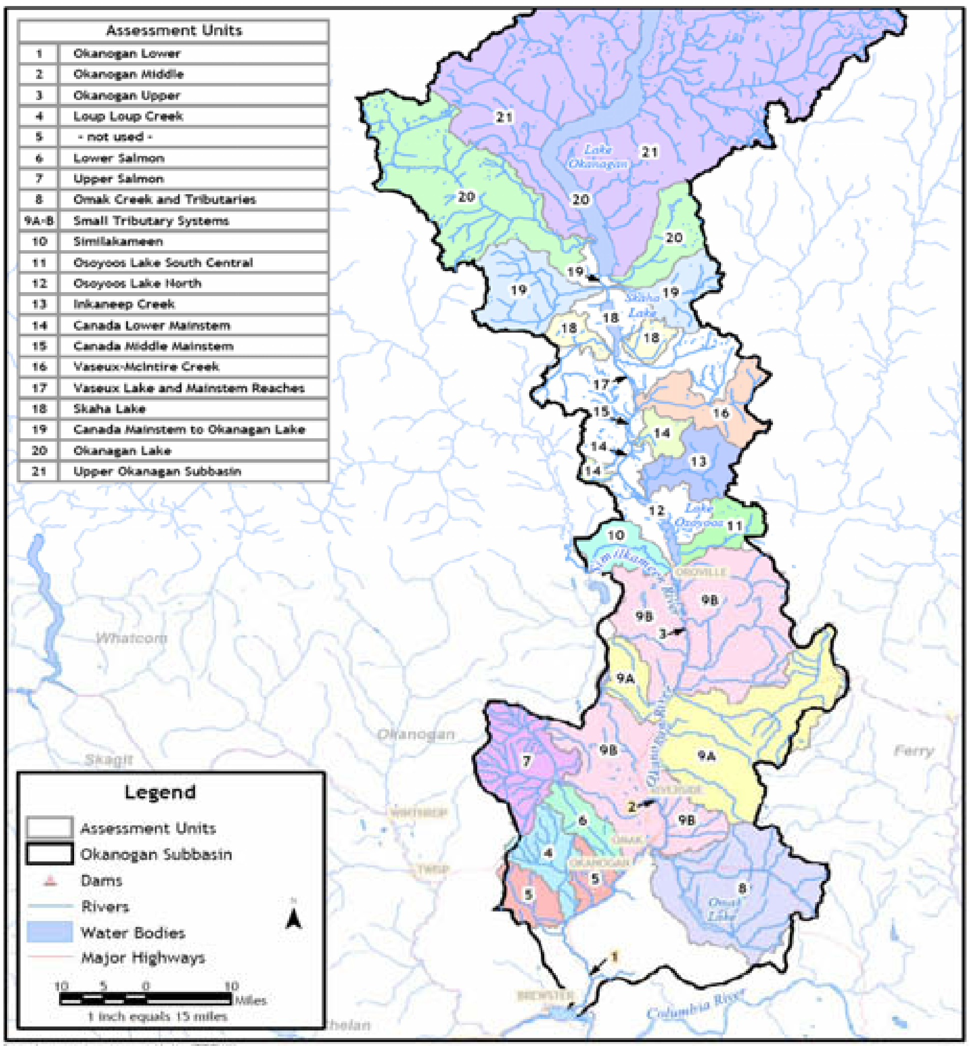
    c) The Okanogan subbasin is a dynamic system that will continue to change through natural events and human activities.

7. **Biological Interactions and Connectivity**. Population, abundance, diversity, and the biotic community reflect ecosystem attributes. Co-evolved assemblages of species share requirements for similar ecosystem attributes, and require connectivity among them.

   a) Sustainable, harvestable and diverse populations of fish and wildlife are dependent upon properly functioning environments and the processes that sustain them.

   b) Changes to the physical characteristics and connectivity of the Okanogan subbasin have contributed to the changes of native fish and wildlife populations; therefore reconnecting the native ranges of fish and wildlife species is critical.

1.3 Assessment Unit Summaries for Focal Fish Species



Data Layers: Assessment Units (TTFWI),
Subbasins and Dams (Streamnet, TRIM),
Counties & Major Rivers (WA Ecology, TRIM),
Major Highways (WashDOT, ESRI)
Projection: Washington State Plane North Zone NAD83
Produced by Jones & Stokes for KWA Ecological Sciences, Inc.
Map Date: 5/15/2004

Figure 7
The Okanogan Subbasin and Subwatersheds in Relation to Assessment Units

The following detailed Assessment Unit Summary Sheets were developed to guide project proponents in coordinating current or future activities within the entire Okanogan River ecosystem. The Assessment Unit's geography was chosen because the scientific data suggested similarities relative to habitat conditions among locations. Twenty-one Assessment Units (AU's) were identified for the Okanogan subbasin.

Considerable similarities between how habitat conditions affected the different species existed among the AU's. In taking the step of dividing the subbasin into these units, it was found that trade-off analysis and multiple iterations of planning was reduced by focusing actions in areas and on habitat attributes that fell within certain feasibility criteria as expressed in the Foundation Principles and the six course-scale filters described below

Scientific underpinnings

Reach analysis tables (EDT consumer reports tables) were used to determine primary and secondary limiting factors within each Assessment Unit. The Subbasin Core Team factored in the results of assessments on focal species and across all reaches in each assessment unit. In general, a survival factor was considered a primary limiting factor if there was high or extreme impacts to key life stages. Exceptions included some reaches where sediment load or temperature only had a high impact to spawning or egg incubation. Additionally, a survival factor was considered a primary limiting factor if there was small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme influences to fewer life stages. Secondary limiting factors generally had small to moderate impacts to several (5-8) life stages. An exception occurred with the survival factor "food"; when there was small to moderate impacts to two or three juvenile life stages in most of the reaches of a particular assessment unit, it was considered a secondary limiting factor. In most reaches and assessment units, the break between primary and secondary limiting factors was obvious.

In some cases where EDT results were not as obvious, other assessment processes and information, such as the Limiting Factors Reports, RTT reports, professional opinion, and local knowledge were then factored into the decision.

The assessment provided a functional tool for addressing habitat needs but did not provide information that was needed to address research, hatchery production, regulatory needs, or political realities. Therefore, it was necessary to incorporate these items using a less robust method of expert opinion. Using a combination of approaches that covered the entire spectrum of natural resource management strategies allowed the flexibility needed to complete a more comprehensive plan than would be possible by focusing on the assessment and habitat issues alone.

Finally, the working hypotheses in these summaries are the "testable" part of the science equation. The strategies themselves provide the metrics for testing and form the most appropriate foundation for the monitoring and evaluation program.

Six course-scale filters were then used to guide the development of strategies:

1. Does the strategy help incorporate one or more of the priority themes?
2. Does the strategy address one or more of the focal species?
3. Is the strategy supported by science and by the assessment findings?
4. Is the strategy effective relative to the cost?
5. Does the strategy have (or is it likely to achieve) public support?
6. Are resources available to implement the strategy and monitor the outcomes—including enforcement where relevant?

Assessment Units: 01 – 021 (U.S. AU Summaries = 1-10, Canada 11-21)

ASSESSMENT UNIT: O1—Okanogan Lower

REACHES: 8

1	2	3	4	5	6	7	8

FOCAL species: Primarily Sockeye salmon, summer/fall Chinook salmon, and steelhead.

Drainage area: Approximately 134 acres of mainstem or 36 river miles

SUBWATERSHEDS Chilliwist, Talent, Davis Canyon, Dan Canyon, Loup Loup (also connectivity to mainstem Col. R which is important rearing and prespawning holding area)

ASSESSMENT UNIT DESCRIPTION: This AU begins at the mouth of Okanogan river and terminates at the Mouth of Salmon Creek near the town of Okanogan. This is 1 of 11 in the US and 1 of 21 combining the US and Canadian portions of the Okanogan subbasin. Reaches from the historic channel (reach 1 especially and 2-4 significantly) are now inundated by the Wells dam reservoir. Effects of inundation can be traced up to approximately Chiliwist Creek. Width to depth ratio is very high in the lower reaches and the channel is moderately constricted by road (Hwy 97) and railroad beds in the middle and upper reaches. Land use is dominated by agriculture (soft fruits and hay operations). Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye are the predominating life history stages in this AU. In Okanogan 1, 2 and 3, habitat quantity was gained as a consequence of Wells dam pool inundation. Fall Chinook production has been reduced in this AU due to hatchery practices that have concentrated all production in the upper AU's and selected against the late arriving, or fall, component in broodstock programs. The primary limiting factors are lack of habitat diversity, sedimentation, and temperature however many of these impacts were created by the inundation from the Wells pool and are therefore unlikely to change in the near future. The data currently available for this section of the Okanogan River is relatively poor and additional habitat information may provide better insight into ways to reduce the inundation impacts. Addressing predation impacts and ensuring that all water withdrawals are properly screened are the most likely ways to improve anadromous fish production in the assessment unit. Replacing lost production by using hatchery supplementation would be another way to offset the inundation impacts from the Wells pool. Hatchery supplementation could also be used to reseed habitats above the inundated zone were considerable habitat that is particularly well suited to summer/fall Chinook production currently exists but is under utilized.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

S-Predation (avian and some exotic fish)

P-Loss of Habitat Diversity in many reaches and at multiple life stages.

P-Sediment

S-Some harassment.

P-Loss of habitat quantity.

P-Prespawn holding habitat loss.

S-Winter temp for sthd

S-High summer temp for spck (if tributary habitat is still in poor condition)\

S-Chemicals

Additional LFA comments:

(all related to flow) Impervious surface, floodplain connectivity, reservoir operations and withdrawals. Generally the influences from changes to the hydrograph in tributaries are captured in EDT. Mainstem areas are affected, but it is unknown to what

ASSESSMENT UNIT: O1—Okanogan Lower

REACHES: 8

1	2	3	4	5	6	7	8

degree (data gap for mainstem).

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 1-1. Provide tribal and selective recreational harvest opportunities for summer/fall Chinook, summer steelhead, sockeye salmon, and spring Chinook were feasible.

Strategy 1-1A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-1B. Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings.

Strategy 1-1C. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Objective 1-2. Increase the number of spawning summer/fall Chinook in this AU by 50%

Strategy 1-2A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-2B. Develop in-stream structures to sort gravel and reduce fine sediment accumulation.

Strategy 1-2C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity.

Hypothesis 2: Increasing habitat diversity (i.e. providing resting and rearing cover) in the middle and upper reaches of the AU will increase survival for summer/fall Chinook, steelhead and sockeye in the 0-age active rearing, prespawn migrant, and prespawn holding life stages.

Objective 2-1. Protect and enhance rearing and prespawn holding habitat by 5% for steelhead, adult sockeye and Chinook using in-stream structures.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for prespawn migrant holding areas.

Strategy 2-1B. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 2-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Objective 2-2. Control poaching and unauthorized take of adult steelhead and salmon.

Strategy 2-2A. Increased enforcement emphasis, fisheries and river use regulations.

Strategy 2-2B. Use sportsman shows and community events to educate anglers on regulations, ethics, and how they can assist in management efforts.

Hypothesis 3: Reducing fine sediment input throughout the Okanogan subbasin will reduce embeddedness by 10% in this assessment unit. (Direct activities in this assessment unit are unlikely to product tangible results).

Strategy 3-1A. Establish baseline for embeddedness.

ASSESSMENT UNIT: O1—Okanogan Lower

REACHES: 8

1	2	3	4	5	6	7	8

Strategy 3-1B. Monitor embeddedness and evaluate trends at EMAP sites.

Objective 3-2. Increase floodplain connectivity along an additional 10% of the assessment unit where feasible to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2 years on average.

Strategy 3-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 3-2B. Determine pre-settlement riparian corridor.

Strategy 3-2C. Restore and conserve historic riparian corridor.

Strategy 3-2D. Protect and re-establish all ground-water sources.

Hypothesis 4: Predation on juvenile salmonids is a limiting factor. Removal of predators will increase survival of steelhead, sockeye and Chinook in the subyearling, yearling, and age 1 and 2 prespawn migrants.

Objective 4-1. Reduce the overall abundance of aquatic predator species by 10% that are known to consume juvenile salmonids (i.e. walleye, smallmouth bass, and northern pike minnow) from all reaches to increase juvenile salmon and steelhead survival.

Strategy 4-1A. Determine baseline predator abundance and consumption rates.

Strategy 4-1B. Eradicate aquatic predators targeting those that have the highest salmonid consumption rates using selective harvest techniques.

Strategy 4-1C. Monitor predator abundance annually and evaluate trends.

Objective 4-2. Determine avian and terrestrial predation rates.

Strategy 4-2A. Determine if non-aquatic predators are consuming significant numbers of salmonid juveniles; determine species, and effective control methods.

Objective 4-3. Determine economic and recreation impacts to salmon and steelhead populations.

Strategy 4-3A. Determine the economic benefits and cost associated with recreational angling along the Okanogan River.

Strategy 4-3B. Conduct creel census of salmon and steelhead caught on the Okanogan River.

Strategy 4-3C. Determine impacts to salmonid populations from recreational activities other than angling that occur along the Okanogan River.

Hypothesis 5: Adult enumeration of salmon and steelhead is critical in this AU and will determine the proportion of adults returning to the Okanogan subbasin verses other subbasins located above Wells Dam. (Note: This has been an acknowledged data gap for many years).

Objective 5-1.Evaluate and monitor the trend in adult returns to the Okanogan subbasin as a method to determine the cumulative success or failure of proposed actions.

Strategy 5-1A. Establish a counting station to monitor migrating adult salmonids.

Strategy 5-1B. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 5-1C. Coordinate data sharing with all agencies with management authority to provide information for adaptive management.

Hypothesis 6: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 6-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Ensure no impact to

ASSESSMENT UNIT: O1—Okanogan Lower

REACHES: 8

1	2	3	4	5	6	7	8

upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 6-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 6-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 6-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 6-1D. Use permits, or other local, state and federal approval mechanisms, to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 6-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 6-1G. Use cost-sharing programs to help landowners screen diversions.

Note: Some of the documented Limiting Factors probably cannot logistically or cost effectively be addressed (sediment for instance) in reaches 1-2 due to significant and insurmountable inundation effects from the Wells Pool. High temperature is a limiting factor in the lower reaches of this AU, however, as with sediments, it is unlikely that any management strategies can logistically or cost effectively be implemented. Some improvements for both temperature and sediment will be realized through increases in habitat diversity (e.g. riparian function, instream structure and land use practices) in the upper reaches and the AU area.

DATA GAPS AND M&E NEEDS:

Stream reach corridor data.

Juvenile outmigration and use.

Adult emigration data.

Predation levels and consumption rates.

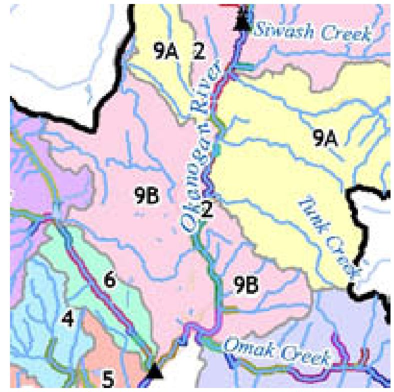
Economic information and harvest activities

Baseline habitat and monitoring information

ASSESSMENT UNIT: O2—Okanogan Middle

REACHES: 18

9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**



FOCAL species: Primarily Sockeye salmon, summer/fall Chinook salmon, and steelhead.

Drainage area: Approximately 62 river miles.

SUBWATERSHEDS: Salmon, Omak, Antoine, Wanacut, Tunk, Bonaparte, Siwash, Tonasket, Whitestone, Aeneas, Johnson

ASSESSMENT UNIT DESCRIPTION: This AU begins at the mouth of Salmon Creek in the Town of Okanogan and ends just North of the City of Tonasket at the mouth of Antoine Creek. The AU is dominated by both meandering and confined mainstem channel conditions. This section contains a high proportion of sand and silts due to input {What type of input??} from Canada and US and low gradient and velocity in these reaches. This section also provides important spawning areas for summer/fall Chinook in areas where water velocities scour gravels clean or near areas with tributary influences. Temperature, sediment, lack of habitat diversity, and low remaining natural population numbers are major limiting factors for this assessment unit. Sediment and temperature issues are chronic and stem from mostly upstream sources and therefore little can be done to rectify this situation in this reach. Improving habitat diversity and increasing population numbers returning to this assessment unit would reduce sedimentation issues in spawning areas as a by-product. Hatchery production would assist in the reclamation of under-utilized spawning areas and increase production within this assessment unit especially for summer/fall Chinook. Tributaries flowing into the Okanogan River throughout this assessment unit provide only a small fraction of their historic flow during summer months due to high irrigation demand in this area. Reduced tributary flows result in lost gravel recruitment and lack of coldwater refugia ,therefore it is important to address instream flow issues throughout this AU..

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Reduced natural population numbers

P-Habitat Diversity

S-Predation

P-Sediment

S-Channel stability

S-Chemicals

S-Temp (winter)

P-Temp (summer)

P-Prevent future artificial barrier and irrigation diversion impacts

Additional LFA comments:

(all related to flow) Impervious surface, floodplain connectivity, and withdrawals. Generally the influences from changes to the hydrograph in tributaries are captured in EDT. Mainstem areas are affected, but it is unknown to what degree (data gap for mainstem).

Refer to Appendix B for reference and specific detail by reach and species

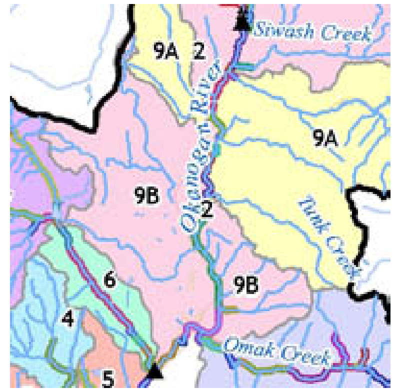
Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities (including ceremonial and subsistence harvest), provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts as a result of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management

ASSESSMENT UNIT: O2—Okanogan Middle

REACHES: 18

9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24



Plans and the artificial production section of this plan)

Objective 1-1. Provide tribal and selective recreational harvest opportunities for summer/fall Chinook, summer steelhead, sockeye salmon, and spring Chinook were feasible.

Strategy 1-1A. Build summer/fall acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-1B. Increase or maintain artificial production capacity at levels necessary to meet management needs.

Strategy 1-1D. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends (refer to OBMEP and CJDHP M&E program goals).

Objective 1-2. Increase the number of spawning summer/fall Chinook in this AU by 50%

Strategy 1-2A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-2B. Develop in-stream structures to sort gravel and reduce fine sediment accumulation.

Strategy 1-2C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity.

Hypothesis 2: Increasing water quality will increase survival for Chinook, steelhead and sockeye, including the following life stages: Juvenile rearing, prespawn holding and active migration..

Objective 2-1. Remove this reach from the Washington Department of Ecology 303(d) listing. This delisting would reduce the chemical impact to all species.

Strategy 2-1A. Address non-point source and point source pollution.

Strategy 2-1B. Remove and properly dispose of contaminated sediments.

Objective 2-2. Reduce summer water temperatures for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 2-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 2-2B. Protect existing shading and plant additional trees and shrubs in areas of exposed rock.

Strategy 2-2C. Protect and re-establish all ground-water sources.

Hypothesis 3: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead and sockeye in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye plus increase spawning distribution for summer/fall Chinook.

Objective 3-1. Protect and enhance rearing and prespawn holding and rearing habitat by 5% for steelhead, sockeye, and Chinook using in-stream structures.

Strategy 3-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for prespawn migrant holding areas.

Strategy 3-1B. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 3-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Objective 3-2. Increase spawning habitats for summer/fall Chinook by 5% to increase egg-fry survival.

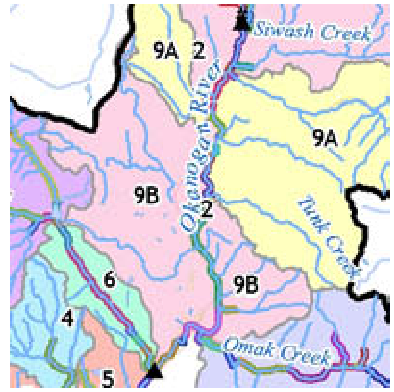
Strategy 3-2A. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 3-2B. Create side-channel habitats, islands, spawning channels, and reconnect back channels to create spawning areas away from the main channel.

ASSESSMENT UNIT: O2—Okanogan Middle

REACHES: 18

9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24



Hypothesis 4: Fine sediment reduction throughout the Okanogan subbasin will reduce embeddedness and width to depth ratios. (Direct activities in this assessment unit are likely to produce only limited benefits) The following life stages would benefit from these activities: incubation, rearing, prespawn holding and rearing mainly for Chinook and steelhead, but possibly migration for sockeye.

Objective 4-1. Reestablish normative width to depth ratios of 10:1.

Strategy 4-1A. Establish baseline for existing width to depth ratio and embeddedness.

Strategy 4-1B. Monitor width to depth ratios and embeddedness annually and evaluate trends.

Strategy 4-1C. Reslope vertical banks and reestablish riparian plant communities

Strategy 4-1D. Stabilize sloughing banks using soft techniques wherever possible and armoring when necessary.

Strategy 4-1E. Use barb and bail techniques to manage sediment loads and move channel away from sensitive banks and reestablish plant communities.

Strategy 4-1F. Grazing access to the riparian corridor should be limited.

Objective 4-3. Increase floodplain connectivity along an additional 10% of the assessment unit, where feasible, to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2-years on average.

Strategy 4-3A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 4-3B. Determine pre-settlement riparian corridor.

Strategy 4-3C. Restore and conserve historic riparian corridor.

Strategy 4-3D. Monitor the proportion of functional riparian area that currently exists verses historic.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.

DATA GAPS AND M&E NEEDS:

Monitor ongoing TMDL for toxics (DOE, EPA)

Increase the quality and quantity of real-time water quality data

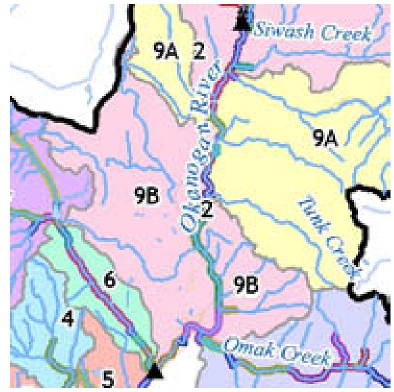
Embeddedness/Width to depth ratio

Mainstem effects from changes to hydrograph

ASSESSMENT UNIT: O2—Okanogan Middle

REACHES: 18

9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
17	**18**	**19**	**20**	**21**	**22**	**23**	**24**



Acquire targeted empirical habitat data through coordinated, subbasin-wide M&E effort.

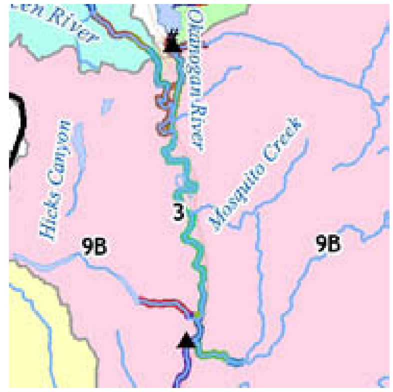
Increase fish monitoring for annual adult returns and juvenile/smolt production.

ASSESSMENT UNIT: O3—Okanogan Upper

REACHES: 9

(US reaches only. See Canadian AU's for additional reaches in upper watershed)

25	**26a**	**26b**	**27**	**28**	**Bf1**	**29**	**30**	**31**



FOCAL species: Primarily Sockeye salmon, summer/fall Chinook salmon, and secondarily summer steelhead.

Drainage area: Approximately 17 river miles.

SUBWATERSHEDS: Antoine, Whitestone, Similkameen, Ninemile, Tonasket, Lake Osoyoos.

ASSESSMENT UNIT DESCRIPTION: This AU begins at the mouth of Antoine Creek and ends at Lake Osoyoos. The state of Washington (DOE) {Department of Ecology owns???} owns Zosel dam and the Oroville Tonasket Irrigation District manages the water plan and the releases out of Osoyoos Lake. High thermal input, with relatively low sediment transport and load, is documented from the Lake and the effects are seen 9-10 miles downstream into this AU. The Similkameen river joins the Okanogan mainstem in this AU and is characterized by cool water input, but with high sediment, transport and load. A distinct mixing zone can be delineated by the recent TIR/LIDAR data collected by the Colville Tribes. The lower and middle sections of the AU (moving south to north) are characterized by confined channels caused by: 1. HWY 97, 2. RR beds, and 3. diking. Channel modification have lead to increased lateral erosion that create large areas of sand and silt substrate below the confluence with the Similkameen River with mostly gravel and cobble substrates above the confluence. Primary limiting factors are sediment, temperature, loss of habitat diversity, lost floodplain connectivity, and artificial production that threatens natural production. Summer/fall Chinook are the primary species that utilizes this assessment unit. Other salmon species use this area as a migration corridor.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Natural reproduction in this AU is threatened by abundant hatchery production returns.

P-Habitat Diversity (loss of sinuosity, length etc.) in the middle reaches.

P-Sediment where influence of Similkameen input dictates.

P-Channel simplification is pervasive in middle AU and in lower reaches of this AU.

P-Loss of connectivity to floodplain in middle reaches.

S-Temperature (major source in upper basin).

S-Predation (model artifact in many cases, but large predator populations do exist).

S-Chemical (from Osoyoos?).

Refer to Appendix B for reference and specific detail by reach and species.

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Protecting existing spawning habitats from degradation and hatchery super-imposition will ensure continued recruitment of native summer/fall Chinook in the Okanogan River.

Objective 1-1: Increase and monitor natural production of summer/fall Chinook above existing levels.

Strategy 1-1A. Monitors redd counts in assessment unit annually and compare trends to established baseline.

Strategy 1-1B. Develop tribal and recreational harvest opportunities that selectively harvest excess hatchery production of summer/fall Chinook.

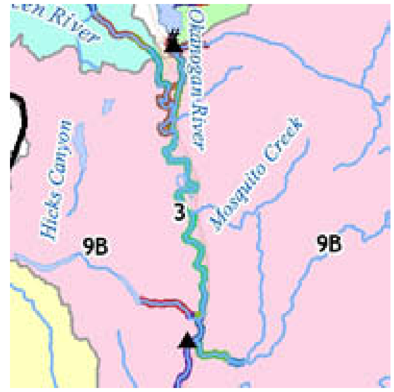
Strategy 1-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity and expand suitable spawning habitats.

ASSESSMENT UNIT: O3—Okanogan Upper

REACHES: 9

(US reaches only. See Canadian AU's for additional reaches in upper watershed)

25	**26a**	**26b**	**27**	**28**	**Bf1**	**29**	**30**	**31**



Objective 1-2: Protect all existing spawning areas for summer/fall Chinook.

Strategy 1-2B. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to protect spawning habitat for summer/fall Chinook.

