SECTION 3 – Table of Contents

3 Aquatic Resources in the Intermountain Province

Most of the assessment analysis for aquatic resources was conducted at the subbasin scale. Detailed, subbasin-specific information can be found in the subbasin specific sections. This section describes aquatic resources in the Intermountain Province (IMP) in general, and the methods used in the aquatic assessment.

3.1 Historic Aquatic Resource Conditions in the Intermountain Province

Prior to settlement, the aquatic habitats of the IMP were primarily affected by natural conditions such as geology, climate, and natural stochastic events such as fires and floods. Natural barriers may have blocked the migration of salmon in the Pend Oreille River near Z Canyon and Metaline Falls. In the Spokane River, Spokane Falls presented a formidable obstacle to migrating salmon and steelhead and was impossible for at least most of the anadromous fish population. Above and below these barriers, resident fish species were present including bull trout, westslope cutthroat trout, redband trout, mountain whitefish, and burbot.

Much of the following material was summarized in a report by Scholz et al (1985), which compiled information about the pre-dam salmon and steelhead fisheries in the upper Columbia River basin. Before construction of the impassible Grand Coulee Dam, summer Chinook salmon and steelhead trout migrated to the Spokane River, San Poil River, and Kettle Falls in extraordinary numbers (Figure 3.1). In the Spokane River watershed, on August 3, 1826, naturalist David Douglas recorded in a notebook, later published by the Royal Horticulture Society (London, England) in 1914, that 1,700 salmon were collected by Spokane Indians in a weir placed in the Little Spokane River near its confluence with the Spokane River in a single day. As late as 1882, Livingston Stone, who surveyed the Spokane River for the U.S. Fisheries Commission, reported that 40,000 to 50,000 salmon were observed on drying racks in the Indian encampment on the Little Spokane River. In 1866, Cadastral surveyor L.P. Beach recorded in his surveying notebook that Indians fishing at Little Falls on the Spokane River mainstem put up at least 250 tons of dried fish during the salmon season. The Spokane and Coeur d' Alene Tribes recorded a harvest of approximately 150,000 salmon per year from five fishing weirs on the Spokane River alone (Scholz et al. 1985).


Figure 3.1. San Poil man spearing fish on the San Poil River near Keller, Washington. Photo courtesy of the Northwest Museum of Arts and Culture/Eastern Washington State Historical Society, Spokane, Washington

In describing the now inundated fishery at Kettle Falls (Figure 3.2), Angus McDonald, who ran the Fort Colville trading post between 1852 and 1872, wrote, “salmon as heavy as one hundred pounds have been caught in those falls. … One basket has caught a thousand salmon in a day” (Howay et al. 1907). At Kettle Falls, U.S. Naval Captain Charles Wilkes (1845), a member of the U.S. Exploring Expedition of the Columbia Basin conducted in 1843, recorded that about 900 salmon a day were collected in baskets suspended over the falls (Scholz et al. 1985). In 1870, the author of an annual report to the Commissioner of Indian Affairs, described the salmon chief (a Colville Indian) distributing salmon among his own and different tribes of Indians including: San Poil, Spokane, Kalispel, Kootenai, Coeur d' Alene, and Nez Perce that assembled at Kettle Falls for the purpose of catching their winter's food supply (Scholz et al. 1985). Based on Wilkes' estimate, Craig and Hacker (1940) computed that the yield of the Kettle Falls fishery was approximately 600,000 pounds of salmon during a 60-day fishing season, with 500 fish caught per day weighing an average of 20 pounds apiece. These figures included only the catch collected in communal basket traps and not those caught by individuals spearing or dipnetting salmon at Kettle Falls (Scholz et al. 1985).

Figure 3.2 Colville men fishing, Kettle Falls, Washington, before 1939. Photo courtesy of the Northwest Museum of Arts and Culture/Eastern Washington State Historical Society, Spokane, Washington.