Strategy 1-2C. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones;

Strategy 1-2D. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 1-2E. Provide incentives and compensation to landowners to retain buffers.

Hypothesis 2: Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages a) spawning b) prespawn holding c) fry colonization. Summer steelhead survival will increase in the following life stages a) spawning b) fry colonization c) age 0-2 juvenile rearing.

Objective 2-1: Protect and restore floodplain connectivity along an additional 10% of the assessment unit where feasible to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2-years on average.

Strategy 2-1A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 2-1B. Conduct a channel migration corridor study and monitor trends.

Strategy 2-1D. Protect and re-establish all ground-water sources.

Strategy 2-1F. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits.

Strategy 2-1G. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation

Strategy 2-1H. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 2-1I. Provide incentives and compensation to landowners to retain buffers.

Hypothesis 3: Fine sediment reduction throughout the Okanogan subbasin and increased bank stability will reduce width to depth ratios and embeddedness. (Direct activities in this assessment unit are likely to produce only limited benefits) The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing mainly for Chinook and steelhead, but possibly migration for sockeye.

Objective 3-1. Reestablish normative width to depth ratios of 10:1.

Strategy 3-1A. Establish baseline for existing width to depth ratio and embeddedness.

Strategy 3-1B. Monitor width to depth ratios and embeddedness at EMAP sites.

Strategy 3-1C. Reslope vertical banks and reestablish riparian plant communities.

Strategy 3-1D. Stabilize sloughing banks using soft techniques wherever possible and armoring when necessary.

Strategy 3-1E. Use barb and bail techniques to manage sediment loads, move channel away from sensitive banks, reestablish plant communities and manage flows for beneficial purposes.

Strategy 3-1F. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

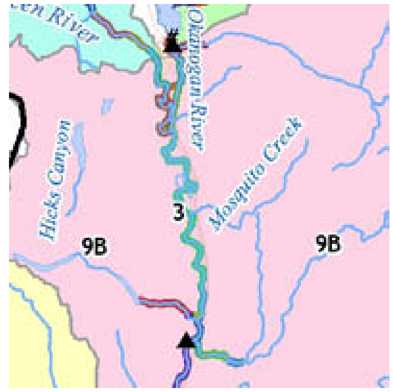
Strategy 3-1G. Increase the amount of flood susceptible areas to reduce lateral scour and flow volume in main channel and protect or

ASSESSMENT UNIT: O3—Okanogan Upper

REACHES: 9

(US reaches only. See Canadian AU's for additional reaches in upper watershed)

25	26a	26b	27	28	Bf1	29	30	31



improve existing spawning habitats for summer/fall Chinook.

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Strategy 3-1H. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed and the Similkameen River watershed specifically.

Strategy 3-1I. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for prespawn migrant holding areas.

Strategy 3-1J. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Hypothesis 4: Adult enumeration of salmon and steelhead is critical in this AU and will determine the proportion of adults returning to the Okanogan subbasin verses other subbasins located above Wells Dam. (Note: This has been an acknowledged data gap for many years).

Objective 4-1.Evaluate and monitor the trend in adult returns to the Okanogan subbasin as a method to determine the cumulative success or failure of proposed actions.

Strategy 4-1A. Establish a counting station to monitor migrating adult salmonids (e.g., Zosel dam).

Strategy 4-1B. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 4-1C. Coordinate data sharing with all agencies with management authority to provide information for adaptive management.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 5-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.

DATA GAPS AND M&E NEEDS:

Predation and pathogen information is lacking and the EDT models' assumptions are course scale at best

Predator population and consumption rates

Increase the quality and quantity of real-time water quality data

Heat budget from Osoyoos Lake

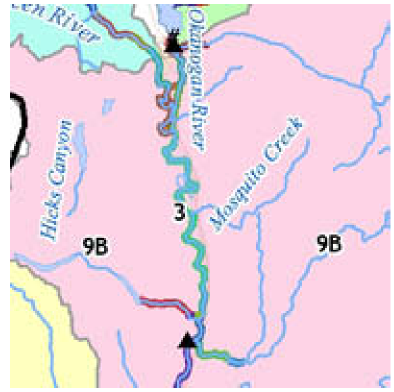
Sediment budget from Similkameen Cr.

ASSESSMENT UNIT: O3—Okanogan Upper

REACHES: 9

(US reaches only. See Canadian AU's for additional reaches in upper watershed)

25	**26a**	**26b**	**27**	**28**	**Bf1**	**29**	**30**	**31**



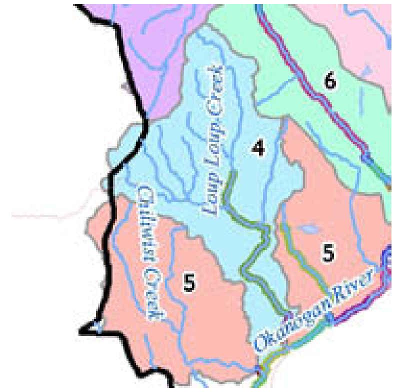
Juvenile/smolt production and adult salmonid enumeration to establish a count of fish destined for Canada.

Baseline habitat data that can be used to monitor status and trend

ASSESSMENT UNIT: O4—Loup Loup

REACHES: 10

1	2	3	4	5	6	7	8	9



FOCAL species: Primarily Summer Steelhead, secondarily Sockeye salmon, and summer/fall Chinook salmon.

Drainage area: 40,868 acres

SUBWATERSHEDS: Little Loup Loup

ASSESSMENT UNIT DESCRIPTION: Loup Loup Creek is a tributary of the Okanogan River and enters the river at RM 16.9, in the small community of Malott, WA. Nearly the entire watershed (40,868 acres) is categorized as forested (86.5%). Peak elevation is approximately 1,700 feet. Land ownership includes the Bureau of Land Management (BLM), Washington Department of Natural Resources (WDNR), United States Forest Service (USFS) and private owners, with WDNR responsible for managing 31,506 acres. Approximately 3,500 acre-feet of Loup Loup Creek is annually diverted into Leader Lake, a storage reservoir used for irrigation. Another irrigation diversion is located at ~ RM 2.0. Typically, due to water withdrawals, the lower reach of Loup Loup Creek is dry by mid-summer. The lower reaches extend from the confluence to the base of a pair of falls approximately 12 feet high at ~ RM 2.5. These falls were likely the extent of the historical range of steelhead in Loup Loup Creek. The upper reach extends from the falls to the headwaters of Loup Loup Creek. Barriers include a road culvert at Hwy 97, the Ralston diversion dam and the falls. Summer steelhead would be the primary species that would benefit from habitat improvements in Loup Loup Creek. The primary limiting factor is lack of flow. The water that historically flowed down Loup Loup Creek has been over allocated for other uses and therefore no water remains in the stream for fish during the irrigation season. Until this issue is addressed, all other habitat improvements would have no benefit to fish, with limited benefit to wildlife.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Habitat Quantity

P-Flow

P-Habitat Diversity

P-Obstructions

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Removing obstructions and enhancing flows in this tributary will increase habitat quantity and survival for steelhead in the following life history stages: a. spawning, b. rearing, and c: active migration for both juveniles and adults.

Objective 1-1. Monitor, protect and increase stream discharge during April and May to a minimum of 14 cfs for migration and spawning of adult fish and protect and increase flows all months other than April and May to a minimum of 1-2 cfs for juvenile rearing.

Strategy 1-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 1-1B Administer and monitor groundwater and surface water right permits and changes consistent with the established in-stream flow.

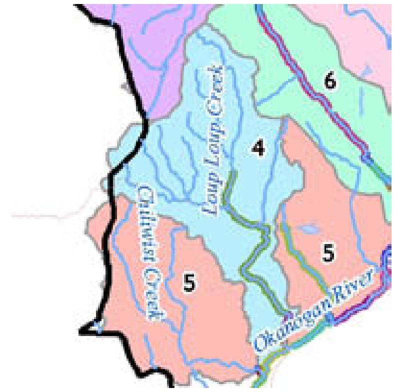
Strategy 1-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 1-1D Conduct a comprehensive in-stream flow study.

ASSESSMENT UNIT: O4—Loup Loup

REACHES: 10

1	2	3	4	5	6	7	8	9



Strategy 1-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, increasing storage capacity, easement purchase and trust water donations).

Strategy 1-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 1-1H Implement activities that promote water storage and groundwater recharge that collectively adds to existing in-stream flows.

Strategy 1-1I Develop, operate, maintain and monitor real-time station to monitor stream discharge and other water quality parameters.

Objective 1-2. Remove all identified fish passage barriers below the natural falls within 5 years of restoring flows

Strategy 1-2A. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 1-2B. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity.

Strategy 1-2C. Use cost-sharing programs to help landowners screen diversions.

Strategy 1-2E. New stream crossing structure designs should meet or exceed design criteria provided through WDFW in the Aquatic Habitat Guidelines guidance documents.

Strategy 1-2F. Monitor and evaluate passage project effectiveness.

Hypothesis 2: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead and sockeye in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye plus increase spawning distribution for summer/fall Chinook.

Objective 2-1. Protect and enhance rearing and spawning habitat by 10% for steelhead using in-stream structures and riparian area restoration.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 2-1B. Restore riparian habitats with the potential to contribute to future LWD recruitment and promote stream channel shading.

Strategy 2-1E. Develop watershed plan to enhance water quantity, quality, and fish habitat.

Hypothesis 3: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan and should only occur after flows have been reestablished)

Objective 3-1. Improve population numbers of summer steelhead to 100 breeding pairs to assist in summer steelhead recovery in the Upper Columbia ESU.

Strategy 3-1A. Use scatter plants of summer steelhead to enhance returns to Loup-Loup Creek.

Strategy 3-1C. Operate and maintain weir sites to collect locally adapted broodstock and monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

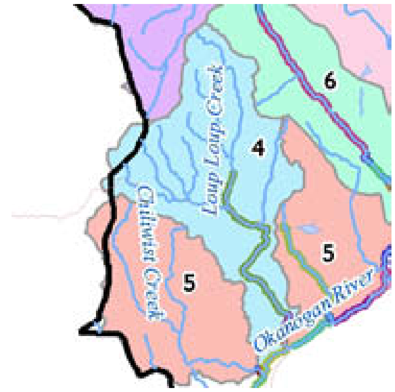
Strategy 3-1D. Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

DATA GAPS AND M&E NEEDS:

ASSESSMENT UNIT: O4—Loup Loup

REACHES: 10

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**



Baseline habitat data to monitor status and trends.

Water rights survey and enforcement

Increase the quality and quantity of real-time water quality data

Adult summer steelhead return enumeration and juvenile production estimates

ASSESSMENT UNIT: O6—Lower Salmon Creek

REACHES: 10

1	**2**	**3**	**4**	**5**
6	**7**	**8**	**9**	**10**

FOCAL species: Primarily Spring Chinook salmon, and steelhead.

Drainage area: 17,920 acres

SUBWATERSHEDS: Watercress Springs (groundwater input)

ASSESSMENT UNIT DESCRIPTION: Salmon Creek is a perennial tributary of the Okanogan River with a total watershed area of about 167 square miles. It enters the Okanogan River at the town of Okanogan. Mountains surround Salmon Creek forming its hydrologic divides. The basin is generally oriented on a northwest-southeast axis, with a broad upper watershed about 8 to 10 miles wide and 12 to 15 miles long. The North Fork, West Fork, and South Fork of Salmon Creek converge at Conconully draining the 119 square-mile upper Salmon watershed. This portion of watershed is inaccessible to anadromous fish because of Conconully Dam and Reservoir. Conconully Dam is approximately 15 miles upstream from the mouth of Salmon Creek. Although data or written references are unavailable to define historic use of the upper watershed by anadromous salmonids, professional opinion is that it was probably limited to less than three miles above the damsite.

The Okanogan Irrigation District (OID) manages Conconully Reservoir to serve District lands east of the watershed. Controlled releases for irrigation deliveries are made from Conconully Reservoir between April and October. These releases are conveyed through 11 miles of natural and modified stream channel (referred to as the middle reach of Salmon Creek) to the OID diversion dam, located 4.3 stream miles above the mouth of Salmon Creek. For more than eighty years, the 4.3 miles of Salmon Creek downstream of the OID diversion dam (referred to as lower Salmon Creek), have been dewatered, except during snowmelt events that result in uncontrolled spill at the OID diversion dam.

The primary limiting factor for Salmon Creek is the lack of flow in the lower 4.3 miles that creates a barrier to anadromous fish and keeps them from immigrating and emigrating between the available habitat in the middle reach, the Okanogan River and the ocean. Excellent habitat for spawning and rearing is available in the middle reach but unless access to this reach is provided then the value to anadromous fish production is lost. Balancing the multiple uses of water in this drainage is a major challenge. Channel modifications and changes in the irrigation system could help reduce the amount of water needed to provide passage so these are also considered primary limiting factors. The primary species that would benefit from improvements to Salmon Creek is summer steelhead. However, other salmon species would benefit due to the coldwater released from the bottom of Conconully Dam.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

NOTE: Most apply to reaches below Watercress Springs

P-Obstructions

P-Channel Stability

P-Flow

P-Habitat Quantity

P-Habitat Diversity

S-Temperature

S-Oxygen (general water quality issues including low DO etc for trapped fish)

NOTE: Apply to reaches above OID diversion

S-Sediment

ASSESSMENT UNIT: O6—Lower Salmon Creek

REACHES: 10

1	**2**	**3**	**4**	**5**
6	**7**	**8**	**9**	**10**

P-Habitat Quantity

P-Flow (overwintering)

P-Habitat Diversity

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Removal or modification of the fish passage barriers will increase habitat quantity available and survival of spring Chinook and steelhead in the adult spawning, migration, and juvenile rearing life stages.

Objective 1-1: Increase the linear distance available for salmon production (spawning areas and juvenile rearing areas) as measured by the passage design criteria.

Strategy 1-1A. Provide water for adult fish passage, over-winter rearing, and juvenile out-migration (below OID).

Strategy 1-1B. Channel rehabilitation from Watercress to mouth.

Strategy 1-1C. Stabilize landfill areas below Watercress.

Objective 1-2: Increasing the overall abundance of salmon upstream of the OID diversion by 20 percent or more (e.g., "the number of Chinook per mile and the number of redds per mile will increase relative to the control sites downstream.")

Strategy 1-2A. Reconnect reaches to the floodplain.

Strategy 1-2B. Grade control structures where high energy is eroding bank.

Strategy 1-2C. Design for unimpeded passage at mouth.

Strategy 1-2D. Protect high quality habitats including areas of groundwater input.

Strategy 1-2E. Reestablish and/or improve existing riparian areas.

Hypothesis 2: Implementing a set of rehabilitative treatments will provide access to higher quality habitats above the OID diversion for all life stages of steelhead and spring Chinook.

Objective 2-1. Provide fish passage through the degraded reach below the OID diversion dam, to access the higher quality habitat between the diversion dam and Conconully Lake.

Level 1. Effective if design criteria are met for 80 percent of the removal action on Year 5 (i.e., no statistical test), and;

Level 2. Effective if a change of 20 percent or more is detected for salmon abundance of either adults, redds, or juveniles between the calculated difference between the paired impact and control areas by Year 5 at the Alpha =0.05 level.

Strategy 2-1A. Implement EIS recommended rehabilitation flows for steelhead and spring Chinook in the lower and middle reaches of Salmon Creek as defined by the EIS Appendix B.

Strategy 2-1B. Steam rehabilitation treatments/strategies

Strategy 2-1C. Channel preservation-No direct action. Preservation of existing channel alignment, bank conditions, in-channel habitat, and floodplain areas.

Hypothesis 3: Protecting and improving habitat diversity, especially in the reaches above the OID diversion dam of this AU, will maintain survival for spring, Chinook and steelhead for all life stages and for rearing summer/fall Chinook near the mouth.

Objective 3-1. Protect intact riparian and flood plain functions.

Strategy 3-1A. Implement BMPs for land use and development.

Strategy 3-1B. Create full-scale coordinated resource management plans (irrigation needs, fish needs, human population needs,

ASSESSMENT UNIT: O6—Lower Salmon Creek

REACHES: 10

1	**2**	**3**	**4**	**5**
6	**7**	**8**	**9**	**10**

recovery needs under ESA and other management plans).

Strategy 3-1C. Top of bank/levee recontouring-Locally remove artificially raised top of banks/levees to reestablish the channel's floodplain connection where consistent with adjacent landowner needs. No change to channel alignment or in-channel habitat. Assumes no net impact or export of material.

Objective 3-2. Increase riparian and flood plain function to at least 80 percent of normative in those areas (~50 percent of the total area) in the first five years to reach LWD 20 pieces/mi, pool frequency ratios of 56-96/mile, etc.

Strategy 3-2A. Bank protection-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows. No change to channel alignment, in-channel habitat, or floodplain connection.

Strategy 3-2B. Bank protection and bed improvements-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. No change to channel alignment or floodplain connection.

Strategy 3-2C. Bank, bed, and floodplain modification-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. Use local cut and fill to contour portions of leveed or terraced banks to reestablish the channel's floodplain connection. No change to channel alignment.

Strategy 3-2D. Full channel reconstruction-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to construct a new channel along a new alignment, reduce channel width, and define a low-flow channel for fish passage. Use local cut and fill to contour leveed or terraced banks and construct a connected floodplain. Note: 1) Geo-technical includes actions such as placement of large, angular rock at the toe of banks, construction of rock walls, and geo-textiles. 2) Bio-stabilization includes re-vegetating with treatments such as plant stakings and vegetation mats.

Note: additional information and alternatives will be available and reviewed in late-2004 from ongoing EIS process in Salmon Creek.

DATA GAPS AND M&E NEEDS:

Basin hydrology

Habitat use for all species

Baseline and status/trend monitoring for adult escapement and juvenile production

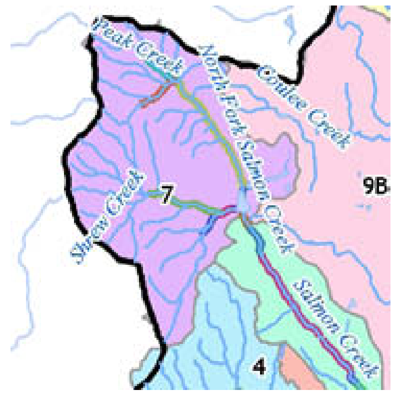
Real-time water quality monitoring

Baseline and status/trend monitoring of habitat

ASSESSMENT UNIT: O7—Upper Salmon Creek and Tributaries

REACHES: 12

40	**41**	**42**	**43**	**44**	**45**
46	**47**	**48**	**49**	**50**	**51**



FOCAL species: Primarily Westslope cutthroat trout and Kokanee in Conconully Reservoir (not stocked on an annual basis). Summer steelhead, spring Chinook were historically present but none have existed for over 80 years with the last reports of bull trout occurring over 50 years ago—although no comprehensive monitoring has occurred throughout suitable habitats in the upper watershed.

Drainage area: 97,808 acres

SUBWATERSHEDS: West Fork, South Fork, North Fork and Pelican Creek

ASSESSMENT UNIT DESCRIPTION:

Salmon Creek is a perennial tributary of the Okanogan River with a total watershed area of about 167 square miles. It enters the Okanogan River at the town of Okanogan. Mountains surround Salmon Creek forming its hydrologic divides. The basin is generally oriented on a northwest-southeast axis, with a broad upper watershed about 8 to 10 miles wide and 12 to 15 miles long. The North Fork, West Fork, and South Fork of Salmon Creek converge at Conconully draining the 119 square-mile upper Salmon watershed. This portion of watershed is inaccessible to anadromous fish because of Conconully Dam and Reservoir. Conconully Dam is approximately 15 miles upstream from the mouth of Salmon Creek. Although data or written references are unavailable to define historic use of the upper watershed by anadromous salmonids, professional opinion is that it was probably limited to less than three miles above the damsite.

The Okanogan Irrigation District (OID) manages Conconully Reservoir to serve District lands east of the watershed. Controlled releases for irrigation deliveries are made from Conconully Reservoir between April and October. These releases are conveyed through 11 miles of natural and modified stream channel (referred to as the middle reach of Salmon Creek) to the OID diversion dam, located 4.3 stream miles above the mouth of Salmon Creek. For more than eighty years, the 4.3 miles of Salmon Creek downstream of the OID diversion dam (referred to as lower Salmon Creek), have been dewatered, except during snowmelt events that result in uncontrolled spill at the OID diversion dam.

The primary limiting factors relate to a lack of habitat diversity and sedimentation issues. Addressing these limiting factors would directly benefit resident fish and indirectly benefit downstream reaches.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Habitat Diversity

S-Temperature

S-Sediment

S-Flow (some minor diversions, but on naturally nominal flows)

Extensive mining in area, but no data to identify effects (implication for "chemical" as a possible LF)

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Increasing habitat diversity throughout the AU will increase Kokanee and cutthroat in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding Kokanee. Objective 2-1. Protect and enhance rearing and spawning habitat by 10% for salmonids by using in-stream structures, disconnected floodplain and riparian area restoration.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

ASSESSMENT UNIT: O7—Upper Salmon Creek and Tributaries

REACHES: 12

40	**41**	**42**	**43**	**44**	**45**
46	**47**	**48**	**49**	**50**	**51**

Strategy 2-1B. Restore riparian habitats with the potential to contribute to future LWD recruitment and promote stream channel shading.

Strategy 2-1E. Develop watershed plan to enhance water quantity, quality, and fish habitat.

Hypothesis 2: Implementing livestock exclusion structures and strategies will increase bank stabilization, riparian function and water quality for all life history stages for steelhead, bull trout and other resident fish species.

Objective 2-1. Expand current efforts to exclude livestock from the stream and riparian areas in this AU or relocate and harden livestock crossings to reduce impacts and achieve PFC for all habitat conditions.

Strategy 2-A. Install and maintain fencing, or fish friendly stream crossing structures, to prevent livestock access to riparian zones and streams.

Hypothesis 3: Reducing overall road density will decrease sediment input into the stream and increase survival at incubation and rearing life stages. Lowered sediment input will also reduce the occurrence of culvert failures in the watershed while culvert replacement programs are fully implemented.

Objective 3-1. Achieve an overall road density of 2-3 miles/sq. mile with roads located in valley bottoms only where other options do not exist.

Strategy 3-A. Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 3-B. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location.

Strategy 3-C. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 3-C. Upgrade stream crossing, culverts and road drainage systems.

Strategy 3-E. Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides.

Strategy 3-F. Construct detention and infiltration ponds to capture runoff from roads, development, farms and irrigation return flows.

Strategy 3-G. Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Hypothesis 4: Improve development and recreational use programs around and adjacent to both Conconully Reservoir and Salmon Lake will protect possible sockeye and Kokanee spawning and rearing habitat and protect resident fish species habitats.

Objective 4-1. Manage development and recreational use, implement water use strategies, and improve water quality to PFC levels for salmonid species.

Strategy 4-A. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits

Strategy 4-B. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon.

Strategy 4-C. Avoid or mitigate adverse impacts of upland development where it has the potential to adversely impact channel conditions, such as when the removal of vegetation and improper drainage result in erosion and the need for shoreline stabilization structures.

Strategy 4-D. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation.

ASSESSMENT UNIT: O7—Upper Salmon Creek and Tributaries

REACHES: 12

40	**41**	**42**	**43**	**44**	**45**
46	**47**	**48**	**49**	**50**	**51**

Strategy 4- E. Rehabilitate areas where mining activities are found to have altered chemistry and/or channel structure.

DATA GAPS AND M&E NEEDS:

Extensive mining in area, but no data to identify effects

Fish distribution, abundance and use for Westslope cutthroat trout

Effects of SF, NF roads on channels

ASSESSMENT UNIT: O8—Omak Creek and Tributaries

REACHES: 24

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**							

FOCAL species: Primarily Steelhead, secondarily Spring Chinook, Sockeye salmon, and summer/fall Chinook salmon.

Drainage area: 90,683 acres

SUBWATERSHEDS: Trail, Swimpkin, Stapaloop.

ASSESSMENT UNIT DESCRIPTION:

Omak Creek is a fourth order tributary of the Okanogan River that flows into the mainstem at RM 31. Of the 90,683 acres in this watershed, 73,029 acres are owned and managed by the Colville Tribes (NRCS 1995). Elevations within the sub-basin range from 860 feet above sea level at the Omak confluence with the Okanogan River, to 6,774 feet at Moses Mountain. The climate of the sub-basin varies from arid to montaine, with an average annual precipitation of 12 inches in the lower elevations to over 45 inches at Moses Mountain. Average daily temperatures range from 23o F in winter to 70o F in the summer. The average growing-season in the watershed lasts 120 days. Omak Creek represents critical summer steelhead habitat with adult escapement levels averaging around 100 fish over the last three years. Potential habitat below Mission Falls could potentially support three times this number. Currently efforts are underway to expand the available habitat into areas above Mission Fall and this would open an addition 7 miles or more of habitat and increase production considerably if successful. The primary limiting factors are sedimentation, barriers, habitat diversity/quantity and channel stability. Riparian restoration, road decommissioning, improved range management, correcting barriers, and artificial production using locally adapted broodstock are priority actions that would address the limiting factors

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

Depressed population numbers

P-Sediment (road density). Good studies.

P-Channel stability

S-Habitat Diversity, P-spck

S-Predation in some reaches

P-Obstructions (especially at Mission Falls), others at culverts

P-Habitat Quantity (Primary in Stappaloop, Swimptkin, first reach of Trail. NOTE: Some “quantity” gain as a result of increased width from sediment input—therefore gain in quantity should not always be considered favorable)

S-Flow, but cumulative, P-spck in summer (prespawn migrants)

S-Food (generally low in tributaries, also noting low carcass)

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Increase habitat diversity (riparian function, LWD, confinement will increase survival of steelhead and spring Chinook in the following life stages: a) spawning, b) egg incubation, c) fry colonization, and d) rearing.

Objective 1-1: Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off channel habitat).

ASSESSMENT UNIT: O8—Omak Creek and Tributaries

REACHES: 24

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**							

Strategy 1-1A. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 1-1B. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Strategy 1-1C. Implement BMPs for general land use and development (e.g., timber and range lands).

Strategy 1-1D. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other Tribal and/or local regulations or permits.

Strategy 1-1F. Replant degraded riparian zones by reestablishing native vegetation.

Strategy 1-1G. Install and maintain fencing or fish friendly stream crossing structures to prevent livestock access to riparian zones and streams.

Strategy 1-1H. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights.

Objective 1-2: For large woody debris, reach or exceed 20 pieces/mi (12” dia. And 35’ long) with adequate recruitment potential. This represents properly functioning condition for large woody debris in Eastern Washington (Bjorn and Reiser 1995).

Strategy 1-2A. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation.

Strategy 1-2B. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones.

Strategy 1-2C. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights.

Strategy 1-2D. Provide incentives and compensation to landowners to retain buffers.

Strategy 1-2F. Add large woody debris and place in-channel engineered log jams.