Dr. George Suckley, who published the results of fish collected during the Pacific Railroad Surveys directed by Governor Isaac Stevens, declared that the Indians at Kettle Falls annually kill hundreds of thousands of salmon. Additionally, Suckley reported that during the fishing season, Indians from all the surrounding country congregate at Kettle

Falls and the population numbered about 1,000 individuals. Other accounts note that Indians from as far away as western Montana and the Dakotas came to Kettle Falls to trade buffalo meat and hides for salmon (Reyes 2002). He also noted, “The Indians sow a little wheat and plant some potatoes but their principle subsistence is salmon” (cited in Scholz et al. 1985). Although Kettle Falls was the preeminent fishery, it was only one of many upper Columbia River fisheries important to the Tribes of the region, such as the San Poil River fishery.

Resident salmonids were also abundant in the Columbia, Spokane and Pend Oreille rivers. For example, in a U.S. Fish Commission Survey, Bean (1894) and Gilbert and Evermann (1895) noted that cutthroat trout and mountain whitefish were abundant in the Spokane River system. Gilbert and Evermann (1895) said of the Pend Oreille River, “Trout are abundant in this river; salmon trout are also quite abundant, and both bite readily.” (Salmon trout was the commonly used term for bull trout in historic documents.) Ray (1937) noted that the Kalispel Tribe maintained a fish trap on Calispell Creek near its confluence with the Pend Oreille River. In the spring, before the salmon season on the Columbia and Spokane Rivers, Indians from several Tribes in the surrounding territory gathered there. They were attracted by the communal distribution of the catch from the trap, which included resident salmonid (trout, whitefish), catostomid (suckers), and cyprinid (minnows) fishes as well as the opportunity to dig camas, which grew in abundance there. In exchange, the resident Colville band – the Sxoielpi – at Kettle Falls reciprocated the hospitality of the Kalispel Tribe by providing them with salmon fishing access at Kettle Falls (Chance 1973). To provide an idea of the numbers of resident trout found in these systems, J.G. Cooper, another naturalist working for the Pacific Railroad Survey noted that, in the Spokane River, Spokane Falls arrested migration of salmon but above the falls, “an abundance of trout, almost equal to the salmon compensate for their loss.” In August 1877, Lt. Abercrombie (U.S. Army) reported that a party of three anglers caught about 450 salmon trout (bull trout or steelhead) in one afternoon fishing on the Spokane River near the City of Spokane Falls. Abercrombie stated, “As fast as we dropped in a hook baited with a grasshopper we would catch a big trout. In fact, the greatest part of the work was catching the grasshoppers.”

3.2 Historic and Current Aquatic Resources in the Subbasins of the Intermountain Province

The fisheries community currently existing throughout the IMP has been severely modified from the historic. Today, a total of 36 resident fish species have been identified, of which many are nonnative and none are anadromous. Current problems for fish populations are summarized in Section 1.4.

3.2.1 Coeur d’ Alene Subbasin

Migratory fishes from the Columbia River were not present in the Coeur d’ Alene Subbasin prior to the construction of Grand Coulee and Chief Joseph dams, due to natural barriers on the Spokane River. The Coeur d’ Alene Indian Tribe historically fished for salmon in portions of the Spokane River and its tributaries downstream of Post Falls, Idaho – areas downstream of the Coeur d' Alene Subbasin. The blockage of anadromous salmon at Grand Coulee Dam eliminated potential for anadromous fish runs that the Coeur d' Alene Tribe used for subsistence and cultural harvest.

Following the loss of anadromous salmon, the Coeur d' Alene Tribe placed more importance on the resident fishes of the Subbasin. Large migratory bull trout and westslope cutthroat trout were historically abundant in the Coeur d' Alene Subbasin. The Coeur d' Alene Tribe still use westslope cutthroat trout for subsistence and cultural purposes, but their populations have been significantly reduced. Main factors implicated in the declines of westslope cutthroat trout and bull trout are habitat degradation, over-harvest, and the introduction of nonnative species. Subsistence and recreational fishing opportunities for introduced nonnative fishes such as kokanee and Chinook salmon have helped to fill the void left from the decrease in the native salmonid populations.