Strategy 1-2G. Restore and reconnect wetlands and floodplains to the riverine system.

Hypothesis 2: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers (i.e. Mission Falls, HWY 155 crossings).

Objective 2-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Ensure no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 2-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 2-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 2-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 2-1D. Use permits or other local, tribal and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 2-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 2-1F. Continue to improve passage at Mission Falls and address culverts in priority order (likely Stapaloop first since this is the largest Sub watershed. Trail next and then Swimptkin).

ASSESSMENT UNIT: O8—Omak Creek and Tributaries

REACHES: 24

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**							

Hypothesis 3: Fine sediment reduction and increased bank stability will reduce width to depth ratios and embeddedness. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 3-1. Reduce embeddedness 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-1A. Establish baseline for embeddedness.

Strategy 3-1B. Monitor embeddedness at EMAP sites and evaluate trends.

Strategy 3-1D. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 3-1E. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 3-1F. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 3-1G. Implement a road maintenance schedule to prevent and mitigate sediment impacts.

Strategy 3-1H. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location.

Strategy 3-1I. Implement road maintenance and abandonment or decommissioning plans.

Strategy 3-1J. Educate timber harvesters, transportation engineers, political officials, planners, and others on the needs to reduce fine sediments in the Omak Creek watershed.

Strategy 3-1L. Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Strategy 3-1M. Conduct road survey and sediment source survey throughout the watershed to determine priority action areas and establish a GIS layer for future land use activity planning.

Objective 3-2. Reestablish normative width to depth ratios of 10:1.

Strategy 3-2A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 3-2B. Minimize total road density to less than 3 miles/square mile within the watershed and provide adequate drainage control for new roads.

Strategy 3-2C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 3-2E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified.

Strategy 3-2F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 3-2G. Reslope vertical banks and reestablish riparian plant communities.

Strategy 3-2H. Stabilize sloughing banks using soft techniques, wherever possible, and armoring when necessary.

Strategy 3-2I. Use barb and bail techniques to manage sediment loads and move channel away from sensitive banks and reestablish plant communities.

Strategy 3-2J. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 3-2K. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

ASSESSMENT UNIT: O8—Omak Creek and Tributaries

REACHES: 24

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**							

Hypothesis 4: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan).

Objective 4-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 4-1A. Operate and maintain the Saint Mary Mission spring Chinook acclimation site and continue efforts to reintroduce spring Chinook back into Omak Creek.

Strategy 4-1B. Expand, operate, and maintain artificial production capacity (Cassimar Bar Hatchery) at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 4-1C. Operate and maintain a weir site on Omak Creek to collect locally adapted broodstock and monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 4-1D. Expand locally adapted broodstock program to include other Okanogan River tributaries if results indicate enhanced survival and returns compared to other stocks of summer steelhead as evaluated through pit-tag studies.

Strategy 4-1E. Determine baseline redd counts for spring Chinook and summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

Strategy 4-1F. Build, operate, and maintain summer/fall Chinook acclimation ponds at Mouth of Omak Creek and release artificial production from this site annually to expand habitat usage in the Okanogan River.

DATA GAPS AND M&E NEEDS:

Adult returns enumeration

Establish baseline habitat data and evaluate over time for status and trend

Outmigrating Smolt and kelt estimates

Better basin wide obstruction rating and ranking is needed

Habitat utilization of Omak Creek spring Chinook.

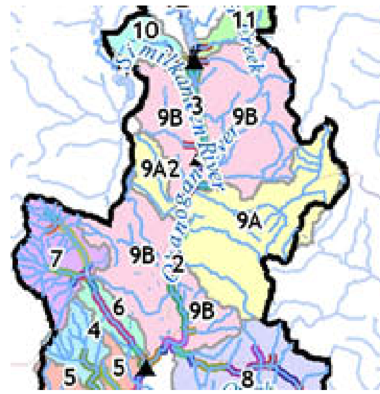
Pit-tag studies to determine survival differences in Wells hatchery stocks and locally adapted Okanogan summer steelhead.

Genetic studies of parental origin and hatchery/wild production differences in Omak Creek

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



FOCAL species: Primarily summer steelhead, secondarily Sockeye salmon, and summer/fall Chinook salmon.

Drainage area: Variable but >125 sq. mi. combined. (80,000 acres)

SUBWATERSHEDS:

9a. Chilliwist, Talent, Aeneas, Johnson,

9b. Tunk and Bonaparte,

9c. Ninemile, Antoine, Tonasket

9d. Siwash, Wanacut and Whitestone

ASSESSMENT UNIT DESCRIPTION:

The Chiliwist/ Talent Creek sub-basin comprises approximately 27,842 acres, representing approximately 1.7% of the Okanogan watershed (OCD 2000). It is located in the southwestern corner of the Okanogan watershed, and is the lowest Okanogan sub-basin upstream of the Okanogan River's confluence with the Columbia River (Figure B-1). Chiliwist Creek enters the Okanogan River on its western side at approximately RM 15.1 (WDNR 1982). The sub-basin includes the entire habitat along the southeast border of the sub-basin (i.e., the western shore of the mainstem Okanogan) for approximately 27 km (before entering the Columbia. The principal tributary within this sub-basin is Chiliwist Creek; however, the sub-basin also includes Sullivan Creek, Smith Lake, and Starzman Lake. None of these other waters within the sub-basin regularly convey surface waters to the Okanogan. Over half of the sub-basin is within the Okanogan National Forest, found in the northwestern and part of the northeastern portions of the sub-basin watershed. These watersheds are thought to contribute minimally, both historically and currently, to the overall production of fish in the Okanogan subbasin. Efforts to maintain coldwater flows and reduce sediment inputs into the Okanogan River would have secondary impacts toward improving habitat condition within the Okanogan main-stem.

Aeneas Creek enters the Okanogan River along the west side at approximately river mile 50. The subwatershed comprises approximately 0.41% percent of the total Okanogan watershed (OCD 2000). Aeneas Creek flows in a southeasterly direction from the slopes of Aeneas Mountain (950 ft el.) to the Okanogan River (Entrix, Inc. and Golder Associates 2001). It has a total stream length of 14 miles, and flows through an area referred to as the "lime belt region." The affect of this lime belt land-type region is evident by the accumulation of calcium carbonate along the streambed channel. Aeneas Creek is spring fed and therefore provides rare and stable coldwater input into the Okanogan River. Little habitat is accessible to anadromous fish due to steep gradient, but the coldwater provided by this watershed provides a vital refugia to migrating sockeye, and summer/fall Chinook. Protecting the flows in this stream is a high priority and maintenance of the watershed integrity to reduce fine sediment inputs would benefit the Okanogan main-stem for all fish species.

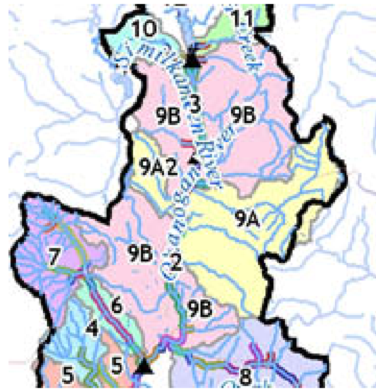
The Johnson Creek sub-basin encompasses 77.5 mi2 of the Lower Okanogan Watershed (Ecology Draft, 1995). It is located on the western portion of the Okanogan Watershed with the Okanogan River as its eastern boundary, Sinlahekin State Wildlife Recreation Area as its northwest boundary, and Salmon Creek sub-basin to southwest. Johnson Creek enters the Okanogan River on the west side at approximately RM 35, just south of Riverside. The Johnson Creek sub-basin runs parallel to the Okanogan River for about 11 miles. The majority of the basin is in the Okanogan River Valley, with patches of mountainous regions to the western, northern and central areas. There is a series of 21 lakes found in the central mountainous region of the sub-basin (USGS 1984). Little information is known about Johnson Creek. Although considerable irrigation demands are placed on this stream, it still provides perennial flows during most years to the Okanogan River. Increasing the level of knowledge about this stream is important to understanding the role it plays in the health of the Okanogan River ecosystem.

Tunk Creek is a perennial tributary of the Okanogan River with a total watershed area of approximately 45,585.7 acres (OK CO Watershed WQ MP). It enters the Okanogan River approximately 5 miles north of the town of Riverside. The basin is generally oriented on an east-west axis. The watershed consists primarily of forest (40%) and rangeland (59.1%). Resource information regarding this sub-basin is very limited. (Okanogan County Watershed Water Quality Management Plan). Although information

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



about this subwatershed is limited it is known to be a stream that receives returning adult steelhead on an annual basis and therefore is likely to contribute in a small way to the production of the overall Okanogan River steelhead population. Less than 1 mile of habitat exists below a natural and impassable falls. Protecting flows and reducing sediment loads are high priorities within this watershed.

The Bonaparte Creek watershed encompasses 102,120 acres of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 59,000 acres (58%); Washington Department of Natural Resources, 9000 acres (9%); Bureau of Land Management managed lands, 1000 acres (1%); and the remaining 33,000 acres (32%) are managed by the US Forest Service (USFS). Bonaparte Creek enters the Okanogan River in the city of Tonasket, Washington, at River Mile (RM) 56.7 of the Okanogan River. The watershed at its longest axis is approximately 20 miles long; its widest point is approximately 17 miles wide. However less than 1 mile of stream habitat is accessible to anadromous fish and most of this habitat is located within the city limits of the town of Tonasket, WA. Efforts to reduce sediment inputs and protect stream flows would be important to the overall Okanogan River ecosystem. Adult Summer Steelhead are observed annually entering and spawning in this Creek but the overall contribution to the Okanogan River population is considered very small.

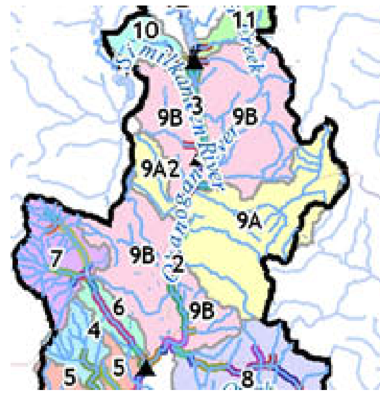
Ninemile Creek Subbasin is in the Northeast corner of the Washington-Canada border of the Okanogan Watershed. The main tributary that forms the subbasin generates from Osoyoos Lake on its western border. A portion of the Ninemile Creek headwaters is in Canada, to the northeast of Osoyoos Lake. The land ranges from arid desert to coniferous forest. The land is mostly held in private ownership and lack of access in the past has led to a tremendous lack of knowledge about this watershed. Recent efforts have identified that adult summer steelhead actively use this watershed, but no information on abundance or production exists. The highest priority for this watershed is to increase knowledge about fish utilization, to locate and protect spawning and rearing areas, maintain or improve flows, and reduce fine sediments .A recent survey of the lower 2+ miles identified no barriers and flow appeared sufficient to provide passage for summer steelhead even during a low water year. One adult steelhead was observed about 600 miles up stream of the mouth and several small fish were observed. The lower 2 miles of stream were channelized and diked over 20 years ago and remain that way today. No flood plain connection exists and down-cutting of the channel has occurred. This channel provides a suitable passage corridor but substrates are cemented and little macro-invertebrate life was observed. Very sparse areas of unconsolidated gravels exist but it appeared that at least one small redd had been excavated in one of these areas. Riparian cover was relatively thick between the dikes but little riparian cover existed outside of the dikes. Stream width varied between 5 feet in the lower portion to 7 feet near the top. Above the property line is a small shale canyon that did not appear to have any significant barrier and the channel was much more natural (Not artificially confined) above this constriction. Above the canyon it appeared riparian condition and channel stability was degraded by grazing activity. Road culverts exist that could be potential barriers and it is believed that some water withdrawal occurs in this area; however, no access could be gained to this private property. Nine-mile Creek has potential for steelhead production and this is the second time recently that steelhead have been positively identified in Nine-mile Creek. The lack of spawning habitat below the canyon and lack of artificial confinement above leads to hypotheses that spawning and rearing currently occurs on private lands and the lower section is mainly utilized as a passage corridor. Considerable data gaps regarding fish populations, habitat, water use/ownership, and historic information exist for this stream. Orchards line the entire lower section of creek on both sides so chemicals could limit fish production. Harassment is known to occur as local orchard owners have attested that their workers have fished for and taken steelhead from the creek.

The Antoine Creek watershed encompasses 46,695 acres of mixed ownership as follows: Private ownership, 30,000 acres (72%); Washington Department of Natural Resources, 2800 acres (6%); Bureau of Land Management managed lands, 459 acres (<1%); and the remaining 9806 acres (21%) are managed by the US Forest Service (USFS). Antoine Creek enters the Okanogan River 4 miles north of the city of Tonasket, Washington, at River Mile (RM) 61.2 of the Okanogan River. The watershed at its longest axis is approximately 14 miles long and its widest point is approximately 10 miles wide. Antoine Creek is dammed at approximately RM 12 by Fancher Dam. Approximately 40% of the watershed acres drain to Antoine Creek above Fancher Dam, with the remaining 60% of the watershed draining to Antoine Creek below Fancher Dam. The water in Fancher Dam reservoir is used for irrigation of croplands. A recent survey of Antoine Creek identified a natural barrier that exists at approximately river mile 1.5. Antoine creek is mainly limited by the amount of discharge resulting in a barrier to fish migration from low flows and limited habitat quantity. This

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



stream averages less than 5 feet wide with a depth of less than 0.5 feet deep. Conditions along the creek are in fair condition but an increase in flow of 50% would be needed to provide sufficient water for adult steelhead passage and spawning to occur. Until this problem is rectified other work to increase habitat quality will have very limited benefits. Riparian area improvements and reducing fine sediment loads would benefit fish in the Mainstem Okanogan River but not to the extent that increased flows would. A dam located in the headwaters of this watershed could be utilized to improve downstream flows during migration and spawning. A number of possible alternatives to increase discharge in Antoine Creek do exist but it will take time to work out all the details. A distinct lack of knowledge about this watershed also exists.

The Tonasket Creek watershed encompasses 35,460 acres of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 20,000 acres (56%); Washington Department of Natural Resources, 5700 acres (16%); Bureau of Land Management managed lands, 960 acres (3%); and the remaining 8,800 acres (25%) are managed by the US Forest Service (USFS). Tonasket Creek enters the Okanogan River east of the city of Oroville, Washington, at River Mile (RM) 77.8 of the Okanogan River. The watershed at its longest axis is approximately 12 miles long and its widest point is approximately 8 miles wide. Flows in Tonasket Creek are intermittent and highly variable between years. In good water years, summer Steelhead are known to spawn in this creek below the falls located at approximately RM 1.0 but during low water years this habitat is unavailable. Increasing flows maybe possible but until these issues can be addressed, other habitat improvement would be of little benefit. Reducing sediment loads could benefit the mainstem Okanogan River. A lack of current data is also prevalent in this watershed. The highest priority would be to determine water availability and possible solutions to increasing in-stream flows and collecting baseline information about the watershed and habitat.

The Siwash Watershed is 30,946 acres. Of these acres, 10,567 (34%) acres are managed by the USFS, the remaining 20,379 (66%) acres are a combination of ownership that includes private owners (60%), Washington Department of Natural Resources (5.5%), and Bureau of Land Management managed lands (<1%). Siwash Creek flows intermittently but is dry for most of all years. This condition is assumed natural, therefore little benefit to fish is provided by this watershed.

Wanacut Creek is an intermittent tributary to the Okanogan River located on the Colville Reservation immediately north of the Omak Creek sub-basin. The total watershed area is 12,595 acres, representing 0.76% of the total Okanogan watershed (OCD 2000). Wanacut Creek is 8 miles long, and the total of 38.7 miles of stream channel in the sub-basin. Wanacut Creek flows westward, entering the eastern side of the Okanogan River at approximately RM 30, (COLVILLE TRIBES 2001). Wanacut Creek flows intermittently but is dry for most of all years. This condition is assumed to be natural, therefore little benefit to fish is provided by this watershed.

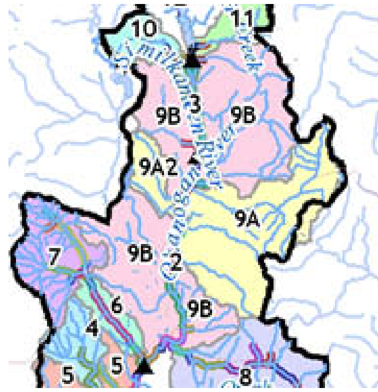
The Whitestone Creek Watershed encompasses six main bodies of water (from north to south): Blue Lake, Wanacut Lake, Spectacle Lake, Whitestone Creek, Whitestone Lake, and Stevens Lake (DOI 1976). The Okanogan River flows along its eastern border, running 33.1 km along the subbasin from Oroville to Tonasket (Murdoch and Miller 1999). The Whitestone Creek subbasin is an island surrounded by larger subbasins of the Okanogan watershed. To the west is the Similkameen River subbasin, to the southwest is the Aeneas Creek, to the southeast is the Siwash Creek, to the east is the Antoine Creek and to the northeast is the Tonasket Creek. Whitestone Creek has perennial flows in some areas and considerable water withdrawals in other areas reduce these flows significantly. Little information exists about this creek but it is assumed inaccessible to anadromous fish due to heavy irrigation withdrawals. This Creek drains several warm water lakes and is therefore assumed to provide warm water to the Okanogan during the summer months. However, concrete data about Whitestone Creek is unavailable and until such time as this data are collected it is difficult to speculate. The most critical priority for this watershed is to collect data on water temperature, discharge, barriers, withdrawals, and general habitat condition. Landowners restricting access to the lower reaches of Whitestone Creek could be problematic.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



FACTORS LIMITING PRODUCTION:

Chiliwist/Talent: lack of knowledge, Flow, passage

Aeneas: Lack of Knowledge, flows should be protected, Sediment,

Johnson: Lack of Knowledge, Flows should be protected, Water quality, passage, riparian function, bank stability and floodplain connectivity Tunk: Sediment, Lack of Knowledge, sediment, flows should be protected, and flow

Bonaparte: sediment, Flows should be protected Nine Mile: Lack of Knowledge, Sediment, channel stability, flow. Antoine: Lack of Knowledge, Flow, sediment,

Tonasket: Flow, sediment,

Siwash: Lack of water precludes fish production Wanacut: Lack of water precludes fish production Channel stability, Flow, food, diversity, predation, sediment and quantity

Whitestone: Obstructions, Lack of Knowledge, Flow, sediment

Overall Priority limiting Factors

P-Lack of knowledge

P-Obstructions

P-Low Flow

P-Habitat Quantity

s-Fine sediments

s-riparian function

s-habitat diversity

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

9a: Chilliwist/Talent, Aeneas, and Johnson Creeks (9 reaches combined—good water quality benefits, low production potential)

Hypothesis 1: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration.

Objective 1-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that Johnson Creek has a minimum of 6 cfs during the months of April and May.

Strategy 1-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 1-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 1-1D Conduct comprehensive in-stream flow study.

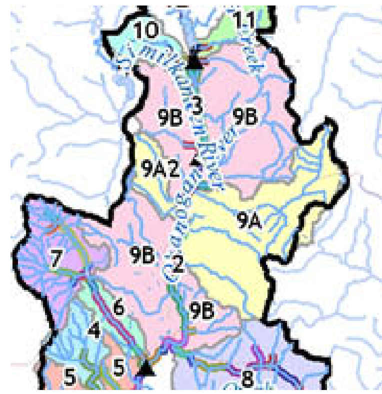
Strategy 1-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 1-1F Develop programs that assist water users and promotes the efficient use of water.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



Strategy 1-1G Enhance riparian canopy cover.

Strategy 1-1H Implement activities that promote water storage and groundwater recharge that collectively adds to existing in-stream flows.

Strategy 1-1I Develop, operate, and maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Hypothesis 2: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

Objective 2-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Ensure no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 2-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 2-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 2-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 2-1D. Use permits or other local, tribal and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 2-1F. Continue to improve passage were know blockages occur and remove artificial confinement to restore floodplain function were possible.

Hypothesis 3: Fine sediment reduction and increased bank stability will contribute to reducing sediment loads and embeddedness throughout the Okanogan subbasin. The following life stages would benefit from these activities: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 3-1.Reduce embeddedness by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 3-1B. Establish baseline for embeddedness at EMAP sites and monitor and evaluate trends.

Strategy 3-1C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 3-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 3-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 3-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 3-1H. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

Strategy 3-1I. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

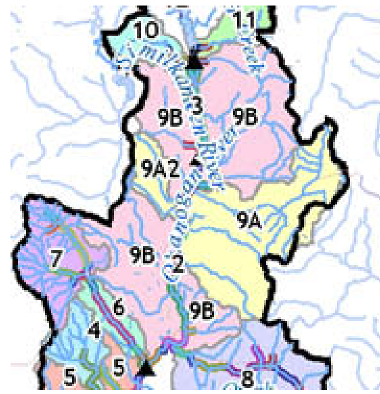
Strategy 3-1K. Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Strategy 3-1L. Develop watershed management plans to enhance water quantity, quality, and fish habitat and conduct baseline surveys for habitat and biological data.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



Hypothesis 4: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 4-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 4-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 4-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 4-1C. Operate and maintain weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

9b: Tunk and Bonaparte Creeks (3 reaches combined—good water quality benefits, some production potential)

Hypothesis 5: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration. These streams also support spawning and rearing habitat for summer steelhead.

Objective 5-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that during the months of April and May minimum flows of 14 cfs exist for migration and spawning of summer steelhead.

Strategy 5-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 5-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 5-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 5-1D Conduct comprehensive in-stream flow study.

Strategy 5-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 5-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 5-1G Enhance riparian canopy cover.

Strategy 5-1H Implement activities that promote water storage and groundwater recharge that collectively adds to existing in-stream flows.

Strategy 5-1I Develop, operate, maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

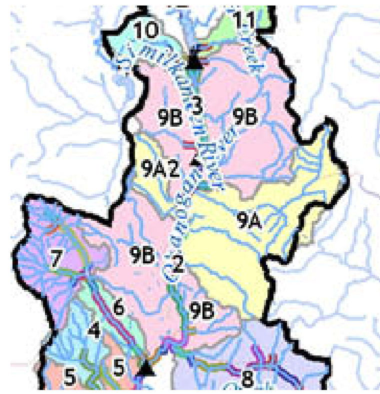
Strategy 5-1J Restrict new development within the floodplain and protect 300 foot riparian buffer zones.

Hypothesis 6: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



Objective 6-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 6-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 6-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 6-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 6-1D. Use permits or other local, tribal, state, and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access or impact riparian areas or flood plain function.

Strategy 6-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 6-1F. Continue to improve passage where known blockages occur and remove artificial confinement to restore floodplain function where possible.

Strategy 6-1G. Develop watershed management plans to enhance water quantity, quality, and fish habitat and conduct baseline surveys for habitat and biological data.

Hypothesis 7: Fine sediment reduction and increased bank stability will contribute to reducing sediment loads and embeddedness throughout the Okanogan subbasin. The following life stages would benefit from these activities: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 7-1.Reduce embeddedness by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 7-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 7-1B. Establish baseline for embeddedness and monitor and evaluate trends.

Strategy 7-1C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 7-1D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 7-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified.

Strategy 7-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 7-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

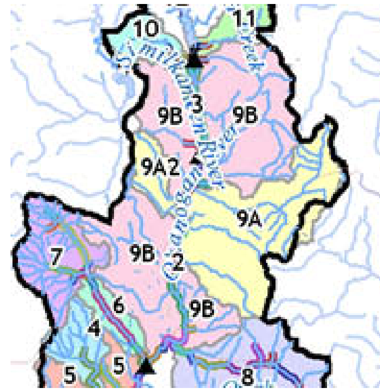
Strategy 7-1K. Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Hypothesis 8: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan).

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



Objective 8-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 8-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 8-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 8-1C. Operate and maintain a weir sites to collect locally adapted broodstock and monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

9c: Ninemile, Antoine and Tonasket Creeks (6 reaches combined—high production potential, flow limiting)

Hypothesis 9: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration. These streams also support spawning and rearing habitat for summer steelhead.

Objective 9-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that during the months of April and May minimum flows of 10 cfs exist for migration and spawning of summer steelhead.

Strategy 9-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 9-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 9-1D Conduct comprehensive in-stream flow study.

Strategy 9-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 9-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 9-1G Enhance riparian canopy cover.

Strategy 9-1H Implement activities that promote water storage and groundwater recharge that collectively adds to existing in-stream flows.

Strategy 9-1I Develop, operate, maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Strategy 9-1J Restrict new development within the floodplain and protect 300 foot riparian buffer zones.

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Objective 9-3. Decrease summer daily maximum temperatures to no more than 4 days greater than 72 OF (24 OC) and show progress toward meeting Washington State temperature standards and TMDL goals

Strategy 9-3A. Remove diking, increase channel sinuosity, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 9-3B. Protect existing shading and plant additional trees and shrubs...

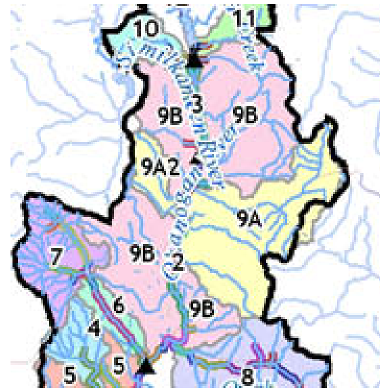
Hypothesis 10: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

Objective 10-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



broodstock collection, monitoring and evaluation) are permissible.

Strategy 10-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 10-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 10-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 10-1D. Use permits or other local, tribal, state, and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access or impact riparian areas or flood plain function.

Strategy 10-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 10-1F. Continue to improve passage where known blockages occur and remove artificial confinement to restore floodplain function where possible.

Hypothesis 11: Fine sediment reduction and increased bank stability will contribute to reducing sediment loads and embeddedness throughout the Okanogan subbasin. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 11-1. Reduce embeddedness by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 11-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 11-1B. Establish baseline for embeddedness and monitor and evaluate trends.

Strategy 11-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 11-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 11-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 11-1I. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location.

Strategy 11-1K.Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Strategy 11-1L. Develop watershed management plans to enhance water quantity, quality, and fish habitat and conduct baseline surveys for habitat and biological data.

Hypothesis 12: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan).

Objective 12-1. Improve population numbers of summer steelhead by 50% above current levels.

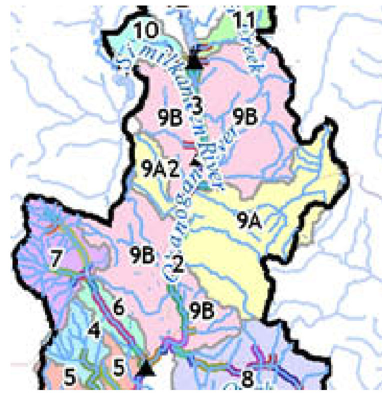
Strategy 12-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 12-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	**3**	**5**	**1**	**3**	**4**	**1**	**3**	**1**	**1**
3	**1**	**1**	**2**	**1**	**2**	**3**	**1**	**1**	**2**
1	**3**	**5**	**1**	**3**	**5**				



Strategy 12-1C. Operate and maintain a weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 12-1D.Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

9d: Siwash, Wanacut and Whitestone Creeks (8 reaches combined—low production potential)

Hypothesis 13: Summer water temperatures in the Okanogan River exceed levels that are known to be stressful to salmonid therefore reducing inputs from small warm tributaries during summer months will benefit water quality in the Okanogan main-stem could enhance water quality in winter months.