3.2.2 Pend Oreille Subbasin

Originally, the lower sections of the Pend Oreille River supported anadromous Chinook salmon and steelhead trout. Anadromous Chinook salmon and steelhead trout are thought to have been restricted to the lower portions of the Pend Oreille River downstream of either Z Canyon or Metaline Falls. The construction of Grand Coulee Dam without fish passage facilities eliminated the potential for anadromous fish to migrate from the Columbia River into the lower Pend Oreille River.

Bull trout and westslope cutthroat trout are still present, although at decreased numbers in the Pend Oreille Subbasin. The construction of five dams on the mainstem Pend Oreille River has reduced the amount of riverine habitat and created large reaches of slow moving slackwater habitat. All five dams located on the mainstem Pend Oreille River are without fish passage facilities, thus eliminating the natural biological connectivity of the system. Although the increase in warmer slackwater habitat has been detrimental to many native fishes such as westslope cutthroat trout, bull trout, and mountain whitefish, it has increased the habitat capacity within the subbasin for nonnative fishes like largemouth bass, yellow perch, and pumpkinseed. The increase in nonnative game fishes within the subbasin has increased the diversity of the sport fishery, while possibly jeopardizing the native fish assemblage. Today, managers try to balance fishing opportunities for nonnative fishes with restoration and management of native fish species.

3.2.3 Upper Columbia Subbasin

Construction of Grand Coulee Dam without fish passage facilities eliminated the potential for anadromous and resident fish to migrate from lower reaches of the Columbia River to the Upper Columbia River Basin. Prior to hydropower development, the Upper Columbia River supported a diverse fish assemblage, which included eleven anadromous salmonid stocks and the Pacific lamprey (Scholz et al. 1985). In addition, anadromous white sturgeon were likely present, migrating considerable distances throughout the Columbia River system. However, construction of Grand Coulee Dam without fish passage caused the extirpation of anadromous salmon and lamprey above the dam, greatly reducing the native species assemblage. The loss of connectivity and free flowing sections of the Columbia River also affected native white sturgeon, bull trout, and burbot. These native fishes are currently well below their historic capacity.

Currently, the fish assemblage of the Upper Columbia Subbasin is characterized by a mix of nonnative sport fishes such as brown trout, coastal rainbow trout, kokanee salmon, brook trout, and warmwater species such as walleye and yellow perch. Native bull trout, westslope cutthroat trout, and redband trout are all still present in the subbasin, although at diminished numbers and are the focus of much of the restoration work that is being done in the subbasin. A white sturgeon recovery plan was developed in 2002 to direct international recovery efforts for white sturgeon in the Upper Columbia River Subbasin and adjacent areas.

3.2.4 Spokane Subbasin

Nine Mile Falls Dam blocked anadromous fish passage in the upper portions of the Spokane River Subbasin in 1908. It was the first of three dams on the Spokane River constructed without fish passage facilities (Little Falls Dam was constructed in 1911 and Long Lake Dam in 1915). The construction of Grand Coulee Dam without fish passage eliminated the potential for anadromous fish to return to all portions of the subbasin. Grand Coulee Dam also flooded the lower reach of the Spokane River, which is now the Spokane Arm of Lake Roosevelt.

Chinook salmon and steelhead trout dominated the Spokane River below Spokane Falls prior to the construction of hydroelectric dams (Scholz et al. 1985). The adult return of anadromous salmonids to the Spokane River system, in its natural condition, was nearly 500,000 fish annually (Scholz et al. 1985). The resident salmonid assemblage currently present in the Spokane Subbasin (primarily redband trout) is at severely diminished numbers from the historic. Habitat degradation, pollutants, sedimentation, declining stream flows, urbanization, fish barriers, and nonnative fishes have all contributed to the decline in native fishes in the Subbasin. While the current nonnative fishes provide recreational opportunities throughout the Subbasin, they also pose a serious threat to the remaining native fish assemblages from direct predation, competition, and hybridization.

3.2.5 San Poil Subbasin

Prior to the construction of Grand Coulee Dam anadromous salmonids spawned and reared in much of the San Poil Subbasin. The San Poil River had no significant natural barriers and anadromous salmonids had access to most of the watershed. Grand Coulee Dam eliminated all anadromous runs of salmon and steelhead to the entire watershed. The San Poil River had large runs of fall and summer Chinook salmon, but was best known for its large runs of summer steelhead, which were a significant resource for the people of the San Poil Subbasin.

Resident fishes of the San Poil Subbasin were also affected by the construction of Grand Coulee and Chief Joseph dams. Portions of the lower San Poil River are no longer free flowing riverine habitat; they are now part of Lake Roosevelt. The exotic species introduced into Lake Roosevelt thrived in the new lake environment and prey heavily on native fish produced in the San Poil River especially when juvenile fish migrate to the lake to rear. Hybridization occurred when nonnative stocks were introduced to bolster over fished resident populations after the anadromous fish stocks were eliminated. The loss of marine-derived nutrients and habitat alteration also contributed to the loss or reduction in the native fish assemblage of the Subbasin. Today, the major salmonid fishes of the subbasin are remnant steelhead hybrids that have adapted an adfluvial life history, genetically pure native resident interior Columbia redband trout still exist above natural barriers, kokanee salmon, and eastern brook trout. Managers focus on these species and enhancing coldwater habitats to maintain an adequate recreational and subsistence fishery for the people of the San Poil Subbasin.

3.2.6 Lake Rufus Woods Subbasin

Historically the Lake Rufus Woods Subbasin supported anadromous and resident salmonids. Anadromous salmonids migrated through and spawned in the former mainstem Columbia River now Lake Rufus Woods. Today only 13 percent of the riverine habitat in the entire Columbia River mainstem still exists. One of the major spawning areas for fall Chinook salmon in the Columbia River basin was located between River Mile (RM) 502 to 596 (River Kilometer (RK) 809 to 960) however most of this area was inundated by Lake Rufus Woods once the Chief Joseph Dam was constructed without fish passage in 1958 at RM 545 (RK 879) (Dauble et al. 2003). Today the habitat is very similar to other reaches that support spawning congregations of fall Chinook in the Columbia River but fish passage still does not exist at Chief Joseph Dam making this habitat inaccessible to anadromous fish. Anadromous salmon also spawned in the lower sections of the Nespelem River, below a natural barrier 1.5 miles upstream from the confluence with the Columbia River.

Historically, resident fish used the mainstem Columbia River as a migration corridor and refuge often entering smaller tributaries to spawn or forage before moving to other areas to meet all of their life history requirements. The passage barrier at Chief Joseph Dam and along tributaries interrupted this process and made migratory life histories strategies obsolete. Resident life history forms now had a competitive advantage. The impacts to resident fish species from passage barriers is poorly understood but steelhead and bull trout, known to have predominantly a migratory life history strategy, are both threatened in the areas around Chief Joseph Dam.

Today, resident kokanee salmon, and nonnative rainbow trout make up the majority of the salmonid fish assemblage within the mainstem reservoir habitats along with other introduced exotic game species. The stream habitats and lakes in the area support naturally reproducing populations of brook, and brown trout and hatchery supplemented rainbow trout populations. A large population of naturally reproducing kokanee salmon is present in Lake Rufus Woods. Managers rely heavily on this population, along with artificial propagation of rainbow trout, to fill the void of lost anadromous salmonid stocks. Habitat degradation, flow alterations, inundation, pollution, and nonnative species interactions are all responsible for the diminished populations of the native fishes in the Subbasin. White sturgeon, Pacific lamprey, and burbot along with several other native species were also impacted but information on historic and current populations of these and other species is largely nonexistent for the Rufus Woods Subbasin.