Objective 13-1. Monitor discharge volume and temperatures to insure water with temperature greater than the Okanogan River Main-stem do not flow during summer months.

Strategy 13-1A. Develop water retention and use plans to ensure that warm water releases do not contribute to Okanogan River flows.

Strategy 13-1B. Study water injection strategies to determine if groundwater flows from these watersheds to the Okanogan River can be enhanced or increased.

Strategy 13-1C. Develop real time monitoring station to monitor discharge and temperature.

DATA GAPS AND M&E NEEDS:

Sediment transport analysis

Develop infrastructure to monitor discharge where not gauged

Habitat quantity and quality data for all tributaries with emphasis in gaining access to upper Nine Mile Creek watershed. Fish species presence/absence, run timing, abundance, and habitat utilization

Water quality, flow, use, ownership, and withdrawals.

Monitor the presence, abundance, run-timing, and habitat utilization of all fish species.

Quantify habitat quality and quantity.

Determine water ownership and use.

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

FOCAL species: Primarily Summer/fall Chinook salmon, secondarily Sockeye salmon and summer steelhead.

Drainage area: 19 sq. mi.

SUBWATERSHEDS: Tulameen, Sinlahekin Creek, Toats Coulee, Palmer Lake

ASSESSMENT UNIT DESCRIPTION:

The Similkameen River provides 75% of the water that flows through the Okanogan River and as the largest tributary exerts a considerable influence on the Okanogan River downstream of the confluence. The expansive watershed that resides mostly in Canada provides the majority of the sediment that exists in the lower Okanogan River therefore any actions that reduce sediment delivery would be considered high priority and beneficial to all downstream reaches. Historic information about fish and human development, tribal culture exist for this area. Many tribal legends describe fish passage barriers at Enloe Falls. Impacts of the dam itself are however poorly understood and/or described. Because of anthropomorphic change to the Similkameen river system, most notably by Enloe dam, upstream bank destabilization, rip rapping, and loss of wetland habitat near Palmer lake, the natural hydrograph in this AU has likely been altered. No empirical data exist to estimate the effects of these activities. Downstream of Enloe dam to the town of Orville the Similkameen river enters a bedrock canyon and below the Town of Orville the gradient and confinement end allowing any transported sediments to be deposited. This deposition zone is also the location of the greatest spawning densities of summer/fall Chinook in the entire Okanogan River basin. Historically mostly gravels settled out here with finer sediments being transported further downstream. However, with the creation of Enloe Dam much of the gravels were deposited in the lake that was created and only fines were transported downstream. The depositional area is highly mobile and has historically meandered across a large area. Human development has placed controls on channel migration and braiding. Restoring hydrological processes and restoring floodplain connectivity is critical in this AU along with protecting the population of wild summer/fall Chinook that spawn in this area that represent the last remaining stock of the Chinook salmon that the Colville Tribes are allowed to harvest. Primary limiting factors are obstructions, sediment, pathogens (hatchery releases), and lack of habitat diversity.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Sediment

P-Habitat Diversity

P-Pathogens (adjacent to large scale summer/fall ck hatchery releases, some sthd releases)

S-Predation

P-Chemicals (likely due to spill from Enloe. WDFW has some gas level measurements. Some GBT reported at the Hatchery. May-June

S-Temperature

P-Obstructions (Falls are natural, Enloe is a dam)

S-Channel stability

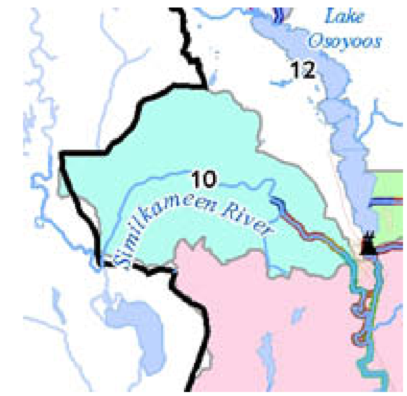
S-Harassment (Core group reports anecdotally). High level of uncertainty as to scale.

S-Flow

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	2	3	4	5	6	7	8	9



Refer to Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Fine sediment reduction and increased bank stability will reduce width to depth ratios. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook, steelhead, and sockeye.

Objective 1-1. Reestablish normative width to depth ratios of 10:1.

Protection strategies:

Strategy 1-A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 1-B. Minimize total road density within the watershed and provide adequate drainage control for new roads.

Strategy 1-C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 1-D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 1-E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified.

Strategy 1-F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Restoration strategies:

Strategy 1-G. Implement a road maintenance schedule to prevent and mitigate sediment impacts

Strategy 1-H. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location.

Strategy 1-I. Implement road maintenance, abandonment or decommissioning, and barrier removal plans.

Strategy 1-J. Upgrade stream crossing, culverts and road drainage systems.

Strategy 1-K. Reconnect floodplains through dike removal or breaching.

Strategy 1-L. Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or channel reconnection.

Strategy 1-N. Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Hypothesis 2: Increase habitat diversity (riparian function, LWD, man-made confinement will increase survival of summer Chinook, steelhead, in the following life stages: a) spawning, b) egg incubation, c) fry colonization, and d) rearing Chinook, steelhead.

Objective 2-1. Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off channel habitat). Restore 30% of the disconnected floodplain.

Strategy 2-B. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits.

Strategy 2-C. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon.

Strategy 2-D. Avoid or mitigate adverse impacts of upland development where it has the potential to adversely impact channel conditions, such as when the removal of vegetation and improper drainage result in erosion and the need for shoreline stabilization structures.

Strategy 2-E. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	2	3	4	5	6	7	8	9

minimize removal of native vegetation.

Strategy 2-F. Reconnect and restore side channels and floodplains throughout this reach where feasible.

Strategy 2-G. Establish salmon friendly land use patterns and design standards.

Strategy 2-H. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones.

Strategy 2-I. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights.

Strategy 2-J. Provide incentives and compensation to landowners to retain buffers.

Restoration strategies:

Strategy 2-K. Measures and actions designed to restore stream flows, sediment loading and riparian zones – such as removing or breaching dikes and levees, managing stormwater and runoff, maintaining or abandoning roads, restoring wetlands, floodplain processes and functions, restoring fish passage, etc. are likely to result in improved channel complexity and habitat connectivity.

Strategy 2-L. Restore and reconnect wetlands and floodplains to the riverine system.

Strategy 2-M. Remove or replace bank stabilization structures.

Strategy 2-N. Replace invasive or non-native vegetation with native vegetation.

Strategy 2-O. Create or redesign pools, spawning habitat, etc.;

Strategy 2-P. Influence or redirect stream flows to reduce erosive forces on stream banks or stream-beds (includes installation of deflectors, barbs and vanes)

Strategy 2-Q. Add large woody debris and place in-channel engineered log jams

Strategy 2-R. Introduce appropriate spawning gravel to the channel.

Strategy 2-S. Replant degraded riparian zones by reestablishing native vegetation

Strategy 2-T. Install and maintain fencing or fish friendly stream crossing structures to prevent livestock access to riparian zones and streams. Provide alternative sites for stock watering.

Hypothesis 3: Increasing water quality will increase survival for Chinook, steelhead and sockeye in the following life stages: Juvenile rearing, prespawn holding and active migration. Some spawning for Chinook.

Objective 3-1. Reduce chemical impacts for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 3-1A. Address non-point source and point source pollution for arsenic.

Strategy 3-1B. Remove and properly dispose of arsenic contaminated sediments.

Objective 3-2. Reduce summer water temperatures for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 3-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 3-2B. Protect existing shading and plant additional trees and.

Strategy 3-2C. Protect and re-establish all ground-water sources.

Objective 3-3. Maintain TDG levels below 110 percent and manage flows to eliminate bed load movement.

Strategy 3-3A. Implement Total Maximum Daily Loads (TMDLs) that address temperature and TDG

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	2	3	4	5	6	7	8	9

Strategy 3-3B. Install flip-lips at Enloe Dam

Strategy 3-3C. Monitor and evaluate TDG levels and other water quality criteria below Enloe Dam.

Hypothesis 4: Protecting existing spawning habitats from degradation and hatchery super-imposition will ensure continued recruitment of native summer/fall Chinook in the Okanogan River.

Objective 4-1: Increase and monitor natural production of summer/fall Chinook above existing levels.

Strategy 4-1A. Monitors redd counts in assessment unit annually and compare trends to established baseline.

Strategy 4-1B. Develop tribal and recreational harvest opportunities that selectively harvest excess hatchery production of summer/fall Chinook.

Strategy 4-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity and expand suitable spawning habitats.

Objective 4-2: Protect through regulation and purchase all existing spawning areas for summer/fall Chinook.

Strategy 4-2A. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat.

Strategy 4-2D. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 4-2E. Provide incentives and compensation to landowners to retain floodplain buffers.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 5-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.

DATA GAPS AND M&E NEEDS:

Information on overall basin hydrology, especially relative to the influence of Enloe dam and changes to the natural hydrograph, is lacking.

Hatchery/wild fish interaction to better manage production programs

Summer/Fall vs. summer and/or fall Chinook

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	2	3	4	5	6	7	8	9

Salmonid distribution and habitat utilization above Enloe dam (Similkameen watershed both US and Canada)

Passage feasibility at Enloe falls

Scale of effects from mineral mining (recreational mainly)

Historical beaver population size v. current. Effects on fluvial geomorphology and hyporehic (groundwater surface water interaction) function.

Detailed sediment recruitment study of entire watershed

Feasibility study of creating a terminal fishery below Enloe Dam.

Assessment Unit (AU): 011—Osoyoos Lake South/Central

Priority Rank Restoration: Reaches: 3

1	**2**	**3**					

FOCAL species: Primarily Sockeye salmon, and steelhead secondarily spring/summer/fall Chinook salmon.

Drainage area:

SUBWATERSHEDS:

Nine Mile Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the central and south basins of Osoyoos Lake. The south basin spans the Canada/U.S. Border, and includes the 6 kilometre (4 miles) portion from Haynes Point south to the lake outlet. The central basin is just over 1 kilometre in length, and spans the portion of lake from Highway 3 in the Town of Osoyoos to Haynes Point.

Fisheries habitat throughout Osoyoos Lake is limited in mid to late summer by anoxic conditions in the hypolimnion and intolerably high water temperatures in the epilimnion. Only in the north basin, there is usually a metalimnetic zone between the epilimnion and hypolimnion, which offers a refuge for fish. However, in the present AU, which is comprised of the south and central basins, there, generally, is no metalimnetic refuge; mid to late summer conditions become intolerable for the focal species.

As a rule, counts of sockeye salmon on the spawning grounds are only about half the counts at Wells Dam. This may be due to differences in counting methods, but it may also be due to losses en route. Installation of counting fences at the inlet of Osoyoos Dam would help to determine where losses were occurring, and, thus, may reveal the causative factors for the loss.

This AU represents habitat that is highly degraded in regards to salmonid habitat and is unlikely to provide large production increases therefore is considered a low priority AU.

LEVEL OF CERTAINTY:

Sufficient limnological work has been conducted throughout Osoyoos Lake to provide a high level of certainty with regard to the limiting factors.

FACTORS LIMITING PRODUCTION:

P-Oxygen

P-Temperature

S-Pathogens

S-Predation

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Moderating high water temperatures in the epilimnion and anoxic conditions in the hypolimnion will increase the size of the rearing and holding area available for sockeye and Chinook.

Objective 1- Address water temperature and dissolved oxygen issues in the southern and central basins of lake Osoyoos.

Strategy 1A-Investigate the timing of the occurrence of intolerable conditions to ascertain the effects on various life history stages of focal species.

Strategy 1B - Measure vertical water temperature and oxygen profiles from bottom to surface from July to September. Compare results with tolerable limits for each focal species and life history stage.

Assessment Unit (AU): 011—Osoyoos Lake South/Central

Priority Rank Restoration: Reaches: 3

1	**2**	**3**					

Strategy 1C- Investigate the feasibility, costs, benefits, and risks of reducing both the length of time the effects occur, and the severity of those effects.

Strategy 1D- Investigate possibilities for BOD sources and possibilities for reduction, water inflow management, and hypolimnetic aeration.

Strategy 1E - Determine survival-to-spawning of sockeye that hold in south/central basin prior to spawning, and compare to other sockeye holding areas.

Hypothesis 2 - Preventing predation from introduced picivores will increase survival of sockeye and Chinook fry.

Objective 1 – Determine abundance species known to consume salmonids and implement ways to reduce salmonid predation.

Strategy 1- Use a species selective fishway to exclude walleye and other predatory fish Osoyoos Lake.

Strategy 2 - Confirm the presence or absence of predatory species north of Zosel Dam.

Strategy 3 - Examine the literature to determine the cost and efficacy of selective fishways and other removal methods.

Strategy 4 - Based on findings, prepare a management plan for implementing ways to reduce predator abundance.

DATA GAPS AND M&E NEEDS:

Resident Chinook in lake have been documented, but nothing is known about stock.

Chinook are believed to rear in Osoyoos Lake (H. Wright, ONA, pers. comm.). It is not known what stock or life history type they are (spring, summer/fall or resident).

The effects of water flow releases on temperature and dissolved oxygen levels are not known.

Although walleye have not been found in Osoyoos Lake, there are reports of their presence from knowledgeable sources. Given their predatory tendencies and the possibility of preventing their entry if they have not yet become established, it is important to confirm their presence.

Adult sockeye survival in south and central basin over summer period and contribution to the spawning population.

Assessment Unit (AU): O12—Osoyoos North

Reaches: 1

1																		

FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Inkaneep Creek (see AU Summary)

Mica Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the north basin of Osoyoos Lake. It is about 7 kilometres (4 miles) in length and stretches from the lake inlet to the Highway 3 crossing in the Town of Osoyoos. It has a maximum depth of 60 metres (200 feet) and a flushing time of 1 year.

Fisheries habitat in Osoyoos Lake is limited in mid to late summer by anoxic conditions in the hypolimnion and intolerably high water temperatures in the epilimnion. In the north basin, there is usually a metalimnetic zone between the epilimnion and hypolimnion that offers a refuge for fish; however, the extent of the metalimnetic zone varies and in some years is virtually non-existent (K. Hyatt, Fisheries and Oceans Canada, pers. comm.).

Mysis relicta have worked their way downstream from Okanagan Lake and were first found in Osoyoos Lake about 5 years ago. Numbers are thought to be increasing and managers are concerned that competition for food and space might adversely impact sockeye salmon.

Because quality rearing habitat is known to be limiting the Sockeye Salmon populations in the Okanogan River this is considered a priority AU for Sockeye. However implementing strategies that would address the known limiting factor could be cost prohibitive and have low efficacy.

LEVEL OF CERTAINTY:

Sufficient limnological work has been conducted throughout Osoyoos Lake to provide a high level of certainty in regard to the limiting factors.

FACTORS LIMITING PRODUCTION:

P-Oxygen

P-Temperature

S-Predation

S-Pathogens

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Additional rearing areas for juvenile sockeye and Chinook salmon, and a larger holding area for adult sockeye and Chinook can be created by moderating epilimnetic water temperature and hypolimnetic oxygen levels in the North Basin of Osoyoos Lake during August and September.

Objective 1 – Model the possible alternatives to address temperature and oxygen issues in the north basin of lake Osoyoos in August and September.

Strategy 1A - Record water temperature and oxygen level from bottom to surface throughout the north basin in August and September. Compare results with requirements of the focal species.

Assessment Unit (AU): O12—Osoyoos North

Reaches: 1

1																	

Strategy 1B - Measure and model the effect of water releases on temperature and oxygen level. Run a computer model to predict the benefits of various levels of water release. Link the model outputs with the Fish Water Management Tool to determine the costs and risks of water release.

Strategy 1C - Review methods of hypolimnetic aeration. Estimate costs, benefits and risks.

Strategy 1D-Based on modeling results implement the least cost approach that is considered feasible.

Hypothesis 2 - Chinook depend upon habitat in the north basin of Osoyoos Lake for juvenile rearing and adult holding.

Objective 1 - Develop a plan for Chinook investigations in Canadian portion of the Okanagan Basin.

Strategy 1A - Form an investigative (recovery) team to guide investigations.

Strategy 1B - Enumerate Chinook migrating into the north basin; collect lake Chinook by using trawls, beach seining (0+), and gillnets at predetermined locations and times.

Strategy 1C - Collect Chinook at various times and locations in the north basin and record distribution, age/growth, life history stage, and genetics; assess degree of anadromy or residency.

Hypothesis 4 - Survival of sockeye salmon underyearlings will increase if competition with Mysis relicta is reduced.

Objective 1 – Study the interaction of Mysis relicta and sockeye salmon

Strategy 1A - Determine the biomass and population trend of Mysis relicta.

Strategy 1B - Use vertical trawls to determine biomass, abundance and distribution of mysids. Monitor over time.

Strategy 1C - Use OLAP results to determine efficacy of mysid harvesting. Compare lake areas and populations to determine whether harvesting would have an effect in Osoyoos Lake.

Strategy 1D – Implement *Mysis relicta* removal program to protect downstream interests from being invaded.

DATA GAPS AND M&E NEEDS:

Holding patterns and timing of sockeye in Osoyoos Lake

The effects of water releases on summer water temperatures and oxygen levels

The extent of shoal spawning by sockeye salmon is unknown (objectives to determine extent and utilization)

The level of competition between Mysis relicta and rearing sockeye

Competition for food and rearing space between sockeye and kokanee

Adult sockeye survival in the north basin over the summer period and contribution to the spawning population

Resident Chinook have been reported, but little is known about their stock status

No protocol has been established for sampling of Canadian Chinook

Study predation of salmonids by introducing exotic predators.

Assessment Unit (AU): O13 - Inkaneep Creek

Reaches: 1

1								

FOCAL species: Primarily Summer steelhead, and sockeye salmon secondarily spring/summer/fall Chinook salmon	Drainage area: 18,764 hectares (46,367 acres)

SUBWATERSHEDS:

None

ASSESSMENT UNIT DESCRIPTION:

Inkaneep Creek flows through the centre of the Osoyoos Reserve and drains the west side of Mount Baldy before empting into the northern basin of Osoyoos Lake. The watershed is 80% forested and 20% burned. According to the BC Watershed Ranking Atlas (1998), agriculture uses comprise 1.8% of the watershed.

Surveys conducted by Colville Tribes and Okanagan Nation Alliance (ONA) in 2004 indicate that habitat is largely intact and could support summer steelhead and, perhaps, other anadromous species. Substrate is mainly large cobble and fines; therefore, it is not optimal for steelhead that prefer 1 to 3 inch size gravels. Substrate conditions would be more conducive to Chinook production; however, pockets of good gravels do exist.

Summer temperatures are known to reach 24 degrees Celsius; therefore, temperature will limit salmonid rearing to areas near groundwater inputs unless fish migrate to the north basin of Osoyoos Lake. Flow and passage appear adequate and riparian areas are in fair condition.

Cattle grazing threaten riparian function and groundwater inputs; however, new management practices implemented 2 years ago appear to be having a positive effect.

A natural falls (11 feet high and 12 feet long) at approximately river kilometre 5 (3 miles) is a barrier to anadromous fish. The origin of O. mykiss caught by anglers below this falls is unknown and could be either adfluvial rainbow trout from Osoyoos Lake or Okanogan River steelhead. O. mykiss may also be dropdown resident rainbows from higher portions of the stream.

Some diking and riprapping has artificially confined some of the lower reaches. Two surface diversions were observed; both are entirely unscreened with placement in-line with main flow, and are possibly resulting in considerable juvenile entrainment. Water withdrawal quantity is unknown but believed to be minor.

Although surveys were conducted during the time steelhead were present in streams further south, no fish were observed; water clarity, however, limited visual observation. Fine sediment in lower reaches is being conveyed from upstream areas; no major sediment recruitment areas were observed below the falls. An area of mass wasting is known to exist along the highway to Mount Baldy Ski Area and high in the watershed. Large woody debris (LWD) was largely non-existent. The lack of knowledge about this watershed makes recommending specific actions difficult. The primary limiting factors have been determined to be high summer water temperatures, sediments, water diversions, habitat diversity/quantity and the lack of knowledge. Research efforts to better understand how this watershed fits into the ecosystem of the Okanogan River subbasin are considered the highest priority at this time.

LEVEL OF CERTAINTY:

A survey and some restoration work have been carried out by Okanagan Nation Alliance (ONA) (see literature cited). ONA and COLVILLE TRIBES fisheries personnel carried out a visual survey in 2004.

FACTORS LIMITING PRODUCTION:

P-High summer water temperature

P-Fine sediments

P-Unscreened water diversions

P-Habitat quantity

P-Lack of knowledge

S-Bank stability and artificial confinement

S-Riparian condition

S-Habitat diversity

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Assessment Unit (AU): O13 - Inkaneep Creek

Reaches: 1

1								

Hypothesis 1 - Inkaneep Creek is an important spawning area for sockeye, and an important spawning and rearing area for rainbow trout/steelhead.

Objective 1- Determine adult escapement numbers and origin of sockeye, rainbow trout, and steelhead.

Strategy 1A – Enumerate adult steelhead and, sockeye.

Strategy 1B- determine juvenile abundance and distribution.

Strategy 1C- Determine whether Onchorhynchus mykiss spawning in Inkaneep Creek are adfluvial rainbow from Osoyoos Lake or steelhead and if sockeye or kokanee utilize this creek for spawning are the proportion of each that make-up the spawning population.

Hypothesis 2 - Sockeye and steelhead egg-to-fry survival will increase when loading of fine sediments in Inkaneep Creek is reduced.

Objective 1 – Reduce embeddedness by 10%.

Strategy 1A-Control erosion resulting from road construction and maintenance.

Strategy 1B - Refer to erosion control methods documented by ONA.

Hypothesis 3 - Screening irrigation diversions on Inkaneep Creek will increase sockeye and steelhead fry survival.

Objective 1 – Screen intakes.

Strategy 1A - Determine practical screening methods, prioritize locations, and develop a plan to implement NOAA Fisheries type specifications for irrigation screening throughout the watershed.

Strategy 1B-.Negotiate cost shares, and implement the plan.

Hypothesis 4 - Increasing the limit of migration of adult steelheads will provide access to more spawning and rearing habitat.

Objective 1 - Determine feasibility of laddering falls.

Strategy 1A - Prepare a plan that provides costs, benefit, and risks of laddering options; implement.

Strategy 1B-implement the plan if determined feasible

Hypothesis 5 – Streamside vegetation and stream bank stability will increase because of improved range management.

Objective 1 – Protect and restore riparian areas and groundwater inputs.

Strategy 1A-Monitor changes in streamside vegetation and bank stability improvements, and determine the extent of improvement due to range management changes.

Strategy 1B-- Negotiate further improvements in range management if indicated by monitoring results.

Strategy 1C- Determine the location, amount of groundwater inputs, and protect these areas.

Strategy 1D-Exclude livestock use in areas of groundwater inputs.

DATA GAPS AND M&E NEEDS:

Determine sediment sources and locations within the Inkaneep Creek watershed (expected to be high)

Determine entrainment into unscreened irrigation canals

Presence, absence, and run timing of focal fish species

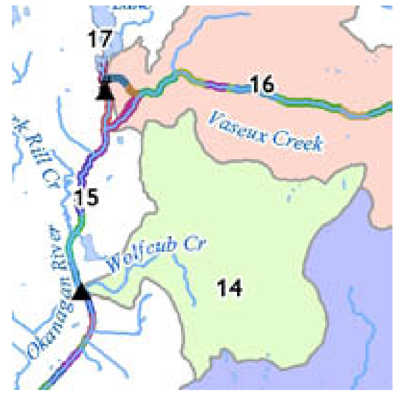
It is not known whether O. mykiss are adfluvial or anadromous

Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCP’s and the M&E guidance section of this plan especially as they relate to flow, temperature, and water quality.

Assessment Unit (AU): O14—Canada Lower Mainstem

reaches: 10

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**								



FOCAL species: Primarily Sockeye salmon and Summer steelhead secondarily spring and summer/fall Chinook salmon.

Drainage area:

SUBWATERSHEDS:

Testalinden Creek

Hester Creek

Wolfcub Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the Okanagan mainstem from Osoyoos Lake upstream to Vertical Drop Structure 12 in the middle of the Town of Oliver. The entire 15 kilometre (9 miles) stretch has been channellized. Habitat diversity is very low within the channel, with no LWD, no cover and few pools and riffles. The channel is not connected to the floodplain and riparian vegetation has been removed. The river in this area includes some riffles, most of which are associated with drop structures.

The tributaries in this section of the river (Testalinden, Hester and Wolfcub Creeks) remain dry for most of the year and are not considered a high priority for protection nor restoration now.

This section of the river supports sockeye, Chinook and steelhead. The major use is as a migratory pathway, but some spawning has been documented. This occurs on the occasional pockets of gravel associated with riffles. Elsewhere, the substrate is mostly sand and silt.

Productivity for focal fish species is presently limited by the low gradient (design grade between drop structures is 0.05%), silty substrates, a lack of habitat diversity within the channel, denuded banks, and lack of a floodplain. There are, however, opportunities for restoring pool/riffle habitats and creating greater habitat diversity, particularly in the vicinity of Vertical Drop Structures where there is sufficient drop to provide a design grade compatible with good fish habitat.

Water quality is unknown, but fertilizers and herbicides are widely used on surrounding vineyards.

Dyke roads parallel the river on both sides for the entire length of the river, but traffic is minimal. Restoration priorities in this AU are mainly to restore floodplain connectivity, restore channel geomorphology, and restore the riparian corridor. However, politically this will be problematic due to development within and along the floodplain. The AU above is still in a much more natural condition and represents a highly productive environment for salmon and steelhead. If restored, this AU could be equally productive.

LEVEL OF CERTAINTY:

The level of certainty is high. This section of the river is highly accessible and has been thoroughly examined.

FACTORS LIMITING PRODUCTION:

P-Habitat diversity

P-Habitat quantity

P-Predation

S- Fish Passage

P-Spawning habitat

S-Harassment

S-Channel stability

Refer to Appendix B for reference and specific detail by reach and species.

Assessment Unit (AU): O14—Canada Lower Mainstem

reaches: 10

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
11	**12**								

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Increasing the number of pool/riffle complexes along the main-stem and in secondary channels in this AU will increase the spawning, Juvenile rearing and overall habitat quantity used by sockeye, Chinook, and rainbow trout/steelhead therefore increasing the overall production of this AU

Objective 1- Increase the number of pool/riffle complexes in the system.