3.3 Aquatic Assessment Methods

3.3.1 Focal Species

The *Technical Guide for Subbasin Planners* (Council, 2001) suggests that Subbasin plans should include a list of focal species. A focal species has special ecological, cultural, or legal status, and is used to evaluate the health of the ecosystem and the effectiveness of management actions. The focal species are used to characterize the status, functions, and management actions in the subbasin. Criteria to be used in selecting focal species include, in order of priority: a) designation as federal endangered or threatened species, b) ecological significance, c) cultural significance, and d) local significance. Guidance was provided by the Technical Coordination Group, with input from each Subbasin Work Team on the selected focal species.

Fish are uniquely different from other wildlife and must be treated differently. They are confined to a more limited range of the landscape (water) and the technologies for analyzing fish and wildlife are quite different and will be discussed separately throughout this document.

In the IMP, the Oversight Committee recommended additional criteria for selecting focal fish species. These criteria were:

- When selecting a focal species, consider species to which one or more criteria apply.
- Endangered Species Act-listed species should be widely distributed within the subbasin.
- Non-game species should be culturally significant, or have subsistence or commercial value.
- Nonnative species should have recreational and/or commercial value.
- Focal species must represent two or more habitat types found within the subbasin.
- Native species must be native to the subbasin (that is, not introduced; for example, rainbow in the Pend Oreille Subbasin).
- If species of international importance are present, they should receive higher consideration.
- Focal species should be indicators of ecological/environmental health.
- Subbasins may select two to five focal species per subbasin.
- Use a tiered approach. For example, focal species may include historic/extirpated species, but they should receive lower priority than currently present species.

Using these criteria, the Technical Coordination Group selected a focal species list for each subbasin to consider (Table 3.1). The loss of anadromous fish has forced local fisheries managers to substitute resident fish for anadromous fish, an approach that has been recognized and supported in the Council's Fish and Wildlife Program. In addition, habitat degradation has, in some situations, forced fisheries managers to manage for nonnative fishes rather than native fishes. For this reason, nonnative fish species were selected as focal species in some subbasins. The selection of focal fish species in the IMP reflects both the desire to re-establish anadromous fish and to manage for native resident fish, and the realistic necessity of managing for nonnative fish. The focal species selected and the reasons for their selection are described in detail in subbasin chapters.

Table 3.1 Focal fish species in the IMP

Species	Subbasins	Reason for selection
Bull trout	Pend Oreille, Coeur d'Alene,	ESA-listed, native species, indicator of environmental health, cultural value, international importance
Westslope cutthroat trout	Pend Oreille, Coeur d'Alene,	Potential ESA-listed species, indicator of environmental health, native species, cultural value
Kokanee	Pend Oreille, Coeur d'Alene, Spokane, Upper Columbia, Lake Rufus Woods, San Poil	Ecological significance, local significance, recreational value
Largemouth bass	Pend Oreille, Spokane (Limited Geographic Area)	Cultural value (resident fish substitution), recreational value
Mountain whitefish	Pend Oreille, Spokane	Ecological significance, native species, indicator of environmental health, cultural value
Rainbow/redband trout	Spokane, Upper Columbia, San Poil, Lake Rufus Woods	Cultural value, recreational value, redband native species, commercial value, indicator of environmental health, international importance.
White sturgeon	Upper Columbia, Lake Rufus Woods	Cultural value, ecological significance, native species, international significance
Burbot	Upper Columbia	Cultural value, native species
Chinook salmon	Lake Rufus Woods, San Poil, Upper Columbia, Spokane	Cultural significance, native species. Considered Tier 2, Reintroduction potential
Brook trout	Lake Rufus Woods	Recreational value, resident fish substitution, subsistence value, habitat suitability
Pacific lamprey	Lake Rufus Woods Upper Columbia, Spokane	Will be discussed in the narrative, fish passage for lamprey is of interest to the Tribes, native species.