Strategy 1 - Replace the gradient drops at vertical drop structures with a series of Newberry rock riffles;

Strategies 2- Where possible, restore channel sinuosity and braiding.

Strategy 3-Where possible, remove dykes and reconnect side channels and floodplain

Hypothesis 2 – Restoring riparian areas will reduce water temperatures, reduce fine sediment recruitment, enhance habitat diversity, and expand wildlife habitat.

Objective 1 - Restore 25% of the historic riparian habitat to functional condition by 2015.

Strategy 1 – Protect key riparian areas through conservation programs, incentives, or purchase.

Strategy 2- Set back or removes dikes.

Strategy 3- Reslope and revegetate areas along the stream corridor using native plants.

Strategy 4- Locate and protect sources of incoming groundwater.

Hypothesis 3 - Replacing the vertical drop structures will increase fry production by reducing predation by exotic fish species. .

Objective 1 – Reduce predation by exotic fish species.

Strategy 1 - In cooperation with provincial water managers, research the possibilities of modifying flows during peak out-migration times

Strategy 2- Replace drop structures with natural rock riffles.

Strategy 3- Determine predator abundance and consumption rates of salmonids.

Strategy 4- Institute a predator removal program and monitor results.

DATA GAPS AND M&E NEEDS:

Spawning usage by sockeye, steelhead and Chinook

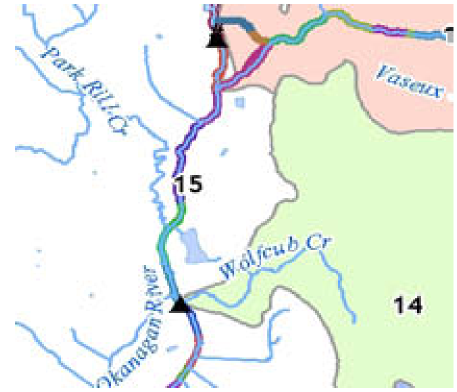
Determine and map the historic and current extent of floodplain throughout this AU

Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline program, hatchery M&E programs, HCPs, and M&E guidance of this plan.

Assessment Unit (AU): O15—Canada Middle Mainstem

Reaches: 6

1	**2**	**3**	**4**	**5**	**6**



FOCAL species: Primarily Sockeye salmon, and summer steelhead, secondarily spring and summer/fall Chinook salmon.

Drainage area:

SUBWATERSHEDS:

Vaseux Creek

Park Rill Creek

ASSESSMENT UNIT DESCRIPTION: The AU represents the pristine habitat remaining in the Okanogan River subbasin and therefore every effort should be made to protect it. Development, roads, flood control, agriculture, and other activities threaten this AU. This AU is the primary location of sockeye spawning in the Okanogan subbasin and other salmon and steelhead have been observed in the reach. McIntyre Dam is located at the upper end of this reach and currently represents the terminus to anadromous fish distributions because it was constructed without fish passage as a way to protect resident fish stocks from exotic introductions. Currently most of the exotic species already exist above this dam due to management and angler introductions. Passage already exists that would provide access into Skaha and Okanogan Lakes all that would be needed is to clean the ladders and remove some dam boards. Placing passage at McIntyre Dam would provide the largest natural increase to salmon and steelhead production possible for a low-cost improvement in the entire Okanogan River subbasin. A very high priority for the Okanogan River especially for sockeye salmon production would be to provide passage at McIntyre Dam. Passage improvements would not only expand spawning habitat for salmon and steelhead but also eliminate the major limiting factor for sockeye salmon (lack of rearing habitat) by providing access to Skaha and Okanagan lakes. If passage is not provided at McIntyre Dam then all activities or improvements made in Aus above this point would have very limited value.

AU WORKING HYPOTHESIS STATEMENT: Protect existing spawning habitat

Strategy 1a--Protect riparian corridor

Strategy 2a--Remove passage barriers especially at McIntyre Dam.

Strategy 3a—Continue dike set back and Newberry riffle programs and monitor

DATA GAPS AND M&E NEEDS: Maintain on-going monitoring and evaluation work (i.e. sockeye spawning and carcass surveys)

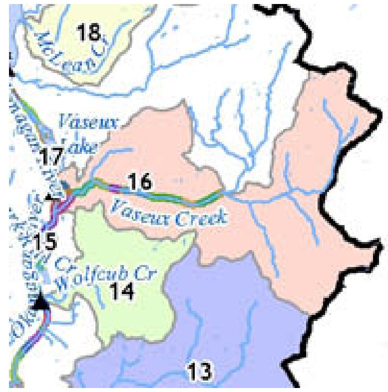
Expand surveys for other salmonid species and determine habitat utilization.

Implement shared monitoring and evaluation goals and protocols consistent with the Okanogan baseline program, hatchery M&E program, HCPs, and the M&E guidance of this plan.

Assessment Unit (AU): O16—Vaseux/McIntyre

Reaches: 1

1										



FOCAL species: Primarily: Sockeye salmon, spring/summer/fall Chinook salmon, and steelhead/rainbow trout.

Drainage area: 26,850 hectares (66,348 acres)

SUBWATERSHEDS:

Solco Creek

ASSESSMENT UNIT DESCRIPTION:

The watershed of Vaseux Creek is 80% forested and 0.7% agricultural. There is negligible urban development.

This AU includes the first reach of Vaseux Creek from its confluence with Okanagan River upstream for approximately 3 miles where a step walled canyon exists and passage is believed to be terminated at a series of falls. Although Vaseux Creek presently runs intermittently in the lower 1-mile reach, there is good continuous flow further upstream.

Local residents report that the creek used to run continuously and supported sockeye, summer steelhead, and Chinook. Sockeye were reportedly so numerous that they plugged irrigation canals; their carcasses were spread on adjacent fields as fertilizer. In addition, Okanagan elders also remember Chinook returning to the system. Some say that channelization in the 1950s scoured the riverbed and opened up filtration galleries that now allow the stream to percolate underground during the summer.

Members of Colville Tribes and Okanagan Nation Alliance (ONA) visited the stream recently and wrote "This stream could be key to salmon recovery efforts in the Okanogan River basin, but little information exists. A recent survey indicated that a huge potential for anadromous fish production exists. Substrate is mainly gravels and small cobble, ideal for steelhead production and other salmon. Substrates are unconsolidated and little fine sediment is present …The lack of knowledge about this stream is a major limiting factor for the entire Okanogan subbasin.…"

Chinook reportedly enter this stream (Howie Wright, ONA, pers. comm.) as do large Oncorhynchus mykiss which may be adfluvial rainbow trout from Osoyoos Lake, steelhead, or both. In summer, the portion below the canyon percolates to the sub-surface and, thus far, there has been little effort to collect data on this stream. The large volume of water that exists in the spring still provides abundant spawning areas, and when flows are present in the fall, spawning sockeye have been observed.

LEVEL OF CERTAINTY:

Although the considerable information is available it is limited to expert opinion and formal inventories are required to provide scientific assessment and quantification.

FACTORS LIMITING PRODUCTION:

P-Insufficient data information exists.

P-Habitat diversity

P-Flow

S-Channel Stability

Refer to Appendix B for reference and specific detail by reach and species.

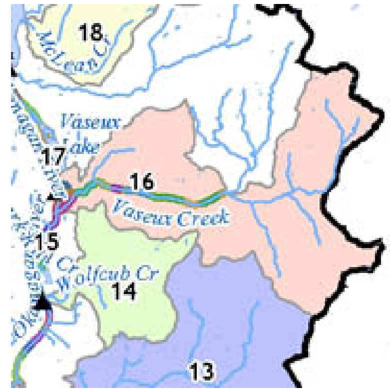
AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Man-made disturbances caused this formerly very productive stream to percolate underground. Restoration will provide spawning and rearing areas for all focal species.

Assessment Unit (AU): O16—Vaseux/McIntyre

Reaches: 1

1										



Objective 1 – Restore perennial in stream flows to historic levels.

Strategy 1-Investigate the percolation problem and determine if restoration is feasible.

Strategy 2-Investigate in-channel restoration options for improved water flow in the lower portion of the creek.

Strategy 3-Aquire water right or use other mechanisms (i.e. water leasing, water banking) to increase in-stream flows.

Hypothesis 2 – Quantify habitat and fish population to gain better understanding of this watershed and its relationship to the Okanogan River eco-system will improve management and provide a blue-print for restoration activities.

Objective 1- Collect baseline data and develop a watershed plan for restoration of McIntyre/Vaseux Creek.

Strategy 1-Collect data to quantify habitat current parameters and attempt to develop historic values to the highest possible degree from existing information.

Strategy 2-Inventory all fish species that currently use this stream and use anecdotal information to derive historic fish community.

Strategy 3- Use fish traps to collect adult salmonids for enumeration and DNA sampling to determine parental origin.

Strategy 4-Use EDT model to determine production potential and determine limiting factors for the entire watershed.

Strategy 5-Determine feasibility of improve passage to provide access to additional river miles above the canyon.

Strategy 6- Implement actions to restore this watershed.

Hypothesis 3 – Protect this watershed from further degradation using regulatory mechanisms will keep existing salmonid production from being reduced.

Objective 1-Insitute tight regulatory controls on development and other human influences in this watershed.

Strategy 1. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 2. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 3. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 4. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 6. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 7. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 8. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 9. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

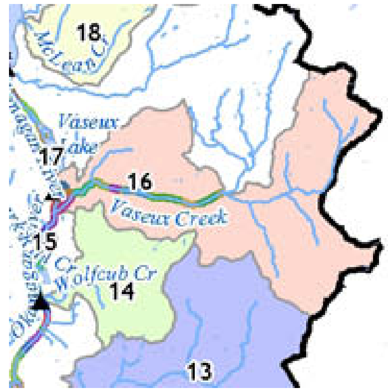
Strategy 10. Develop watershed management plans to enhance water quantity, quality, and fish habitat and conduct baseline surveys for habitat and biological data.

Strategy 11. Use regulatory mechanisms and cost-sharing to insure that all water withdrawal are screened to NOAA specifications.

Assessment Unit (AU): O16—Vaseux/McIntyre

Reaches: 1

1										



DATA GAPS AND M&E NEEDS:

Fish Genetics, presence, absence, distribution, abundance, and habitat utilization

Water discharge, withdrawals, and quality data

Natural barrier surveys

Habitat data

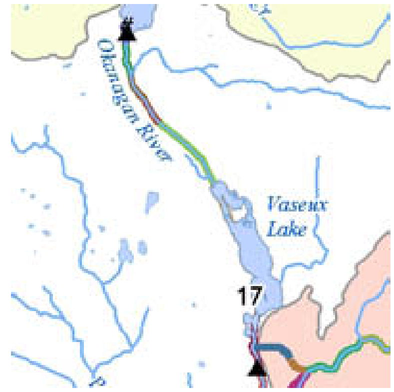
Historical information

COLVILLE TRIBES and ONA state that "…this Creek will require major efforts to collect, analyze data and develop a watershed recovery plan. This should be one of the highest priorities in the entire Okanogan River subbasin for both the U.S. and Canada."

Assessment Unit (AU): O17—Vaseux Lake and some Mainstem reaches

reaches: 7

19a	**19b**	**20**	**21**	**22**	**23**	**24**					



FOCAL species: Primarily: Sockeye salmon, Secondarily: spring and summer/fall Chinook salmon, and summer steelhead.

Drainage area:

SUBWATERSHEDS:

Shuttleworth Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the Okanagan River mainstem from McIntyre Dam north (upstream) to the outlet of Skaha Lake at the Town of Okanagan Falls. Vaseux Lake is included within the AU.

McIntyre Dam is a low head dam approximately 3 metres high. Its purpose is to divert water into a very large irrigation ditch that serves the southern Okanagan Valley. It also serves as a balancing reservoir to stabilize the height of water in Vaseux Lake. Many years ago, large mouth bass moved into the Okanagan from the U.S., and in an attempt to contain them, fisheries officers decided that McIntyre Dam should not be allowed to pass fish. McIntyre Dam has blocked migration for all anadromous species since then.

The irrigation canal immediately upstream from McIntyre Dam remains unscreened; if anadromous fish were allowed to pass McIntyre Dam, the canal would destroy many fry.

Vaseux Lake lies within this AU. It supports populations of both large and small mouth bass, and may present a predation problem for out-migrating salmon fry. Kokanee and rainbow trout populations are depressed, indicating that the lake does not have much potential for rearing salmonids, possibly due to unsuitable limnological conditions (high epilimnial temperature, low hypolimnetic oxygen levels) or high levels of predation by exotic fish species.

The Okanogan River is channellized in this AU, and for the most part, is too low in gradient to be used by focal species. The exception is the northern reaches that extend from the outlet of Skaha Lake downstream to the confluence with Shuttleworth Creek. This reach has not been channeled and has a good gradient and mixture of cobble and gravel substrate. A modest fishery for rainbow trout currently occurs in this reach; the area may be suitable for steelhead and other salmon species if they are able to get by McIntyre Dam.

Shuttleworth Creek has huge problems with mass wasting and unstable banks. It introduces vast quantities of silt into Okanagan River between its confluence and Vaseux Lake. A sediment-catching basin has been constructed at the mouth of Shuttleworth Creek, but appears ineffective.

The priority for this AU is to provide access past McIntyre Dam. Other habitat improvements would have little benefit before this is completed. After passage of anadromous fish above McIntyre dam is completed, then the primary focus of improvements should be on reducing production losses from irrigation diversions, reducing fine sediment inputs, and reducing predation from exotic fish species.

LEVEL OF CERTAINTY:

The level of certainty for this AU can be described as fair to good. Effects of low gradients, siltation, and channelization are obvious.

FACTORS LIMITING PRODUCTION:

P-Fish passage

P-Habitat diversity

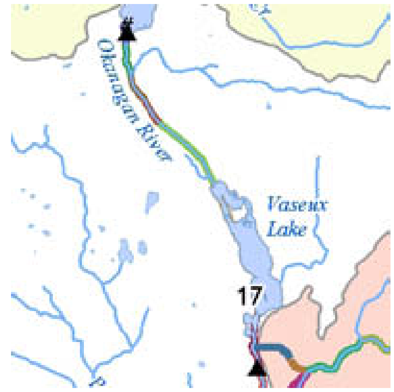
P-Irrigation Withdrawals

P-Habitat quantity

Assessment Unit (AU): O17—Vaseux Lake and some Mainstem reaches

reaches: 7

19a	**19b**	**20**	**21**	**22**	**23**	**24**					



P-Predation

P-Fine Sediments

S-Channel Stability

S-Pathogens

s-Water Quality

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1-Providing passage at McIntyre Dam would provide access to this habitat by focal fish species and increase production for the entire Okanogan River as a result.

Objective 1-Provide fish passage at McIntyre Dam in the very near term

Strategy 1- Design a system for removing laddering, bypassing or changing the operation of McIntyre Dam.

Strategy 2-Construct passage at McIntyre Dam

Strategy 3-Remove McIntyre Dam

Strategy 4 - Design a plan for restoring the fishway at Okanagan Falls Dam.

Strategy 5 - Design a plan for screening the irrigation canal at McIntyre Dam.

Hypothesis 2 - Predation by warm water species in Vaseux Lake will limit production of anadromous focal species.

Objective 1-Reduce predation on salmonids by exotic fish species

Strategy 1 - Assess the potential predation of warm water species in Vaseux Lake on out-migrating salmon fry.

Strategy 2-Implement a predator reduction program.

Hypothesis 2 - The Okanagan River Reach between Shuttleworth Creek and Skaha Lake is suitable habitat for Chinook/steelhead/sockeye spawning and Chinook/steelhead rearing.

Objective 1 - Determine the extent of quality spawning and rearing habitat.

Strategy 1 - Survey this reach and compare with steelhead and Chinook spawning and rearing habitat requirements. Prepare management plan.

Strategy 2-Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline program, hatchery M&E programs, HCPs, and M&E guidance of this plan.

Strategy 3-Develops a sediment reduction plan for the Shuttleworth Creek watershed.

DATA GAPS AND M&E NEEDS:

Habitat suitability studies

Inventory of present use by salmonids (rainbow trout)

Potential predation problems in Vaseux Lake

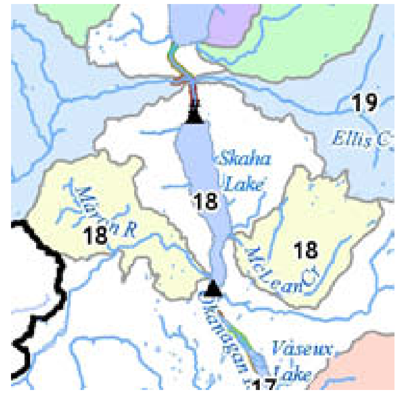
Species interaction studies

Sediment source analysis

Assessment Unit (AU): O18—Skaha Lake

Reaches: 2

1	**2**						



FOCAL species: Primarily Sockeye salmon, Secondarily spring and summer/fall Chinook salmon, and steelhead

Drainage area:

SUBWATERSHEDS:

McLean Creek

Marron River

ASSESSMENT UNIT DESCRIPTION:

This AU is comprised of the north and south basins of Skaha Lake. The lake is oligotrophic/mesotrophic with a maximum depth of 53 metres (175 feet) and a flushing rate of 1 year. In the late 1960s, Skaha was bordering on eutrophic, but tertiary sewage treatment has lowered the trophic status.

Limitations for rearing sockeye fry and holding sockeye adults in Osoyoos Lake have prompted recommendations for reintroduction of sockeye to Okanagan Lake, a cooler and more well oxygenated water body. Provincial fisheries' authorities expressed concerns about competition between sockeye and kokanee, and as a result, a decision was made to use Skaha Lake for an experimental introduction. This experiment will prompt an active research program into the costs, benefits and risks of extending the present range of focal species, beginning with sockeye. Habitat in Skaha Lake would reduce the major limiting factor to the Okanogan River sockeye salmon population that is currently a lack of adequate juvenile rearing habitat. Habitat restoration activities in this AU are considered low priority until passage is provided at McIntyre Dam downstream that currently blocks any of the focal species from reaching this AU.

LEVEL OF CERTAINTY:

High. A number of basic limnology studies and fish inventories have been carried out on Skaha Lake.

FACTORS LIMITING PRODUCTION:

P-Passage of McIntyre Dam and Okanagan Falls outlet dam

S-Competition with Mysis relicta and kokanee

S-Predation from small mouth bass and other exotic species

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1-Until focal species have access to this lake, no salmon or steelhead production is possible.

Objective-1 Once McIntyre dam is removed, monitor adult escapement into these habitats.

Strategy 1-Establish a video counting weir at Skaha Dam to monitor anadromous numbers and movement into this habitat.

Strategy 2-Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline program, hatchery M&E programs, HCPs, and M&E guidance of this plan.

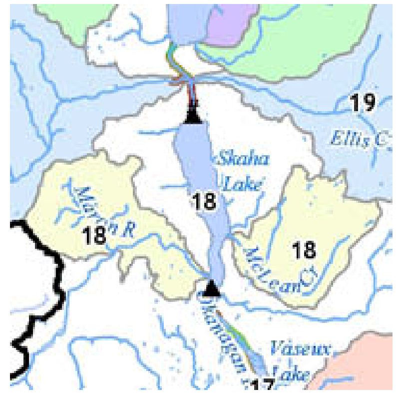
Hypothesis 2 – Until passage at McIntyre Dam is provided researching available habitat, potential species interactions, historic habitat conditions, fish species habitat utilization, and developing restoration plans will provide important information for future habitat expansion in the Okanogan River Basin.

Objective 1 - Determine if sockeye production in Skaha Lake is equal to or greater than in Osoyoos Lake.

Assessment Unit (AU): O18—Skaha Lake

Reaches: 2

1	**2**						



Strategy 1 - Identify funding sources, and implement an experimental sockeye fry reintroduction program into Skaha Lake; monitor and evaluate program. Follow the assessment program outlined in detail by ONA.

Objective 2 - Determine if Mysis relicta limit sockeye fry survival in Skaha Lake.

Strategy 1 - Investigate the standing stock and diet of Mysis relicta and compare with the diet of sockeye and kokanee; determine interrelationships.

Objective 3 - Determine if adult sockeye over-summer survival-to-spawning in Skaha Lake is greater compared to sockeye in Osoyoos Lake basins.

Strategy 1- Trap and transport adult sockeye into both lakes (and basins), and monitor over-summer survival to spawning.

Objective 4 - Determine if exotic species limit O. nerka (sockeye and kokanee) fry-to-smolt (1.0) survival.

Strategy 1 Implement a predator removal program..

Objective 5- Determine salmon recovery goals for stock and habitat restoration of upper Okanagan.

Strategy 1 - Use a combination of traditional knowledge with western science to develop a watershed recovery plan for anadromous fish above Skaha Lake.

Strategy 2-Once anadromous fish begin returning above Skaha Dam, begin implementation of the Watershed Recovery plan.

DATA GAPS AND M&E NEEDS:

Mysid standing stocks

Kokanee standing stocks and biomass

Level of competition between sockeye, kokanee and mysids

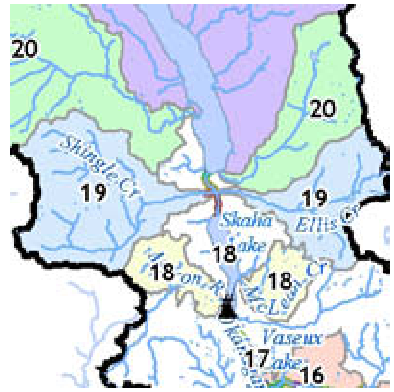
Historical information on salmon species in the upper Okanagan

Methods for creating fish passage

Assessment Unit (AU): O19—Canada Main Stem to Okanagan Lake

Reaches: 3

1	**2**	**3**	**4**							



FOCAL species: Primarily: Sockeye salmon, Secondarily: spring summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Ellis Creek

Shingle Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the 6 kilometre (4 miles) stretch of Okanagan River located between Okanagan and Skaha Lakes. It has been completely channellized, and the grade of the lower portion is too low to be useful to the focal species except as a migration path. The middle and upper portions of the AU, however, do have a suitable gradient, and are presently used by spawning kokanee, some of which are as large as sockeye.

This AU is lake-headed. That, plus riprapped dikes, preclude the recruitment of any spawning gravel. As a result, gravel has been added in the past, and has been a successful improvement for spawning kokanee. Similar steps will be needed to accommodate sockeye.

Two tributaries enter this AU: Ellis Creek and Shingle Creek. Ellis Creek runs through the industrial section of Penticton, and drains a watershed of 12,182 hectares. It is intermittent, steep, and has a substrate of large boulders and cobbles. In freshet, it carries heavy loads of silt, and in mid-summer, dries completely. A few kokanee spawn in the lowest reach of Ellis Creek, but they soon encounter an impassable concrete dam. Costs of laddering the dam would outweigh benefits as the upstream habitat is too steep and confined to be useful.

Shingle Creek is described in a separate AU summary. All Focal species in this AU are currently precluded from reaching available habitats by the barriers at McIntyre Dam and at the Skaha Lake dam. Until anadromous fish are provided access to the area above Skaha Lake Dam, restoration activities are unlikely to benefit Okanogan River production for any focal species.

LEVEL OF CERTAINTY:

The level of certainty is good. This AU has been under close surveillance for many decades.

FACTORS LIMITING PRODUCTION:

P-Fish passage barriers

P-Habitat diversity

P-Habitat quantity

P-Sediments

S-Predation

S-Harassment

Obstruction in Ellis Creek

Shingle Creek has an obstruction about 1kilometre above, with passage provisions, but not operative.

Refer to Appendix B for reference and specific detail by reach and species.

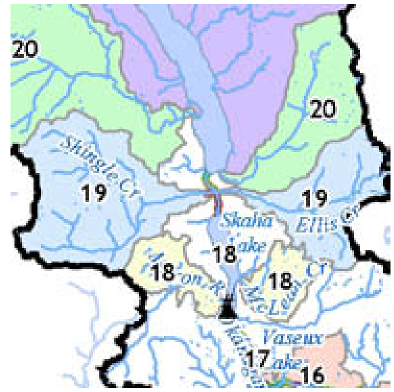
AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1-Until focal species have access to this lake no salmon or steelhead production is possible.

Assessment Unit (AU): O19—Canada Main Stem to Okanagan Lake

Reaches: 3

1	**2**	**3**	**4**							



Objective-1 Once McIntyre dam is removed monitor adult escapement into these habitats.

Strategy 1-Establish a video counting weir at Skaha Dam to monitor anadromous numbers and movement into this habitat.

Strategy 2-Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline program, hatchery M&E programs, HCPs, and M&E guidance of this plan.

Hypothesis 2 – Until passage at McIntyre Dam is provided researching available habitat, potential species interactions, historic habitat conditions, fish species habitat utilization, and developing restoration plans will provide important information for future habitat expansion in the Okanogan River Basin.

Objective 1 - Determine if sockeye and Skaha kokanee spawning habitat overlaps.

Strategy 1 - Trap and transport adult sockeye into Skaha Lake; monitor and evaluate.

Hypothesis 2 - Eggs and fry of all focal species (starting with sockeye) will survive better when a functional floodplain is available to provide cover and shade, a settling area for fines, a filter for runoff, stabilization for banks, improved habitat diversity and increased habitat quantity.

Objective 1 - Restore a natural floodplain and riparian zone where possible.

Strategy 1 - Acquire key riverfront properties which will allow removal or setting back of dykes.

Strategy 2 - Conduct stream restoration on acquired riverfront properties.

Strategy 3-Reconnect side channel and back channel habitats

Hypothesis 2 - Sockeye egg-to-fry survival is limited by lack of gravel recruitment.

Objective 1 - Compensate for the lack of gravel recruitment.

Strategy 1 - Construct gravel spawning beds in conjunction with habitat restoration; monitor and evaluate.

Strategy 2- Supplement gravel recruitment from outside sources.

DATA GAPS AND M&E NEEDS:

Determine sediment delivery sources and develop sediment management plan

Assessment Unit (AU): O20—Okanagan Lake

Reaches: 1

1										

FOCAL species: Primarily: kokanee and rainbow trout Secondarily: sockeye salmon,

Drainage area:

SUBWATERSHEDS:

Penticton Creek

Trout Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes a 7 kilometre (4½ miles) portion of Okanagan Lake from the lake outlet at Penticton north to Trout Creek. This small portion of Okanagan Lake was included in the Subbasin Plan to mark a placeholder for Okanagan Lake. Limited resources precluded the inclusion of a larger section of the lake.

Of all the lakes in the drainage basin, Okanagan Lake stands out as having the greatest potential for rearing sockeye. The lake is 35,000 hectares (88,000 acres) in surface area and up to 240 metres (800 feet) in depth. It is more oligotrophic than the downstream lakes and has an unlimited zone of tolerable conditions. Furthermore, it has many tributary streams that offer suitable spawning.

The decision to reintroduce sockeye to Okanagan Lake will not be made until monitoring and evaluation of results from the experimental reintroduction at Skaha Lake. In the meantime, Okanagan Lake will be included in planning exercises because of its tremendous potential. Salmon focal species other than sockeye will not be discussed at this time. Due to the political uncertainty of sockeye re-introductions into Okanogan Lake, subbasin planners do not believe it is likely that sockeye will exist in this AU within the time horizon of this planning document. They do believe, however, that any discussion of the Okanogan subbasin ecosystem would be incomplete without mentioning this important habitat.

LEVEL OF CERTAINTY:

Good. Okanagan has been the centre of scientific attention since the Okanagan Basin Study in the early 1970s. More recently, a major scientific program called Okanagan Lake Action Plan (OLAP) has been deployed to address the reasons and solutions for the collapse of the kokanee population. Planning designed to improve conditions for kokanee have a high likelihood of improving conditions for sockeye salmon.

FACTORS LIMITING PRODUCTION:

P-Passage at Okanagan Lake outlet dam (fish ladder available but not operated)

Competition with Mysis relicta

P-Destruction of stream spawning areas

P-Tributary flows

Nutrient imbalances

Kokanee fry to 1.0 survival (overwinter survival)

Refer to Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT: Until sockeye salmon reintroduction efforts are considered imminent the objectives and strategies in this AU are considered low priority. Priority objectives and strategies developed under the OLAP will be given the highest priority and will supersede these objectives and strategies once they are developed.

Hypothesis 1- Benefits of reintroducing sockeye salmon to Okanagan Lake will outweigh the costs and risks.

Objective - Determine costs, benefits and risks of sockeye reintroduction.

Assessment Unit (AU): O20—Okanagan Lake

Reaches: 1

1										

Strategy 1 - Use information gained in the Skaha Lake experiment to model Okanagan Lake. Use strategy outlined in detail by ONA.

Hypothesis 2 - Kokanee fry to 1.0 survival is reduced due to overwinter mortality.

Objective - Determine if overwinter mortality is a significant factor in reduced kokanee fry to 1.0 survival.

Strategy 1 - Conduct seasonal acoustic and trawl surveys to verify overwinter mortality.

Strategy 2- If significant overwinter mortality, determine causes and evaluate costs/benefits/risks of remediation.

Hypothesis 3 - Mysis relicta limit kokanee production in Okanagan Lake.

Objective - Determine if M. relicta limit kokanee production.

Strategy 1 - Conduct mysid harvesting to increase kokanee rearing capacity; monitor and evaluate.

Hypothesis 4 - A nutrient imbalance of reduced dissolved nitrogen levels during the late summer fall in Okanagan Lake provides conditions more favorable for cyanobacteria (blue-green algae) and; therefore, limits kokanee production through the food chain (less desirable food for desired zooplankton species; less desired zooplankton species for kokanee).

Objective - To determine if improving nutrient imbalance will increase kokanee production.

Strategy 1 - Evaluate costs/benefits/risks of nutrient addition to improve nutrient conditions.

Strategy 2 - Implement small-scale experiments to evaluate benefits of nutrient addition.

Strategy 3 - Conduct community consultations, evaluate costs/benefits and risks, implement, monitor and evaluate.

Hypothesis 5 - Channelized and water flow limit rainbow trout and kokanee production in Trout Creek.

Objective - Improve flow conditions and restore habitat functions to improve rainbow trout and kokanee production.

Strategy 1 - Set back dike where possible, increase water flows (license buy backs, water planning, and alternate water sources).

DATA GAPS AND M&E NEEDS:

Sockeye/kokanee interactions

Effect of Mysis relicta on Onchorhynchus nerka stocks

Benefits of re-introducing sockeye to Okanagan Lake

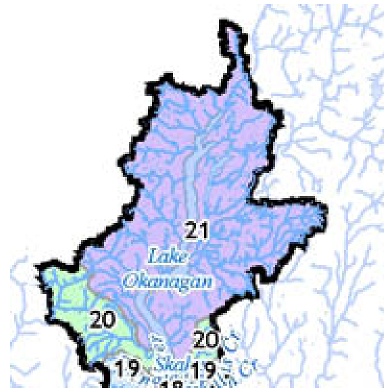
Overwinter mortality of kokanee fry to 1.0.

Tributary habitat assessment and barrier inventory

Assessment Unit (AU): O21—Shingle Creek

Reaches: 1

1										



FOCAL species: Primarily: Sockeye salmon and steelhead

Drainage area:

SUBWATERSHEDS:

Shatford Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes a 1kilometre (0.6 miles) portion of Shingle Creek from its confluence with Okanagan River to a fishway and low-head dam located on Penticton Reserve.

Shingle Creek was, historically, a major fishing area for First Nations; the name for this creek translates to “place of the steelhead.” Additional information on salmon, however, is lacking (H. Wright, ONA, pers. comm.). McIntyre Dam has cut off access to this stream, but the stream continues to be an important producer of rainbow trout and kokanee.

Shingle Creek and its tributary, Shatford Creek, drain a watershed of 22,040 hectares (54,460 acres). The watershed is 80-90% forested with 3% agricultural use.

The AU is wholly within the Penticton Reserve, and the Band is keenly interested in restoring anadromous salmonids to the upper Okanagan. The value of this habitat can only be gained by providing access to Anadromous fish. Until passage is provided and anadromous fish begin to be counted at Skaha Dam, habitat restoration will be considered a low priority. Protecting the existing habitat and research is a higher priority until anadromous fish are given access to this habitat.

LEVEL OF CERTAINTY:

Fair. As a part of the Okanagan System, Shingle Creek has been of considerable interest; however, its location on Reserve has limited access.

FACTORS LIMITING PRODUCTION:

P-Water withdrawal

P-Bank instability (natural but worsened by cattle and horses)

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Habitat degradation and water flow limit rainbow trout and kokanee (and in the future, sockeye) production in Shingle Creek.

Objective 1 - Improve flow conditions and restore habitat functions to improve rainbow trout and kokanee (and in the future, sockeye) production.

Strategy 1 - increase water flows (license buy backs, water planning, and alternate water sources).

Strategy 2-Protect and restore riparian habitats that can benefit fish and wildlife.

Strategy 3-Protect and restore natural geomorphology of the stream.

Hypothesis 2 – Historically, there were steelhead and other salmon returning above Okanagan Falls and into Shingle Creek.

Objective 1 - Determine salmon recovery goals for stock and habitat restoration of Shingle Creek as information is lacking

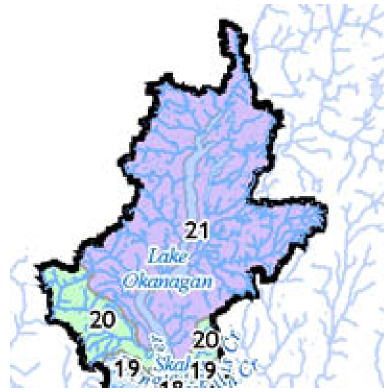
Strategy 1 - Use a combination of traditional knowledge with western science to develop a watershed recovery plan.

Strategy 2- Implement the recommendation of the Shingle Creek watershed recovery plan.

Assessment Unit (AU): O21—Shingle Creek

Reaches: 1

1										



DATA GAPS AND M&E NEEDS:

Benefits, costs, and risks of steelhead reintroduction

Methods of steelhead reintroduction

Quantity and quality of spawning and rearing habitat

Traditional knowledge of the historic fishery (species, numbers, and timing)

1.4 Basin-wide Wildlife Management Plan Goals and Objectives

The basin wide objectives blend the physical, biological and social aspects of natural resource management within the subbasin needed to achieve the vision and address the limiting factors affecting the sustainability and conservation of focal species and their habitats. Functioning ecosystems require a management plan at the regional scale but implemented at the subbasin and local level. Future projects will be based on the findings collected from baseline assessments as well as through the effectiveness monitoring and evaluation of implemented projects.

The management objectives identified are habitat based and describe priority areas and environmental conditions needed to allow ecosystem processes to function effectively. Mutual collaboration amongst other planning processes, such as the Eco-regional Assessment currently being developed by The Nature Conservancy, and the Watersheds and Fish Sustainability Project in Canada, will stand to benefit all parties greatly in the sharing of information and this information will need to be appended to this plan once available. Where possible, biological parameters and performance standards are identified and scientifically rationalized. The intent the biological goals objectives and strategies are that they be:

- Consistent with regional and subbasin level visions and strategies;
- Developed from a group of potential objectives based on the subbasin assessment and resulting working hypotheses;
- Realistic and obtainable within the subbasin;
- Consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife resources in the subbasin and agreed upon by the co-managers in the subbasin;
- Complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin, and
- Quantitatively and have measurable outcomes where practical.

Strategies

Strategies are sets of actions to accomplish the biological objectives. In developing strategies, planners took into account not only the desired outcomes, but also the physical, biological and social realities expressed in the working hypothesis. Strategies are not projects but instead are the guidance for the development of projects as part of the implementation plan.

1.4.1 Ponderosa Pine

Ponderosa pine has been selected as a focal habitat due to the extensive loss and degradation of forest characteristics of this series. Declines of this forest habitat type are some of the most widespread within the interior Columbia Basin largely due to fire suppression, timber harvest and urban/rural development. Because of this large decline and ecological importance of this habitat type within the sub-basin, management priority is to first assess the current conditions, identify restorative opportunities and monitor the effectiveness of habitat conditions at meeting the biological needs for focal species associated with this environment. The desired condition in Ponderosa pine forest is a large tree, single-layered canopy with an open, park-like understory dominated by herbaceous cover with scattered shrub cover and pine regeneration.

Goal: Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3 (Inventory and Assessment).

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitat to sustain focal species populations.

- Identify and distinguish ecologically functioning and non-functioning ponderosa pine habitats, corridors, and linkages.
- Identify sites that are currently not in ponderosa pine habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

- Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
- Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).
- Emphasize conservation of large blocks and connectivity of functional, high quality ponderosa pine habitat.
- Uphold existing land use and environmental regulations that protect habitats.
- Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture practices, fire management, weed control, livestock grazing practices, and road management on existing and restored ponderosa pine habitats.

Strategies:

- Provide information, outreach, and coordination with public and private land managers to improve the use of prescribed fire, fire protection, and silviculture practices to restore and conserve habitat functionality.
- Implement habitat stewardship projects with private landowners.
- Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
- Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
- Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Show an increase in distribution and population status of white-headed woodpecker, flammulated owl, gray flycatcher, and pygmy nuthatch.

Strategies:

- Select survey protocol and determine current distribution and population status of each ponderosa pine focal species.
- Identify current and potential areas of high quality habitat for each of the ponderosa pine focal species.
- Work with state, federal, tribal, county, and private entities to maintain and improve structural stand conditions of ponderosa pine habitat.

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other ponderosa pine obligate populations to test assumption of the umbrella species concept for conservation of other ponderosa pine obligates.

Strategies:

- Implement federal, state, tribal management and recovery plans.

1.4.2 Shrubsteppe

Shrub-steppe habitat is selected as a focal habitat largely due to the substantial contrast of historical prevalence and contemporary degradation and loss within the sub-basin. Declines of this habitat type are due largely to agriculture, fire suppression, hydro development, urbanization, noxious weeds and grazing. Because of the large decline and ecological importance of this habitat type within the sub-basin, management priority is to first assess the current conditions, identify restorative opportunities and monitor the effectiveness of habitat conditions at meeting the biological needs for focal species associated with this environment.

Goal: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrubsteppe toward conditions 1, 2 and 3 identified in 3.1.7.2.3 (Inventory and Assessment).

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of shrubsteppe habitat to sustain focal species populations.

Strategies:

- Identify and distinguish ecologically functioning and non-functioning shrubsteppe habitats, corridors, and linkages.
- Identify sites that are currently not in Shrubsteppe habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

- Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
- Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).
- Emphasize conservation of large blocks and connectivity of functional, high quality shrubsteppe habitat.
- Uphold existing land use and environmental regulations that protect habitats.
- Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing and restored shrubsteppe.

Strategies:

- Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to restore and conserve habitat functionality.
- Implement habitat stewardship projects with private landowners.
- Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
- Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.

- Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Determine population status of the grasshopper sparrow, Brewer's sparrow, Sharp-tailed grouse, and mule deer by 2008.

Strategies:

- Select survey protocol and measure population status of focal species.
- Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).

Biological Objective 2: Re-introduce sharp-tailed grouse to desired viable population levels by 2024.

Strategies:

- Implement state and tribal management recovery plans.
- Re-introduce Sharp-tailed grouse into the sub-basin.
- Ensure Sharp-tailed grouse habitat needs are met on federal, state, and tribal managed lands during land use planning.

Biological Objective 3: Maintain and enhance mule deer populations consistent with state/tribal herd management objectives.

Strategies:

- Implement state and tribal management plans.
- Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning.
- Maintain mule deer populations within landowner tolerances.
- Protect and enhance important winter range and areas of sensitive habitat.
- Work with state, federal, tribal, and private entities to improve habitat quality within ponderosa pine habitat (road closures, weed management, improved forage, etc)

1.4.3 Riparian Wetlands

Riparian wetlands are selected as a focal habitat due to importance of wetlands to watershed hydrology and species assemblages. This habitat type can be characterized by a mosaic of plant communities occurring at irregular intervals along streams, lakes or wetlands by some combination of grass-forbs, shrub thickets and mature forest of deciduous trees. They are the lifeblood to approximately 80% of wildlife species dependent on these areas at some time of their lifecycle (Thomas et al. 1979). Decline of this habitat type can be attributed to agriculture, hydro development, urbanization, and grazing. Because of the large decline and ecological importance of this habitat type within the sub-basin, management priority is to first assess the current conditions, identify restorative opportunities and monitor the effectiveness of habitat conditions at meeting the biological needs for focal species associated with this environment.

Goal: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions Okanogan Wildlife Inventory and Assessment 1a, 1b, and 2 identified in 3.1.7.3.3

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of riparian wetland habitat to sustain focal species populations.

Strategies:

- Identify and distinguish ecologically functioning and non-functioning riparian wetland habitats, corridors, and linkages.
- Identify sites that are currently not in riparian wetland habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

- Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.
- Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).
- Emphasize conservation of large blocks and connectivity of functional, high quality riparian wetland habitat.
- Uphold existing land use and environmental regulations that protect habitats.
- Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.

Strategies:

- Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to produce desired riparian wetland habitat conditions.
- Implement habitat stewardship projects with private landowners.

- Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.
- Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.
- Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Determine population status of beaver, red-eyed vireo, and, yellow-breasted chat by 2008.

Strategies:

- Select survey protocol and measure population status of focal species.
- Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates.

Strategies:

- Implement federal, state, tribal management and recovery plans.

Biological Objective 3: Based on findings of Biological Objective 1, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.

Strategies:

- Protect, and where necessary restore, habitat to support beaver.
- Reintroduce beaver into suitable habitat where natural re-colonization may not occur.
- Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2.

1.5 Specific Production Goals by fish species

Context for ongoing and Future Artificial Propagation Programs

Because of the ecological context of the Okanogan subbasin and the socio-economic needs of the Colville Tribes, recreational constituencies and local communities, artificial propagation programs are necessary to mitigate for subbasin losses and to conserve the species present in the Okanogan. The following strategies are designed for both conservation and harvest purposes.

The use of artificial production programs in the Okanagan is predicated on the following principle linking it directly to actions and goals in the subbasin plan (from the Chief Joseph Dam Hatchery Project, 2004).

> *Salmon (bull trout and steelhead) recovery is a race between the time a population or group of populations will be extirpated and the time habitat to support those populations can be recovered. Whether [artificial] supplementation is appropriate for a population depends on the anticipated time to extirpation compared to the time required for habitat recovery. Supplementation should be considered appropriate if a population would be extirpated before habitat could be recovered if the habitat could be recovered in the extended period that supplementation could provide. Given the history of overall human impacts as evidenced by hydropower, agricultural and industrial development in the main stem areas, and by similar effects to valley bottoms and tributaries, it is probable that no other region in the Columbia Basin personify these principles more poignantly than the combined territories of the Okanogan.*

Goals for Species and Supplementation

This plan describes existing programs, improvements to those programs, and new programs to ensure conservation of endemic species and reintroduction of extirpated species, and programs to restore tribal ceremonial and subsistence harvest and recreational angling opportunities. It should be noted, however, that Canadian Agencies focus resource restoration activities on initiatives that complement the natural ecosystem as a whole and insist on a very thorough review of any proposed salmonid restoration strategies that involve significant mixing of hatchery and wild stocks in the Canadian portions of the Okanagan River watershed. It is the current position of the Canadian managers that no outplants are allowed in Canadian waters of the Okanagan Basin unless authorized by the Canada / BC Introduction and Transplant Committee (ITC)"

Summer/Fall Chinook

Habitat Escapement Objective: The long-standing escapement objective for summer Chinook has been 3,500 adult fish upstream of Wells Dam. This objective applies to both the Methow and Okanogan subbasins.

The Okanogan River Summer/Fall Chinook HGMP prepared to guide comprehensive management of summer/fall Chinook in the Okanogan provides for an initial natural spawning escapement goal of 3,500 early-arriving summer/fall Chinook and 1,200 later-arriving summer/fall Chinook above Wells Dam. This broader escapement goal emphasizes the need to restore the later portion of the Chinook run that has not been represented in the broodstock for the current artificial propagation program. These later-arriving Chinook are thought to spawn primarily in the lower Okanogan River and perhaps in the Columbia River from Chief Joseph Dam down to the confluence of the Okanogan River.

With initiation in 2005 of a new baseline M&E program in the Okanogan River, and anticipated expansion of artificial propagation programs for the Okanogan River, the escapement objective will be adjusted based on M&E results. For the future, the M&E program will also allow management entities to establish spawning escapement objectives specifically for the Okanogan River.

Hatchery Broodstock Objective:

The current hatchery broodstock objective for summer/fall Chinook is 556 for the Okanogan and Methow programs (early-arriving Chinook). These fish are collected at Wells Dam from mid-July to late August. This program has used a high proportion of hatchery-origin fish, a high number of which have been found to be strays from downriver programs (Wells Hatchery and Turtle Rock Hatchery). With the recent increased runs, broodstock collection has most recently targeted natural-origin Chinook, improving the viability of the hatchery program and eliminating the use of stray fish.

With implementation of the proposed Chief Joseph Dam Hatchery Program, the broodstock objective for the Methow and Okanogan programs and direct hatchery releases into the Columbia River will increase to 1,070 early-arriving summer/fall Chinook and 618 later-arriving summer/fall Chinook. Collection of broodstock for fish released in the Okanogan River or directly from Chief Joseph Dam Hatchery will be collected from the run destined for the Okanogan River using live-capture, selective fishing gears. Collection at Wells Dam will only occur on a contingency basis.

The HGMP contains protocols for inclusion of hatchery-origin fish in the broodstock, ranging from a high of 50% in the lowest run years to 0% in the higher run years.

Relationship of Hatchery-Origin and Natural Origin Fish in the Okanogan

Management of summer/fall Chinook in the Okanogan River has emphasized achievement of the escapement objective irrespective of fish origin. Tribal and recreational harvest management similarly has not distinguished between hatchery and natural origin Chinook. From 1998-2002 the proportion of hatchery-origin fish spawning in the Similkameen River has averaged 57% (range 41-70%), while in the Okanogan River, hatchery-origin fish have averaged 51% of the natural spawners (range 33-61%). In both rivers, the proportion of hatchery-origin spawners increases with increasing escapement.

With implementation of the propagation and harvest programs described in the HGMP, health of the naturally spawning population in the Okanogan River will be emphasized (integrated recovery program). This will be accomplished by emphasizing escapement of natural-origin fish to meet natural spawning objectives. The HGMP provides initial escapement protocols to achieve less than 50% hatchery-origin fish in the lowest runs of early-arriving summer/fall Chinook and achieve less than 20% hatchery-origin fish in the largest runs. Similar natural-origin escapement objectives have not been established for the later-arriving Chinook since initially, large numbers of hatchery-origin fish will be needed to repopulation the lower river habitat.

The emphasis on escapement of natural-origin fish will be accomplished by several actions. Broodstock collection for hatchery programs, particularly of natural-origin fish, will be limited when necessary to achieve natural escapement objectives. Tribal C&S and recreational harvest will selectively target marked, hatchery-origin fish to improve the proportion of natural-origin fish in the wild. Harvest will only target natural-origin Chinook in years of significantly surplus natural production. If excessive numbers of hatchery-origin fish continue to escape, then the Tribes' and recreational anglers selective fishing capacity will be increased. If management objectives are still not met, then hatchery releases into the Okanogan will be reduced by either shifting releases back to CJD Hatchery or reducing production of fish.

The artificial propagation program for releases of summer/fall Chinook directly from CJD Hatchery into the Columbia River will emphasize tribal C&S and recreational harvest, compatible with population health in the Okanogan River (integrated harvest program). An intensive, but selective terminal fishery will be established in the 11 miles of the Columbia River upstream from the confluence of the Okanogan River.

Subbasin Harvest Objective

Runs of summer/fall Chinook to the Okanogan River have been highly variable. Tribal and recreational harvest of summer/fall Chinook in the Okanogan River and the Columbia River from its confluence to Chief Joseph Dam generally depends on run strength as predicted preseason by fishery management agencies and then actually measured at Rocky Reach and Wells dams. Recreational fisheries in the Okanogan have been infrequent and are not planned unless at least 11,000 summer/fall Chinook pass Priest Rapids Dam. Tribal fisheries primarily below Chief Joseph Dam occur annually with harvest generally proportional to run size.

With implementation of the CJD Hatchery Program, the run of early-arriving summer/fall Chinook is expected to increase by 3,000 – 15,000 fish while the later-arriving portion of the run is expected to increase by 3,000 – 14,000 Chinook. In time, the natural-origin run of summer/fall Chinook should increase with the increased utilization of the historical spawning habitat and planned improvements to mainstem passage.

The HGMP contains a detailed harvest management protocol for sharing of harvest between tribal and recreational anglers and for harvest of hatchery-origin and natural-origin Chinook. With the highly variable smolt-to-adult survival rates due to downstream migration and ocean conditions, total harvest in the Okanogan River and Columbia River below CJD will continue to be highly variable, between 7,000 and 50,000 Chinook.

Out of Subbasin Harvest Objective

Downstream of the Okanogan River, harvest rates on summer/fall Chinook will be driven by fisheries management under the auspices of the US/Canada Treaty, Pacific Fishery Management Council, and the Columbia River Compact. Historically, these fisheries took large numbers of summer/fall Chinook and recently have been significantly restricted to protect ESA-listed stocks. The HGMP is based on the assumption that future harvest on Okanogan summer/fall Chinook will be managed in these river and ocean fisheries at rates similar to current levels.

Hatchery Contingency Plans

Contingency actions have been included in the summer/fall Chinook HGMP and in the design of the CJD Hatchery Program in anticipation of needed adjustments in initial program elements. Performance indicators have been established to guide direction of a comprehensive M&E program and annual review of the programs' benefits and risks. To meet management objectives and respond to new scientific and social information, adjustments can be easily made between the integrated recovery and integrated harvest programs. Harvest capacity has been planned to be responsive to highly variable run sizes. Acclimation and release sites can be varied and production numbers can and will be adjusted as needed.

Relationship of Hatchery Programs to Habitat Initiatives

The artificial propagation programs in the Okanogan River are designed to use historical habitat more productively. First, the current releases of 576,000 smolts in the Similkameen River will be split, with 200,000 of the fish being moved to an acclimation site lower on the Okanogan River. This action should alleviate the over escapement and super imposition of spawning in the Similkameen River and better utilize historical habitat on the upper Okanogan River. New summer/fall Chinook production from CJD Hatchery will be acclimated at two new sites to increase homing and spawning on underutilized historical habitats in the mid and lower reaches of the river. The emphasis on producing later-arriving summer/fall Chinook is to rebuild that portion of the run that should be better adapted to the underutilized habitat in the lower river.

Underutilized spawning habitat on the Okanogan River is typified by excessive sediments. Repeated spawning by increased numbers of hatchery-origin Chinook in these degraded habitats is expected to improve the quality of its egg incubation properties. Should gravels remain too heavily impacted by sediments, then use of a mechanical gravel-cleaning machine will be explored. The Okanogan's low gradient and shallow depths make it a good candidate for mechanical cleaning.

Juvenile summer/fall Chinook emigrate from the Okanogan River in the spring and early summer before lethal temperatures can occur starting in about mid-July. Most of these fish enter the ocean as sub-yearlings. Those that demonstrate a yearling life history are believed to over winter rear in the Columbia River reservoirs. Therefore, juvenile rearing habitat in the Okanogan River is not thought to be limiting. In the long term, some riparian restoration, particularly of mature ponderosa pine, may provide rearing benefits to Chinook by reducing solar heating.

Spring Chinook

Habitat Escapement Objective:

Spring Chinook were extirpated from the Okanogan subbasin from early habitat destruction and constant over harvest before scientific observations could sufficiently document their habitats and life histories. Mitigation programs were not initiated in the Okanogan subbasin as elsewhere. Only in the past three years have small numbers (50,000–150,000 smolts) of Carson stock Chinook been acclimated and released in the Okanogan. The first adult returns to Omak Creek are anticipated in 2005 at which time information on habitat utilization and production can be collected.

An Okanogan River Spring Chinook HGMP has been developed to plan and direct management of spring Chinook in the Okanogan River and in the terminal portion of the

Columbia River from Chief Joseph Dam downstream to the confluence of the Okanogan River. In Phase I of the HGMP, Carson-stock fish will be used to test the suitability of Okanogan habitats and collect critical life history and biological performance information (integrated recovery program). If Phase I proves successful, then in Phase II of the HGMP, ESA-listed Methow Composite stock will be introduced into the subbasin to replace the Carson stock.

The HGMP specifies an initial escapement objective of 300 spring Chinook. This objective will be adjusted based on performance and the extent to which historical habitats in Salmon Creek and in Canada are restored.

An isolated harvest production program is also described in the HGMP. This program will release Carson stock spring Chinook directly into the Columbia River at CJD Hatchery and also from an acclimation site on the upper Okanogan River. Relative to escapement, the objective for this program is to remove all returning fish for either hatchery broodstock or harvest and prevent their possible spawning in the Okanogan subbasin.

Hatchery Broodstock Objective

The Phase I integrated recovery program will require 38 adult fish, increasing to 74 when Salmon Creek is reconnected to the Okanogan River. The Phase I isolated harvest program will require 286 adults, increasing to 570 upon full implementation with operation of CJD Hatchery. The primary broodstock collection point for the integrated recovery program will be at a weir in Omak Creek. Broodstock for the initial years of the Phase I isolated harvest program will be collected and spawned at Leavenworth NFH in the Wenatchee subbasin. Later with construction of CJD Hatchery, the primary broodstock collection will be at the hatchery and using live-capture, selective fishing gears in the Columbia River upstream of the Okanogan River.

The HGMP would be revised if reintroduction of spring Chinook is deemed appropriate in the Canadian Okanagan River.

Relationship Hatchery-Origin and Natural Origin

For the isolated harvest programs in the Columbia and Okanogan rivers, the objective will be to prevent any significant numbers of hatchery-origin fish from spawning in the Okanogan subbasin.