The technical assessment includes an assessment of limiting factors for the focal species in each subbasin. Limiting factors are any biological, cultural or economic conditions that are constraining the biological potential of a focal species. For salmonid fishes in rivers and streams, limiting factors were assessed using the Qualitative Habitat Analysis (QHA) model.

3.3.2 Qualitative Habitat Assessment

Beginning in early 2002 subbasin planners in the IMP began discussing potential tools to use for the aquatic assessment in the IMP. IMP subbasin planners met with Council staff and other experts to discuss the use of the Ecosystem Diagnosis and Treatment (EDT) model in the IMP on numerous occasion throughout 2002 and early 2003. A great deal of the guidance in the Technical Guide for Subbasin Planners is derived directly from the EDT model's outputs. However, at the time of these discussions the EDT model was not configured to evaluate resident fish species or lake and reservoir conditions (and with very limited exceptions still is not). Moreover, the Qualitative Habitat Assessment (QHA) model, which provides subbasin planners with an alternate tool to address some of the outputs associated with EDT, was not developed and made available to planners until late 2003. During these initial meetings, IMP subbasin planners were assured that the EDT model would be adapted for use with a handful of resident fish species in time to be used in the subbasin planning process.

As part of efforts to adapt EDT for use in areas with no anadromous fish, the San Poil Subbasin was used to run a test of some revised EDT rules. The Colville Tribes contributed significant time and resources to work with representatives from Mobrand Biometrics to populate the San Poil model and provide input on early development of rules. However, outputs from this effort were never completed. In light of the lack of other alternatives, and in their desire to meet, to the extent possible, the requirements of the Technical Guide for Subbasin Planners, subbasin planners in the IMP elected to use the QHA model. It is important to note that the outputs from the QHA model are in some areas substantially different from EDT and therefore do not in all cases align well with the portions of the Technical Guide for Subbasin Planners which are oriented specifically toward anadromous fish and related EDT outputs.

The QHA technique provides a structured, "qualitative" approach to analyzing the relationship between a given fish species and its habitat. It does this through a systematic assessment of the condition of several aquatic habitat attributes that are thought to be key to biological production and sustainability. Habitat attributes are assessed for each of several stream reaches or small watersheds within a larger hydrologic system where selected focal species were historically and/or are currently distributed. The decisions about how to divide the subbasins into stream reaches or small watersheds were made by the local biologists based on their familiarity with the available data and the uniformity of aquatic habitats. Habitat attribute findings were then considered in terms of their influence on a given species and respective life stage (that is, spawning and incubation, growth and feeding, migration). Definitions of the 11 physical habitat attributes used in the QHA are summarized below:

> **Riparian Condition:** Condition of the streamside vegetation, land form and subsurface water flow.
>
> **Channel Stability:** How the channel can move laterally and vertically and to form a "normal" sequence of stream unit types.

Habitat Diversity: Diversity and complexity of the channel including amount of large woody debris (LWD) and multiple channels. The complex of habitat types formed by geomorphic processes (including LWD) within the stream (for example, pools, riffles, glides, etc.)

Sediment Load: Amount of fine sediment within the stream, especially in spawning riffles.

High Flow: Frequency and amount of high flow events.

Low Flow: Frequency and amount of low flow events.

Oxygen: Dissolved oxygen in water column and stream substrate.

Low Temperature: Duration and amount of low winter temperatures that can be limiting to fish survival.

High Temperature: Duration and amount of high summer water temperatures that can be limiting to fish survival.

Pollutants: Introduction of toxic (acute and chronic) substances into the stream.