The HGMP describes protocols for management of Carson stock spring Chinook returning to Omak Creek. Emphasis will be on ensuring adequate escapement before fish are removed for hatchery broodstock. M&E will determine the extent of natural production and the feasibility of the Creek to sustain a supplemented run. Management of Omak Creek will focus on reestablishing a spring Chinook run with hatchery-origin fish allowed to spawn only to the extent needed to meet minimum escapement needs. When Salmon Creek is reconnected to the Okanogan via a flow restoration project, a similar reintroduction program will be promptly initiated. In years of insufficient returns for broodstock, eggs will be obtained from Leavenworth NFH.

Should the Phase I program demonstrate viable habitat conditions for spring Chinook, exist, then the Carson stock would be replaced by the Methow Composite stock of the UCR Spring Chinook ESU, initiating Phase II. This endangered stock would be used in the Okanogan subbasin when a surplus of hatchery-origin fish exists in the Methow subbasin and would be introduced only as an ESA "experimental population". The local Methow stock is believed to offer the greatest opportunity to reproduce successfully in the wild and a successful reintroduction would contribute to the species survival and recovery.

Subbasin Harvest Objective

Colville Tribal and recreational fisheries in the Okanogan River and in the Columbia River below CJD will employ selective fishing gears to remove all hatchery-origin fish from the isolated harvest program. The HGMP contains harvest protocols to share harvestable surpluses between tribal and recreational fisheries and prescribing the conditions under which limited harvest of unmarked fish would be allowed.

Runs of spring Chinook back to the Okanogan River and terminal portion of the Columbia River are expected to be highly variable. Under the Phase I program, between 1,600 and 5,600 adult spring Chinook are expected to be available for harvest. Selective fisheries in the Okanogan River will be restricted as necessary to avoid significant mortalities of unmarked fish destined for the integrated recovery program. Management will be based on preseason forecasts and enumeration of the actual run as it is counted at Rocky Reach and Wells dams.

Out of Subbasin Harvest Objective:

Downstream of the Okanogan River, harvest rates on spring Chinook will be driven by fisheries management under the auspices of the US/Canada Treaty, Pacific Fishery Management Council, and the Columbia River Compact. Historically, only the in river Compact fisheries took large numbers of spring Chinook, but have been significantly restricted in recent years to protect ESA-listed stocks. The HGMP is based on the assumption that future harvest on Okanogan spring Chinook will be managed in these river and ocean fisheries at rates similar to current levels.

Hatchery Contingency Plans:

Contingency actions have been included in the spring Chinook HGMP and in the design of the CJD Hatchery Program in anticipation of needed adjustments in initial program elements. Performance indicators have been established to guide direction of a comprehensive M&E program and annual review of the programs' benefits and risks. To meet management objectives and respond to new scientific and social information, adjustments can be easily made between the integrated recovery and integrated harvest programs. Harvest capacity has been planned to be responsive to highly variable run sizes. Acclimation and release sites can be varied and production numbers can and will be adjusted as needed.

Two significant spring Chinook issues require careful monitoring. First, Carson stock spring Chinook should not be allowed to spawn to any significant degree with the endemic summer/fall Chinook population. Second, Carson-stock spring Chinook should not be allowed to stray into the Methow River and spawn in any significant numbers. The HGMP contains a number of contingency actions should these infractions occur, including increasing selective harvest capacity, altering acclimation locations, reducing production numbers, and finally eliminating the isolated harvest program.

Relationship of Hatchery Programs to Habitat Initiatives:

Reintroduction of a naturally spawning population into the Okanogan subbasin would not be possible without reconnecting and improving historical tributary habitats in the U.S. or Canadian habitats. Omak Creek was reconnected to the Okanogan River in the 1990s and is the initial focus of reintroduction efforts. Only monitoring of returning Chinook will demonstrate whether the habitat improvements made to the creek have been sufficient to support natural reproduction. The creek still requires riparian and watershed improvements and healing time before its full potential to support salmon and steelhead will be realized.

Salmon Creek is believed to have been the primary spring Chinook habitat within the U.S. portion of the Okanogan subbasin. Historical habitat was completely disconnected from the Okanogan River by irrigation development in the early 20th century. The proposed Salmon Creek Project would reconnect 11 miles of potential Chinook spawning and rearing waters. This project, the primary feature of which is a new pumping station to offset irrigation waters reallocated back to stream flows, is required before any reintroduction could be implemented. The 11 miles of Salmon Creek that would become available for Chinook production would be characterized by a substantially intact riparian corridor and an optimal annual flow regime from Conconully Reservoir. The temperature regime of reservoir outflows should be near optimal for most life stages, but could delay the onset of spawning. Currently the preferred alternative for this project includes a pump station sized to achieve a flow regime sufficient for steelhead only. A larger pump station to ensure annual flows sufficient for spring Chinook will only be constructed should the federal government include the Okanogan subbasin in recovery plans for the endangered ESU.

The temperatures in the mainstem Okanogan River are expected to limit the natural production potential of the subbasin. In most years, high river temperatures can be expected to block spring Chinook migration in July. Any Chinook not already into tributary or lake holding waters by that time will most likely not survive through the summer to spawn. Should sufficient natural production be reestablished in the subbasin, the run would be expected to evolve to an early return timing as later arriving fish would not contribute to the gene pool. No habitat improvements can be expected to improve fully the temperature regime of the Okanogan. In the long term, restoration of riparian ponderosa pines and other actions may temper the heating of river flows.

Canadian waters may offer the greatest potential to support a significant natural run of spring Chinook in the Okanogan subbasin. The combination of tributary spawning habitat and productive rearing and holding waters in the lake environs could support a core population substantially more viable than other habitats in the Columbia Cascade Province. Specific habitat initiatives in the Canadian waters and a propagation program to seed a reintroduction experiment need to be developed.

Steelhead

Habitat Escapement Objective:

With U.S. tributary habitat either severely degraded or completely disconnected from the Okanogan River, little natural spawning has occurred in the subbasin until recent years. A well-defined steelhead habitat escapement objective does not yet exist for the Okanogan River. However, a comprehensive Okanogan River Steelhead HGMP is now under preparation that will define an initial escapement objective for the subbasin and its major tributaries. Omak Creek, the first tributary to receive significant rehabilitation had a spawning run of 104 steelhead in 2004.

Hatchery Broodstock Objective:

The upcoming steelhead HGMP will describe a number of programs for the Okanogan subbasin. The longstanding integrated harvest program using Wells stock steelhead will continue along with two new integrated recovery programs, an Omak Creek local steelhead broodstock program and a steelhead kelt reconditioning program in Omak Creek. The Wells Hatchery program obtains its broodstock at Wells Dam. The new local broodstock program takes 10-16 adults from a weir in lower Omak Creek. The weir is also used to collect kelts. The size of the kelt program will be determined in the HGMP.

When Salmon Creek is reconnected to the Okanogan River, similar local broodstock and kelt reconditioning programs will be initiated as described in the HGMP. In the longer term, the local broodstock and kelt reconditioning programs will be expanded to the entire subbasin. At that time, the Wells Hatchery fish will not be used in the subbasin.

Relationship Hatchery-Origin and Natural Origin:

Steelhead production in the Okanogan subbasin was substantially eliminated by tributary habitat degradation, cumulative passage mortalities at mainstem dams, incidental losses in lower river fisheries, and by the continued use of an aggregate, domesticated hatchery stock. The remaining run of steelhead into the Okanogan is now largely hatchery-origin fish from Wells Hatchery. Natural-origin fish are of similar lineage.

The goal of the new HGMP will be to create a local steelhead population that will evolve to the conditions of the Okanogan subbasin. HGMP objectives will emphasize integrated recovery programs to create a steelhead population best adapted to the Okanogan with increased VSP characteristics. The HGMP will propose acclimating the Wells Hatchery fish in an upriver location that will best minimize their straying to the tributary streams being managed for development of local populations. Eventually the Wells Hatchery fish will be replaced with broodstock from the locally adapting population.

Subbasin Harvest Objective:

The opportunity for steelhead harvest is erratic depending on the highly variable smolt-to-adult survival rates of the smolts from Wells Hatchery. Fisheries were closed when the UCR Steelhead ESU was listed as an endangered species. With the recent large runs of steelhead, the recreational fishery was recently reopened in large part to remove excess hatchery-origin fish from the naturally spawning population. The fishery is selective requiring the release of unmarked fish. This fishery targeting an endangered species is unique and allowed only as a conservation measure to improve the viability of the natural population.

Future harvest will depend on the recovery of the UCR Steelhead ESU and the Okanogan population specifically, and the flexibility allowed in the administration of the ESA. The HGMP will detail a harvest management regime to protect needed natural escapement and hatchery broodstock, and allocate harvestable fish between recreational and tribal C&S fisheries. Future fisheries will continue to be selective.

Out of Subbasin Harvest Objective:

Downstream of the Okanogan River, harvest rates on steelhead will be driven by fisheries management under the auspices of the Columbia River Compact. Compact fisheries have been significantly restricted in recent years to protect ESA-listed stocks. The upcoming HGMP will be based on the assumption that future harvest on Okanogan steelhead will be managed in the river fisheries at rates similar to current levels.

Hatchery Contingency Plans:

As with Okanogan Chinook HGMPs, the steelhead propagation programs will be designed with change in mind. Contingency plans will be developed to implement when M&E results indicate that a better course of action is required to meet management objectives.

Relationship of Hatchery Programs to Habitat Initiatives:

Habitat restoration has and will continue to steer the new artificial propagation programs. Initial rehabilitation of Omak Creek has allowed the initiation of integrated recovery programs there using smolts and reconditioned kelts. When the Salmon Creek Project is implemented, reconnecting that watershed to the Okanogan River, then smolt and kelt programs will be initiated similar to those starting in Omak Creek.

Habitat rehabilitation, particularly restoration of flows, in the smaller tributary streams of the Okanogan subbasin will allow acclimation and reintroduction of local steelhead stock into those systems. The HGMP will include increase production when necessary to seed the tributary streams when sufficient habitat recovery is deemed to have occurred.

Finally, the HGMP will be modified as appropriate to provide for recovery of steelhead in the Canadian portion of the basin.

Coho: **no specific goals have been identified for this extirpated stock at this time.**

Sockeye

Okanagan sockeye are one of only two remaining viable populations remaining in the Columbia River. Returns during the 1990's have been lowest from the past 45 years of escapement records with three of those years being the lowest on record (Hyatt and Rankin 1999). More recently, returns in 2000, 2001 and 2004 have been the largest in the past 20 years. However, overall there has been a continual decline and without intervention, this population is predicted to decline further.

Fisheries and Oceans Canada (DFO) have targeted the Canadian domestic objective for Okanagan sockeye at 58,730 adults past Wells Dam, which is based on the lake rearing capacity of Osoyoos Lake (Hyatt and Rankin 1999). Spawning habitat is abundant and lake-rearing capacity is considered the limit for sockeye production due to the temperature/oxygen extremes even though escapement levels have rarely exceeded it. This suggests that further work to determine other factors limiting production should be investigated (Hyatt and Rankin 1999). This is the conservation target and does not include food and ceremonial harvest by the Okanagan Nation. In addition, the Canadian domestic objective is different to that of the lower Columbia escapement objective.

- See--Hyatt, K. D., and D. P. Rankin. 1999. A Habitat Based Evaluation of Okanagan Sockeye Salmon Escapement Objectives. Canadian Stock Assessment Secretariat 99:59pp.

Spawning and rearing of this population occurs wholly within Canada where Canadian fisheries authorities have adopted a terms of reference with an ecosystem principled approach to restoration (www.obtwg.ca). Priorities include protection of current spawning habitat, improving water management, reintroduction to historic range, and habitat restoration. Initiatives for this population include implementing a decision analysis model to improve water management decisions for the benefit of sockeye to increase production (Fish Water Management Tools) and experimental reintroduction into Skaha Lake.

The Fish Water Management Tools Project (FWMT) is a state-of-the art computer model developed specifically to help authorities manage water flows in the Okanagan River in a “fish friendly” manner. It was developed and implemented in 2001 through a cooperative venture between the COBTWG and Douglas County Public Utility District. The model benefits kokanee as well as sockeye salmon since water levels in Okanagan Lake are used to provide for Okanagan River flows. The FWMT computer model uses real time field data and can quickly predict the benefits and the risks of numerous water storage and release options. These predictions allow a multi-disciplinary team of decision makers to choose the best option for releasing flows in a manner that will benefit fish while respecting the needs of other water users.

Government agencies and non-government organizations have worked cooperatively to produce a plan to restore portions of the river. This is particularly critical on Okanagan River because channelization completed in the 1950s have decreased the mean river corridor width by 89% and the wetland area by 88% (Gaboury, 2004). As an additional benefit, riparian restoration will also benefit a number of terrestrial species, including two bird species listed under Canada’s Species at Risk Act.

Pool/riffle habitats will be created within a meandering channel providing high quality spawning areas for the salmon. Restoring connectivity with a functioning floodplain will allow fines to settle naturally on the floodplain rather than lodging in the main channel. It will also provide a place for flood flows to disperse rather than restricting them between narrow dykes where they scour spawning gravel. The result will be improved egg to fry survival for salmon. Value added benefits include improved flood protection (Gaboury, 2004) and a riparian refuge for endangered plants and animals such as water birch/dogwood plant communities, Western Yellow Breasted Chat, and Western Screech Owl (Bull, 2003).

The Skaha Lake Sockeye Reintroduction Program opted for fry supplementation because of the increased learning benefits for monitoring the Skaha sockeye population (e.g. A known number of fry for calculating fry to smolt survival, etc) and effects on residents Skaha Lake stocks, with the least impact on the current Osoyoos sockeye population spawning downstream (Wright and Smith 2003). For future consideration during the 12-year program are trap and transport of adults to determine spawning success and mysis shrimp harvest to determine effect on species competition. A sunset date of 12 years has been targeted for the program where a final decision on passage can be made and natural sockeye production can occur. At this time, discussions on future work for reintroduction of sockeye into Okanagan Lake can occur.

This program has set a female broodstock collection limit of no more than 5% of Wells Dam counts and a conservation limit of zero broodstock collection when counts are below 5,000 adults. In addition, the maximum broodstock collection has been set at 1,750 females for hatchery planning purposes. In subsequent years when Skaha sockeye are returning, hatchery origin sockeye will constitute no more than 50% of broodstock collection. Escapement objectives will need to include provisions for future broodstock collection.

Non-focal Species and Resident Fish Recommendations

Pacific Lamprey

Goal: Provide conditions for viable and sustainable Pacific Lamprey populations.

Objective 28. Improve information base for overall life history, distribution and abundance.

- Strategy 28-1. Estimate total amount of habitat available for all life stages and carrying capacity.
- Strategy 28-2. Estimate location, condition and extent of spawning and rearing habitats in the Okanogan/Okanagan subbasin.
- Strategy 28-3. Collect genetic data.

Bull trout

Currently, it is unknown to what degree bull trout utilize the Okanogan Watershed. If studies show bull trout are present, then the following apply.

Goal 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distribution across the species' native range, so that the species can eventually be delisted.

Objectives:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Okanogan Core Area.
- Maintain stable or increasing trends in abundance of bull trout.
- Restore and maintain suitable habitat conditions for all bull trout life stages and strategies.
- Conserve genetic diversity and provide opportunity for genetic exchange.

Goal 2: Reduce threats to the long-term persistence of bull trout populations and their habitat, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Objectives:

- Restore passage of specific man-made migrational barriers within the Okanogan Watershed, providing the barriers are not providing protection from invasive species such as brook trout.
- Reduce impacts to stream corridor through improved road management throughout the Okanogan Watershed.
- Reduce impacts to the stream corridor through improved land use practices such as increased riparian buffer widths, decrease livestock grazing and improved irrigation efficiencies.
- Reduce or eliminate impacts from past, present and future mining activities.
- Reduce impacts from residential and recreational development.
- Reduce or eliminate effect from non-native species. This includes brook trout eradication and elimination of non-native species stocking programs.
- Maintain and restore floodplain connectivity throughout the watershed.

Goal 3: Improve current knowledge base on bull trout throughout the Okanogan watershed.

Objectives:

- Complete a bull trout fish use study in the mainstem Okanogan.
- Complete a population distribution and abundance study, where bull trout might be present in the Okanogan watershed.

If bull trout are found in the Okanogan, complete a life history study throughout the watershed.

Westslope cutthroat trout

Goal 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of Westslope Cutthroat Trout distribution across the species' native range.

- Objectives: Maintain current distribution of Westslope Cutthroat Trout and restore distribution in previously occupied areas within the Okanogan Core Area.
- Maintain stable or increasing trends in abundance of Westslope Cutthroat Trout.
- Restore and maintain suitable habitat conditions for all Westslope Cutthroat Trout life stages and strategies
- Conserve genetic diversity and provide opportunity for genetic exchange.

Goal 2: Reduce threats to the long-term persistence of Westslope Cutthroat Trout populations and their habitat, ensuring the security of multiple interacting groups of Westslope Cutthroat Trout.

Objectives:

- Restore passage of specific man-made migrational barriers within the Okanogan Watershed, providing the barriers are not providing protection from invasive species such as brook trout and lake trout.
- Reduce or eliminate impacts from past, present and future mining activities.
- Reduce impacts from residential and recreational development.
- Reduce or eliminate effect from non-native species.
- Restore connectivity from the tributaries to the lake during drawdown.

Goal 3: Improve current knowledge base of Westslope Cutthroat Trout throughout the Okanogan Watershed.

Objectives:

- Complete a Westslope Cutthroat Trout use study in the tributaries to Okanogan.
- Complete a population distribution and abundance study, where Westslope Cutthroat Trout might be present in the Okanogan watershed.
- Complete a life history study throughout the watershed.

1.6 Salmon and Steelhead Population Designations--Consistency with ESA/CWA Requirements

Clean Water Act (CWA)

The Technical Guide for Subbasin Planners says, "The management plan should describe how the objectives and strategies are reflective of, and integrated with, the recovery goals for listed species within the subbasin, and the water quality management plan within that particular state. Coordination with NOAA Fisheries' Technical Review Teams and the state agency charges with implementing the CWA will be an important step in ensuring consistency with ESA and CWA requirements."

Throughout the subbasin planning process fisheries experts representing NOAA fisheries and the USFWS were enlisted to assist in plan development and review. Inclusion of these individuals and other local managers insured that this plan stayed aligned with the 2000 BiOP and other ESA documents such as the bull trout recovery plan. Many of the same individual that prepared the recovery plans were involved in this process to insure consistency.

Coordination with Canadian interests was arranged through the Canadian Okanagan Basin Technical Working Group a tri-partite working group that deals with technical issues associated with management of salmon and resident fish stocks and their associated habitat requirements in the Canadian portions of the Okanagan River basin. Participants to the COBTWG include Fisheries and Oceans Canada (federal), Okanagan Nation Alliance Fisheries Program (Okanagan Nation), and the B. C. Ministry of Water, Land and Air Protection (provincial)".

Of primary concern in the development of this plan were summer steelhead that were listed as Endangered in the upper Columbia ESU in August of 1997 and were therefore considered a focal species within the Okanogan subbasin. This plan outlines specific actions that if implemented would result in increased survival, abundance, and habitat therefore complementing recovery efforts for summer steelhead, but does not take all steps necessary to compare actions across other regulatory processes. This is simply a matter of time and funding resources. Future iterations of the subbasin plan will surely take additional steps toward integration and cross walks between multiple regulatory and planning efforts.

Federally listed wildlife species are recognized in the management plans with objectives that call for protection of these species and their habitats. Therefore, the management plan is consistent with ESA requirements. Additional species-specific detail considered throughout the development of this plan is included below for each ESA listed species.

1.6.1 Columbia River Bull Trout ESU

The distinct population segment for bull trout, incorporating the entire Columbia (i.e., upper and lower), was listed as Threatened under the ESA on June 10, 1998. The Okanogan River mainstem and lower tributaries may not provide suitable habitat for bull trout because of their requirement for very cold, clean waters and clean gravel/cobble substrate for successful spawning and rearing. However, it is thought that bull trout may use the mainstem Okanogan for foraging, rearing and overwintering during certain parts of the year. FWS currently identifies bull trout in the Okanogan as occupancy unknown. In the Okanogan basin, bull trout are documented to have used Salmon Creek and Loup Loup Creek. Bull Trout were reported in creel census records from the 1940s and 1950s in the North Fork of Salmon Creek (Fisher 2002). The introduction of Brook Trout and resulting hybridization of the two species are considered primary factor in the decline of bull trout in the Okanogan River basin (FWS 2000). Scott and Crossman (1973) reported that bull trout were/are not present within the Canadian portion of the Okanogan River system.

1.6.2 Upper Columbia River spring-run ESU

Myers et al. (1998) defined the Upper Columbia River spring-run ESU as stream-type Chinook that spawn in the Wenatchee, Entiat, and Methow rivers. They explain that the biological review team (BRT) felt that in spite of the tremendous amount of hatchery influence on these fish, they still represented an important genetic resource, partially because it was presumed it still contained the last remnants of the gene pools for populations from the headwaters of the Columbia River. The Okanogan spring Chinook are believed to be extinct, possibly since the 1930s, but many posit them an important and unique element within the ESU, especially in terms of spatial diversity and an important part of the overall and historic distribution pattern.

Ford et al. (2001) concluded that there were currently three independent populations of spring Chinook within the Upper Columbia spring Chinook ESU; Wenatchee, Entiat, and Methow basins. Brannon et al. (2002) separated the Methow spring Chinook first-order metapopulation from the Wenatchee and Entiat populations, which were linked together.

Within these populations there are other sub-populations that Ford et al. (2001) suggested should be considered when reviewing management actions within these geographic areas to maintain potential adaptive advantages of these sub-populations. The Interior Columbia Basin Technical Recovery Team (TRT), in its draft report (TRT 2003) agrees with the initial designation of independent populations by Ford et al. (2001).

1.6.3 Upper Columbia summer steelhead ESU

Busby et al. (1996) determined that the ESU for Upper Columbia summer steelhead comprised the populations that currently spawn in the Wenatchee, Entiat, Methow, and possibly Okanogan rivers. The BRT felt that because of past hatchery practices (see below) there has been substantial homogenization of the gene pool. However, there is probably remnant genetic material from ancestral populations that could have been “stored” in resident populations (Mullan et al. 1992CPa). Ford et al. (2001) agreed with the delineation described by Busby et al. (1996), but described each subbasin, with the possible exception of the Okanogan, as an independent population (see definition above).Brannon et al. (2002) combined all of the first-order metapopulations of summer steelhead upstream of the Yakima River into one metapopulation.

The TRT recently listed the Okanogan Basin steelhead as an independent population: “The current status of steelhead endemic to the Okanogan is unknown. Currently, low numbers of natural steelhead return to this system, but may be offspring from hatchery returns.

However, the Okanogan appears to have supported an independent population of steelhead historically. Although habitat conditions for rearing are highly degraded in the system, the Okanogan and its tributaries in the US and Canada appear to have contained sufficient habitat to support an independent population of steelhead. In addition, the Okanogan is found in a substantially different habitat than other populations in this ESU, further supporting delineation of this population" (TRT 2003).

In conclusion, for the purposes of subbasin planning, it was assumed that there are four independent populations (Wenatchee, Entiat, Methow, and Okanogan) within the large groups of populations that spawn naturally upstream from Rock Island Dam.

The Okanogan Subbasin Core Team and Habitat Working Group developed objectives and strategies that will lead to improvements in water quality. This is particularly emphasized where water quality does not currently meet water quality standards. In some cases, the subbasin plan specifically acknowledges the work being done by other entities to improve water quality and recommends consistency with other management plans, such as working towards defining and implementing a total maximum daily load (TMDL). Therefore, the subbasin management plan is consistent with CWA requirements.

1.7 Relationship to Other Planning Efforts

In the Okanogan, an open dialogue existed throughout this process to include state, federal, tribal, and other stakeholder interest and to coordinate with other planning efforts through the Habitat Working Group, and Subbasin Core Group. Both groups included members who were working on watershed planning, State Salmon Recovery Planning, The federal BIOP, Bull Trout Recovery Planning, Mid-Columbia Habitat Conservation Planning, TMDL, water quality planning, Growth Management Planning, Land Use Planning, and FERC hydropower re-licensing. Participation of these members assures that the subbasin plan is compatible with other planning efforts.

A primary strategy was to coordinate with, and have the plan reviewed by the Technical Recovery Teams developed by the Upper Columbia Salmon Recovery Board. The Upper Columbia Salmon Recovery Board has established technical, policy, and stakeholder groups that meet regularly to coordinate, evaluate, and implement mitigation measures within this subbasin. Coordination with Canadian interests was developed by creating the Canadian Okanogan Basin Technical Working Group and through coordination with SERA activities. Many documents were utilized to develop the subbasin plan including but not limited to:

- Habitat Conservation Plans
- Hatchery Genetic Management Plans
- The Clean Water Act
- The Powers Act

- The Northwest Power and Conservation Councils 2000 Fish and Wildlife Program (and the Technical Guide to Subbasin Planning)
- Assorted Watershed Management Plans
- The 2001 Federal BIOP
- Pacific Salmon Treaty
- Colville Tribes Integrated Resource Management Plan
- Washington State Wild Salmonid Policy
- Watershed based Fish sustainability Planning
- Species Act Risk Act (SARA)
- The Endangered Species Act
- FWS Draft: Bull trout Recovery Plan
- FWS Proposed Critical Habitat Designation for Bull Trout
- FWS Draft: Bull trout Recovery Plan
- FWS Proposed Critical Habitat Designation for Bull Trout

1.8 Research

Generally, the AU summary section of this plan will be used to guide research activities until baseline information is obtained sufficient to identify these uncertainties, M&E will play a greater role than pure research activities in the Okanogan subbasin. However, the Northwest Power and Conservation Council developed the draft Columbia River Basin Research Plan to enhance current coordination and facilitate future collaboration. It recognizes other research plans as important components of a potentially integrated regional research program, and provides a framework for establishing linkages between existing research programs and initiatives. This subbasin plan anticipates integrating the guidance offered by this document as it becomes final.

Examples questions forming a draft research framework for the Okanogan include:

- What is Known/Unknown (about each proposed hypothesis)
- Anticipated Results and Possible Interpretations
- Potential Management Application (of the anticipated research results)
- Experimental Design/Approach (for hypothesis testing)
- Statistical Analyses/Evaluation

- Spatial Scale (where will the research take place? what is the geographic scope of the study?)
- Temporal Scale (when will research start and end? at what intervals will research occur?)
- Application of Research Results (to specific species or conditions)
- Budget Considerations
- End Products (or data formats)
- Data Storage, Access, and Distribution

Basin Wide Priorities to be incorporated in the Okanogan Research Plan (from the NPCC draft plan, 2004).

- Effectiveness of hatchery programs
- Hydrosystem effects
- Habitat
- Recovery Planning
- Harvest Management
- Monitoring Programs
- Out of Subbasin Effects *(very important to the Upper Columbia and Okanogan in particular).*
- Estuary
- Natural Variation and Ocean Conditions
- Impacts of Climate Change on Fish and Wildlife Restoration
- Toxics
- Invasive Species
- Impact of Human Development Patterns on Fish and Wildlife Restoration

1.9 Monitoring and Evaluation (M&E)

The Okanogan Basin Monitoring and Evaluation Program (OBMEP) M&E plan provides a rigorous and comprehensive program for monitoring fish population status, trend, and eventually, project effectiveness in the subbasin. Wildlife monitoring is handled under cooperative programs between the USFWS, WDFW and the Colville Tribes.

The monitoring plan described in this document is not another regional monitoring strategy. Rather, this plan draws from the existing strategies (ISAB, Action

Agencies/NOAA Fisheries, PNAMP, CSMEP, EMAP and WSRFB) and outlines an approach specific to the Upper Columbia Basin.

The plan described here addresses the following basic questions:

1. What are the current habitat conditions and abundance, distribution, life-stage survival, and age-composition of anadromous fish in the Upper Columbia Basin (status monitoring)?

2. How do these factors change over time (trend monitoring)?

3. What effects do tributary habitat actions have on fish populations and habitat conditions (effectiveness monitoring)?

4. What effects do fishery management actions have on fish populations (effectiveness monitoring)?

5. Are the goals, vision and objectives of the subbasin plan being met?

Specific Monitoring Goals

The monitoring plan proposed requires a long-term commitment, as most outcomes will not be realized for 7 to 20+ years. This project is designed to achieve these goals:

1. Determine if there is a statistically significant difference in the abundance, survival, and timing and life history characteristics of summer/fall, spring Chinook, sockeye, and steelhead (7-20+ year period).

2. Determine if there is a statistically significant difference in selected physical habitat parameters and characteristics for summer/fall, spring Chinook, sockeye, and steelhead in the Okanogan basin resulting from the cumulative benefits of habitat actions (7-20+ year period).

3. Estimate in-basin and out-of-basin harvest and stock-specific harvest of hatchery and wild anadromous salmonids within the Okanogan subbasin (ongoing)

4. Research selective fishing gears for potential effectiveness and sites, and possible future use for selective Tribal subsistence fisheries. This work will be closely aligned and coordinated with the Colville Tribal Hatchery Master Plan (7-20+ year period).

5. Conduct a baseline Okanogan Basin inventory & analysis: a. Collect data, to raise physical habitat data to an empirical level for use in EDT. b.) Collect data on historical and current fish population distributions, and c.) Collect passage conditions throughout the basin for use in EDT modeling runs to assist in future enhancement-planning processes (1-20+ year period).

Detailed hypotheses, task and objectives can be found in: BPA Project Number 200302200

Approach

A coordinated and comprehensive approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support restoration efforts in the Columbia Cascade Province and in the Okanogan subbasin in particular. Currently, independent research projects and some monitoring activities are conducted by various state and federal agencies, tribes, and to some extent by watershed councils or landowners, but there has been no overall framework for coordination of efforts or for interpretation and synthesis of results until now.

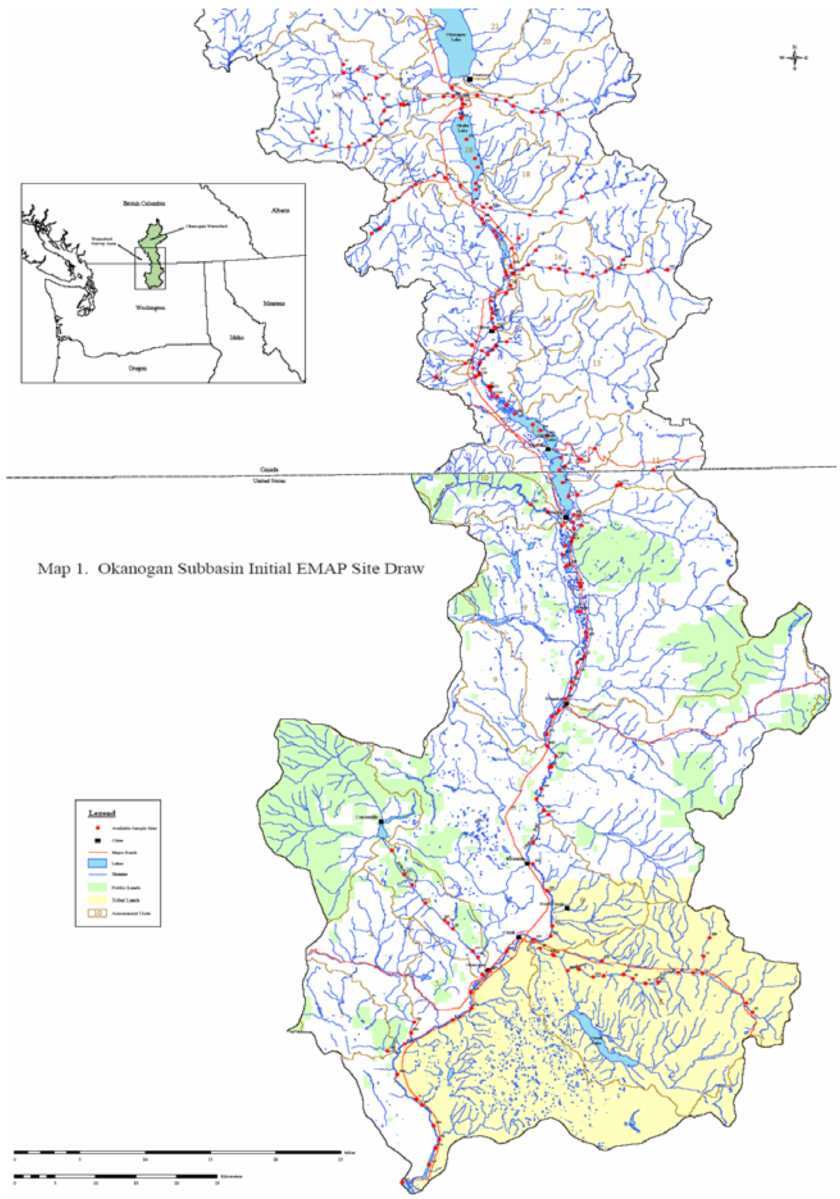


Figure 3. EMAP site locations in the Okanogan subbasin. 150 sites make up the sampling "frame," 50 are sampled each year with all sites visited every five years in a rotating panel design. Trend and status monitoring are the focus on this design.

This M&E program is consistent with the objectives established for the Columbia Basin. For example, the ISRP said this in its 2002 review of this project:

> ***Comment:*** *Fundable with high priority. The ISRP appreciates the effort put into providing an excellent response to our concerns. If funded, the project would serve as a model for other monitoring and evaluation projects in the Columbia Cascade Province and elsewhere [emphasis added]. This project would provide a model for monitoring and evaluation in the Columbia Basin of Washington much as the monitoring and evaluation program in the John Day Subbasin is evolving as a model in the Columbia Basin of Oregon. Both propose the use the EMAP sampling protocols as a basis for probabilistic sampling of the subbasins.*
>
> *The ISRP strongly recommended funding of this project.*

Year 2004 was the initial (pilot) year of the Okanogan Baseline Monitoring and Evaluation Program (OBMEP). The OBMEP is funded by the Bonneville Power Administration to conduct Status and Trend Monitoring in the Okanogan Subbasin. Funding currently is for the U.S. portion of the subbasin with work in the Canadian portion anticipated to begin in year 2005. This program is intended to assess both current status as well as temporal and spatial changes in anadromous salmonid populations and habitat within the Okanogan subbasin. Program design considerations have included compatibility with:

- Other regional and local monitoring and evaluation efforts,
- Established protocols,
- Subbasin planning,
- ESA and State recovery planning,
- Increased "level of confidence" in model inputs (e.g., EDT)
- Specific management needs of the Colville Confederated Tribes
- Specific management needs of NOAA and BPA (Canadian tribes, province and feds too).
- Collaboration and cost sharing where possible with existing efforts has also been a primary design consideration. .

The OBMEP is structured in accordance with the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) and the Monitoring Strategy for the Upper Columbia Basin (Hillman 2004). Included is a six panel (1 annual, 5 rotating) design scheme in which a total of 150 sites are sampled throughout the entire anadromous portion of the watershed during each five year period. Also included is a generalized random-tessellation stratified (GRTS) sampling design random selection of spatially balanced sampling sites throughout the watershed. Examples of points drawn for the Okanogan Subbasin are included in the attached map.

Assumptions

Monitoring and evaluation coordination and implementation will be an ongoing activity at the reach, subbasin, and regional levels. The subbasin planners assume these iterative, concurrent processes at different scales will be coordinated to optimize when and where implementation occurs to increase learning from broader scale monitoring both within and across subbasins.

Monitoring that is proposed will be more effective if it fits within a broader programmatic network of status monitoring programs and intensively monitored watersheds. The subbasin planners assume that M&E efforts will be able to rely on broader monitoring frameworks and programmatic activities (where they exist) to meet some of their needs.

The subbasin planners assume that local, bottom-up approaches developed within subbasins will have a higher likelihood for successful funding and meaningful results if they reflect the approaches being developed within the comprehensive state, tribal initiatives, and federal pilot projects, and the top-down framework and considerations being developed by PNAMP.

Guidance for this M&E Program

Four primary documents make up the current framework for anadromous fish monitoring and evaluation in the Okanogan subbasin while primarily HEP assessments are used for wildlife.

Future activities for monitoring and evaluation to be coordinated and compatible with the following:

1. The Okanogan Baseline M&E Program (BPA project 200302200)
2. The Upper Columbia Monitoring Strategy (Hillman, et al. 2004)
3. Considerations for Monitoring in Subbasin Plan (PNAMP 2004)
4. Considerations for Monitoring Wildlife in Subbasin Plan (NPCC, 2004)

Additional documents are under development to help construct the Okanogan Monitoring Framework. Examples of these and other documents to use as guidance include:

- Field manual for the Okanogan monitoring and evaluation program physical habitat protocols.
- The M&E Program for the Chief Joseph Hatchery (Conceptual Master Plan)
- The Pacific Northwest Aquatic Monitoring Partnership (PNAMP)—Draft Guidance to the State, Feds and Tribes for Monitoring (2004)
- The Coordinated System Wide Monitoring and Evaluation Project (CSMEP) Work Plan.
- 2001 ISRP (review of the Okanogan Baseline Program, 2001)

- 2003 ISAB Review of Supplementation
- Federal Research Evaluation and Monitoring (RME) Plan
- The Pacific Coastal Salmon Recovery Fund (PCSRF) Performance Standards
- The Pacific Coastal Salmon Recovery Fund Data Definitions
- A Data Management Protocol (Wolf, Jordan, Toshach et al.—in press)
- BPA Pilot Studies in Wenatchee and John Day (data dictionary and geospatial database structure)
- The Washington Coordinated Monitoring Strategy
- The Oregon Monitoring Plan
- The Skaha Lake Sockeye Reintroduction Program
- The Yakima Klickitat Fisheries Project: http://www.ykfp.org
- The Northeast Oregon Hatchery: http://www.cbfwa.org/2001/projects/198805301.htm
- The Columbia Basin Fish and Wildlife Authority (M&E): http://www.cbfwa.org/rme.htm
- The State of Washington: Outline for Salmon Regional Recovery Plans. http://www.wdfw.wa.gov/recovery/recovery_model.htm
- Coordinated Management Strategy. http://www.iac.wa.gov/srfb/monitoring.htm

Measurable M&E Objectives

Monitoring and evaluation plans should be developed to capture the variables and indicators necessary to determine whether progress is being made to achieve this list of habitat and artificial production objectives. Individual Assessment Unit summaries provide a long list of relevant detailed habitat objectives by geographic area. Production objectives are outlined in this subbasin plan's biological objectives. A long-term commitment is needed for status and trend monitoring to be effective, as most outcomes will not be realized for 7 to 20+ years.

The hypotheses in this subbasin plan are the basis for "testing" the assumptions, strategies and objectives in the plan. The OBMEP program will be modified, if necessary, to detect the concomitant environmental and population change, and eventually, to monitor the action effectiveness metrics.

Current Indicators

Indicator variables identified in the UCMS template are consistent with those identified in the Action Agencies/NOAA Fisheries RME Plan and with most of the indicators identified in the WSRFB (2003) monitoring strategy. The Action Agencies/NOAA Fisheries selected indicators based on their review of the literature (e.g., Bjornn and

Reiser 1991; Spence et al. 1996; and Gregory and Bisson 1997) and several regional monitoring programs (e.g., PIBO, AREMP, EMAP, WSRFB, and the Oregon Plan). They selected variables that met various purposes including assessment of fish production and survival, identifying limiting factors, assessing effects of various land uses, and evaluating habitat actions. Their criteria for selecting variables were based on the following characteristics:

- Indicators should be sensitive to land-use activities or stresses.
- They should be consistent with other regional monitoring programs.
- They should lend themselves to reliable measurement.
- Physical/environmental indicators would relate quantitatively with fish and wildlife production.

Table 1 Biological indicator variables (with conceptual protocols) to be monitored in the Okanogan Baseline M&E Program and Chief Joseph Hatchery M&E Program

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Adults	Escapement/ Number	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	Total number of fish harvested in Colville Tribes summer/fall fisheries. Annual number of summer/fall Chinook spawners in each spawning area, by age (Similkameen River, Okanogan River, Columbia River above Wells Dam).
	Age structure	Borgerson (1992)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Sex ratio	Strange (1996)	Annual	To be completed as above
	Origin (hatchery or wild)	Borgerson (1992)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
	Fecundity	Cailliet et al. (1986)	Annual	To be completed as above
Redds	Number	Mosey and Murphy (2002)	Annual	To be completed as above
	Distribution	Mosey and Murphy (2002)	Annual	To be completed as above
Parr/Juveniles	Abundance/Distribution	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	To be completed as above

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
Smolts	Number	Murdoch et al. (2000)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
Macroinvertebrates	Transport	Wipfli and Gregovich (2002)	Annual/Monthly	To be completed as above
	Composition	Peck et al. (2001)1	Annual	To be completed as above

Measuring Protocols

An important component of all regional monitoring strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB) is that the same measurement method be used to measure a given indicator. The reason for this is to allow comparisons of biological and physical/environmental conditions within and among watersheds and basins.

Efforts are underway in the Okanogan basin to develop a set of sampling protocols for aquatic habitats and biota and these should be used to maintain consistency wherever applicable. Although these protocols are just now being developed for anadromous fish, wildlife and resident fish protocols should also be developed in the future.

Wildlife

Table 2 General objectives for monitoring. Examples from Reid (ca. 1994)

Objective	Comments	Examples
Early warning:		
Of large events	Long-term; accuracy more important than consistency, so improved methods are incorporated as developed	National Weather Service rainfall records used in flood forecasting
Of detrimental trends	Long-term; consistency as important as accuracy	Atmospheric CO_2; Christmas bird counts
Evaluate effectiveness of a practice or method	Timing and attributes keyed to knowledge of response mechanism; may be short-term; usually is effectiveness or validation monitoring	USFS BMPEP
Test hypotheses of associative or causal relations	Timing and attributes keyed to hypothesis and knowledge of response mechanism; may be short-term	Many research experiments
Regulatory oversight:		
Was action carried out?	Implementation monitoring; timing keyed to timing of activity, attributes to wording of regulations; long-term. If standards defined by implementation, may be same as compliance monitoring.	County building permit inspections

Objective	Comments	Examples
Was goal attained?	Compliance monitoring; attributes keyed to wording of regulations, timing to knowledge of response mechanism and timing of activity; long-term	EPA water quality
Define resource to facilitate planning:		
Through time	Baseline monitoring, usually short term	Stream gauging for reservoir planning
Through space	Inventory, usually carried out once	Forest stand inventory
Describe something	Not a valid objective; for what purpose is it to be described?	Many inventories
Compare areas	Not a valid objective; for what purpose are they to be compared?	Many inventories

Examples of specific objectives of natural resource planning monitoring

Examples of specific objectives can be found on http://www.fs.fed.us/oonf/reports/det2.html (source: USDA Forest Service), which include monitoring parameters of (1) ecosystem condition, health, and sustainability; (2) sustainable multiple forest and range benefits; and (3) organizational effectiveness.

Many other examples are available in the literature and on the Web. Specific to monitoring within the Columbia River basin is the publication by Bisbal (2001):

Abstract (Bisbal 2001)

A logical sequence of seven steps is proposed as a generic template to design plans for monitoring and evaluating fish and wildlife in the Columbia River ecosystem. Management programs for these resources fail to include coordinated monitoring and evaluation plans. This shortcoming is indicative of pervasive management conflicts detected from regional to local geographic scales.

In the absence of a cohesive ecological management framework, monitoring and evaluation activities proceed without a clear understanding of what uncertainty they are intended to address, nor is there a clear description of the process to utilize the information gained. As a result, the accountability for the investment of public funds for fish and wildlife restoration is poor; information collected from the environment is not included in decision-making, and the ability to gain knowledge while taking management actions is compromised.

The sequence of steps discussed here does not identify or describe distinct monitoring activities or methodologies at any particular location or listed under any specific monitoring plan. Instead, it concentrates on the generic elements necessary for the design and implementation of coordinated fish and wildlife monitoring plans. It is proposed that at least four major issues demand considerable attention in order to improve regional monitoring and evaluation capabilities: The first is adoption of an ecological framework for the management of fish and wildlife at relevant geographic scales within the ecosystem. Such a framework must include an explicit identification of goals, objectives, and actions to steer coordinated decisions across the boundaries of technical disciplines, management jurisdictions, and institutional responsibilities.

The second is that the identification of these management goals for the geographic location of interest must precede the design of monitoring and evaluation plans from the top down. Third, the evaluation component must be considered early on in the planning process, so that it blends smoothly with monitoring at the time of implementation. Fourth, decision-makers and scientists engaged in the planning of fish and wildlife monitoring and evaluation efforts in the region must have a close collaborative relationship.

Monitoring and evaluation plans designed under these premises may enhance our collective observational capabilities, promote cost-effectiveness and adequate evaluation, and provide a useful tool to adjust our management practices to the challenges of complex ecosystems.

As an example, the main hypotheses and key assumptions pertaining to the "key ecological functions" part of the IBIS database can be listed (see http://www.spiritone.com/~brucem/kef1.htm#Hypotheses) as a basis for selected research studies.

A Skaha Lake Monitoring and Assessment Plan – a model for range restoration above Okanagan Falls

Okanagan River sockeye salmon, which spawn near the town of Oliver, B.C., have their farther upstream migration limited by several water control and diversion dams. Stock numbers have been declining for many years and the Okanagan Native Alliance Fisheries Department (ONAFD) has been the principal advocate of a program to restore their numbers and range by reintroducing them into upstream waters where they may once have occurred in substantial numbers

Some investigators have warned that without effective intervention Okanagan sockeye are at considerable risk of extinction. Among a host of threats, the quality of water in the single nursery areas in Osoyoos Lake is deteriorating and a sanctuary such as that afforded in larger lakes higher in the system could be essential.

Because the proposed reintroduction upstream has implications for other fish species, (particularly kokanee, the so-called "landlocked sockeye" which reside in many Okanagan lakes), the proponents undertook a three-year investigation, with funding from the Bonneville Power Administration and the Confederated Tribes of the Colville Tribes. This project was designed to identify possible problem areas, and the parties committed to an interim experimental reintroduction to Skaha Lake where any problems could be worked out before a more ambitious reintroduction, (e.g. to Okanagan Lake) could be formally considered.

The three-year investigation was completed in the spring of 2003. It included an assessment of risks from disease or the possible introduction of unwanted exotic species. It also considered the present quality and quantity of sockeye habitat, and opportunities for expanding or improving it. Finally, ecological complexity encouraged the development of a life history model to examine interactions of sockeye with other fishes and their food organisms.

While some problem areas were exposed in the course of these studies, they appeared to be manageable and the concept of an experimental reintroduction was largely supported but with the proviso that there should be a thorough evaluation and reporting of progress and results. A 2004 start on implementation and monitoring has now been proposed.

The Canadian Okanagan Basin Technical Working Group (COBTWG), with research and other expertise from participating agencies, the project has since 1997, provided guidance in moving toward a comprehensive implementation and monitoring program. (Much of the technical input from COBTWG is by a sub-committee of fisheries experts from federal, provincial and Okanagan Nation member agencies.)

Participants reviewed several introduction options and concluded that capture of mature adults on the spawning grounds, and extraction and fertilization of eggs gave the least risk, and offered the greatest learning opportunities - for instance for studies of sockeye-kokanee interactions at various life stages. Eggs would be incubated in a local hatchery and known numbers of fry would be planted in the river from which point they would be expected to move downstream and into Skaha Lake.

Planned studies are also expected to expand knowledge of sockeye and kokanee interactions with food organisms, particularly the ubiquitous shrimp *Mysis relicta* which represents a food supply for growing sockeye and kokanee, and at the same time competes with them for planktonic forage organisms. While there is uncertainty about the weight that should be assigned to each of these disparate roles, modeling results suggest that mysids may be a greater hazard for lake-dwelling kokanee than sockeye.

As the program moves forward, conservation measures for the existing stock are being built in. For instance yearly escapement records from Wells Dam on the Columbia River permit a forecast of corresponding run sizes on the spawning grounds, and investigators have proposed that no fish should be removed for brood stock purposes, when runs are smaller than 10,000 sockeye at Wells.

Modeling results were instructive when considering levels for fry plants. Simulated fry introductions ranging from 200-7500 fry/ha suggested that numbers as high as 1000 fry/ha would have little effect on survival of either kokanee or mysids, and that stepped increases as high as 5000 fry/ha would generate increases in sockeye fry survivals, but that survival would begin to decline above that level.

Fry cultured for the Skaha Lake reintroduction will be distinctively marked so their behavior, growth and survival can be measured at successive life stages. Marking will also help in distinguishing them from kokanee fry of similar size and appearance. Unique marks will be selected to identify the bearers if mixed with fish from any other marking programs in the Columbia Basin.

The central question in this investigation relates to the performance of the resident kokanee population during the reintroduction of their anadromous counterparts. Investigators must decide how great a change in growth and survival of kokanee (particularly juveniles), and over how long, should be accepted as clear evidence of success or failure of the reintroduction experiment.

To get at this question a series of hypotheses will be tested and suitable performance measures are now being developed. There will be several levels of fry introduction over the years, and a comparison of both sockeye and kokanee population responses, such as growth rates, will be measured. Kokanee response data will be compared with like data from years when there were no sockeye in Skaha L.

The ONAFD seeks efficiency and year-to-year consistency in the critical task of obtaining brood stock and to this end it is developing a detailed Procedures Manual for fieldwork. This draws upon the extensive experience of government agency culturists and others and can be upgraded after each year's work experience.

A detailed work plan has been developed, featuring essential tasks, and setting down procedures and processes designed to maximize both performance and efficiency and an M&E framework has been developed.

Canadian Science Coordination for Monitoring and evaluation in the Okanogan

The Canadian Okanagan Basin Technical Working Group (COBTWG) is a tripartite working group consisting of federal Fisheries and Oceans Canada (DFO), the Okanagan Nation Alliance (ONA), and the provincial Ministry of Water, Land and Air Protection (WLAP). COBTWG deals with salmon and resident fish population issues in the Canadian portion of the Okanagan basin (www.obtwg.ca). The members of COBTWG have been involved with this initiative since the first workshop in 1997 (Peters et al. 1998). They participated in the review, development, and recommendations for the evaluation phase of the project from 2000-2003, and, jointly with the ONAFD, in planning and developing essential features of the Year 1 incubation and fry rearing phases.

A workshop was called by COBTWG on November 24, 2003 to discuss the Implementation, Monitoring and Evaluation plans. It was decided that technical input to plan development would thereafter be by a sub-committee of members from DFO, WLAP and ONAFD.

The COBTWG sub-committee will provide historical data input, an initial program review monitoring and evaluation parameters, and recommend to the parent committee. It will act as a technical advisory body on the implementation strategy and arrange for annual, and other reports to be provided to both COBTWG representatives and funding agencies. The subcommittee will be provided with technical assistance as required

At a meeting of the sub-committee on November 25, 2003 and during a teleconference on December 22, 2003 members developed the monitoring and evaluation plan and the first year work plan. In addition, a subsequent discussion at the January 15, 2004 COBTWG meeting was held prior to development of this report to be sent out for final comment.

Appendix MP-1

List of Acronyms

BLM	Bureau of Land Management
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
BiOP	Biological Opinion
COBTWG	Canadian Okanagan Basin Technical Working Group
CDC	B.C. Conservation Data Center
cfs	cubic feet per second
Corps	US Army Corps of Engineers
Colville Tribes	Colville Tribes
CRITFC	Columbia River Inter-Tribal Fish Commission
CRMP	Cultural Resources Management Plan
CWA	Clean Water Act
DOE	US. Department of Energy
DOI	US Department of the Interior
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EC	Environment Canada
ECP	Eco-regional Conservation Planning
EDT	Ecosystem Diagnostic & Treatment
EIS	Environmental Impact Statement
EMS	Energy Management System
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FOC/DFO	Fisheries and Oceans Canada
FWS	US Fish and Wildlife Service
GIS	Geographic Information System
HCP	Habitat Conservation Plan

HEP	Habitat Evaluation Procedure
HGMP	Hatchery Genetic Management Plan
huc	habitat
IBIS	Interactive Biological Information System
ISRP	Independent Scientific Review Panel
JFC	Joint Fisheries Committee
LAW B.C.	Land and Water B.C.
LFA	Limiting Factors Analysis
LRMP	B.C. Land and Resources Management Plan
MSRM	B.C. Ministry of Sustainable Resource Management
MWLAP	B.C. Ministry of Water, Land and Air Protection
MOF	B.C. Ministry of Forests
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPCC	Northwest Power Planning and Conservation Council
OCD	Okanogan Conservation District
OLAP	Okanagan Lake Action Plan
ONA	Okanagan Nation Alliance
ONFC	Okanagan Nation Fisheries Commission (ONA)
OSBFP	Okanagan-Similkameen-Boundary Fisheries Partnership
PA	Programmatic Agreement
PFRCC	Pacific Fisheries Resource Conservation Council
PUD	Public Utility District
RC&D	North Central Washington Resource Conservation & Development Council
RM	river mile
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project

TMDL	Total Maximum Daily Load
TSS	Total Suspended Sediment
UCSRB	Upper Columbia Salmon Recovery Board
UCRFEG	Upper Columbia River Fisheries Enhancement Group
USFS	US Forest Service
USGS	US Geological Survey
WQI	water quality index
WDFW	Washington Department of Fish and Wildlife
WSCC	Washington State Conservation Commission
Yakama Nation	Confederated Tribes and Bands of the Yakama Indian Nation
YKFP	Yakima Klickitat Fisheries Project
YFRM	Yakama Fisheries Resource Management