Obstructions: Natural or man-made barriers preventing the upstream or downstream migration of fish.

QHA relies on the expert knowledge of natural resource professionals with experience and data in a given local area to describe current and historical "reference" physical conditions in the target stream and to create a working hypothesis about how the habitat attribute would be used by a given fish species during each life stage. In July 2003, data input was completed as a collaborative effort of the fisheries Technical Coordination Group based on available data and best professional judgment and reviewed by the group in September 2003 for accuracy (Figure 3.3-1).

Figure 3.3-1. Biologists in the IMP work on populating the QHA model for the IMP Subbasin Plan, July 2003

The QHA model assesses both reference and current conditions for 11 physical habitat parameters using a ranking system between 0 (poor condition) and 4 (optimal condition). Reference conditions regarding current reservoir habitats referred to pre-impoundment conditions. In general, reference (or historic) habitat conditions were considered optimal (value = 4) unless otherwise noted. For example, some reaches had natural fish barriers or geological characteristics prone to greater sedimentation, thus lowering habitat conditions less than optimal.

The working hypothesis is the “lens” through which physical stream habitat conditions are assessed. The hypothesis consists of weighted scores that were assigned by the Technical Coordination Group to each life stage and habitat attribute specific for that life stage with respect to each focal species. The life stage weighted score ranges from 0 to 3, with 3 being the highest value assigned based on the duration of the life stage and its potential vulnerability to physical habitat conditions. For example, the life stage of spawning and incubation was often ranked higher that migration for resident fishes. The habitat attribute weighted score ranges from 0 to 2 with 2 being the highest value based on the importance ascribed to the attribute in regard to the life stage for that focal species.

The composite weighted score (life stage and habitat attribute) results in an overall reach score depicting the difference between current and the reference physical habitat condition in each reach. The reference condition represents un-impacted or "desired" conditions. QHA reach score and rank (not a prioritization list) depicts the relative degree of physical habitat deviation from reference conditions and the least amount of habitat deviation from reference conditions within each subbasin for a selected focal species. The QHA process is shown in Figure 3.3.2.

The QHA model was adapted from the Ecological Diagnosis and Treatment (EDT) Model to assess salmonids potential in streams. Keep in mind that the QHA model does not address lake or ocean environments and was not used to analyze focal species requiring lake or ocean habitat during their life history (for example, largemouth bass), with the exception of kokanee salmon. Kokanee salmon often utilize stream habitat for spawning and incubation and natural resource professionals participating in the decision-making process elected kokanee salmon to be incorporated into the QHA model. For the other non-salmonid species requiring lake habitats, a narrative assessment of limiting factors is presented describing the best available scientific information about the limiting factors for those species or those habitats. Additionally, reservoirs historically classified as rivers prior to impoundment were included into the QHA analysis.

Readers should be cautious not to interpret the rankings as a priority list for restoration. In some situations, the watersheds and streams that have the greatest deviation from the reference condition are not recommended to be the top priority for restoration because these streams are so degraded that restoration activities are not practical at this time. In addition, the QHA model only considers physical habitat factors. Biological considerations, such as competing species, disease, hybridization or current population abundance, are not included in the analysis. Some of these considerations, where known, are included in the species by species descriptions in the text.

The QHA output is shown in the form or tables, tornado diagrams, and maps that are presented within the aquatic assessment for each subbasin as well as incorporated within the discussion for the respective focal species. The tornado diagrams and maps display the reach scores for both current habitat condition (ranging from zero to positive one) and protection (ranging from zero to negative one). Scores closest to negative one depict reaches most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

The results of the QHA modeling are presented in the aquatic assessment sections for each subbasin. The modeling results give site-specific information about watersheds within each subbasin that will be most useful for planning specific projects during the next phase of fish and wildlife planning.

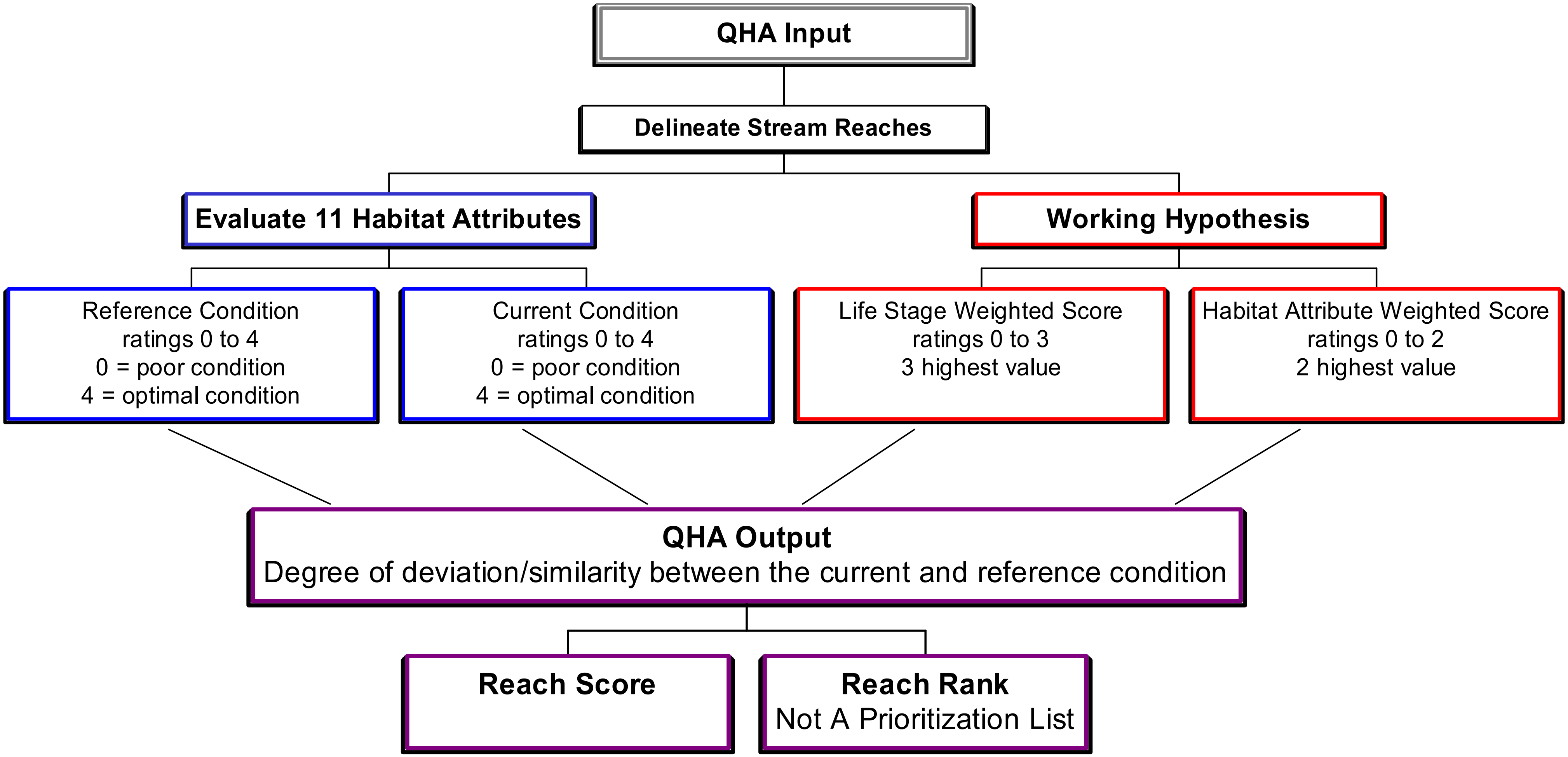

Figure 3.3.2 Logic path for QHA process