Section 5. Management Plan

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5. Management Plan

5.1 General Approach and Methods

The logic path used by subbasin planners in developing the management plan is summarized in Figure 1. The management plan for the Umatilla/Willow subbasin begins with a vision statement (Section 5.2), which describes the desired future condition of the subbasin and reflects the current conditions, values, and priorities of the subbasin in a manner that is consistent with the Council's vision described for the Columbia basin (Council 2000). The Umatilla/Willow subbasin vision statement was adopted by the Core Partnership on November 6, 2003 and was presented and approved at a public meeting on November 12, 2003.

The development of objectives and strategies for the subbasin's aquatic and terrestrial wildlife management plan was driven by the vision, the current biological and ecological conditions in the subbasin, and the economic and social realities described in the assessment (Section 3.0). The biological objectives describe the physical and biological changes within the subbasin needed to achieve the vision. When forming aquatic and wildlife biological objectives, subbasin planners worked to satisfy the criteria set forth by the Council (2001) in its *Technical Guide to Subbasin Planners*. Thus, biological objectives in this plan are:

- empirically measurable and based on an explicit scientific rationale
- both short-term and long-term
- consistent with basin-level visions, objectives, and strategies adopted in the Council's program
- consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin, and agreed upon by co-managers in the subbasin
- complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin
- consistent with the ESA recovery goals and CWA requirements
- quantitative with measurable outcomes where appropriate

Strategies developed for the Umatilla/Willow subbasin describe sets of actions needed to accomplish the biological objectives. They take into account not only the desired outcomes, but the physical and biological realities expressed in the working hypotheses, and are meant to guide the development of projects as part of the implementation of the plan. When possible, strategies are prioritized. A limited set of aquatic and terrestrial objectives and strategies was presented at a public meeting on May 6, 2004, and suggestions provided at that meeting were incorporated into the plan.

Adaptive management will be used to refine and modify objectives and strategies throughout the implementation of the Umatilla/Willow subbasin plan. Important data gaps and critical uncertainties became evident as the subbasin assessment and inventory were completed and are described in detail in Sections 4.5 and 5.5. As these gaps are

filled, objectives and strategies will be modified, as needed. Another necessary component of adaptive management is a strong monitoring and evaluation program. The inventory clearly illustrates the difficulties that arise in the absence of coordinated, well-funded monitoring and evaluation programs for appraising the effectiveness of fish and wildlife efforts. To address this deficiency, this plan includes a detailed monitoring and evaluation program (Section 5.5 and Appendix H). If properly funded, the implementation of this program will be pivotal for successful adaptive management.

Finally, it should be noted that the objectives and strategies presented in this plan are consistent with the scientific principles that underlie the Council's Fish and Wildlife Program (Table 1).

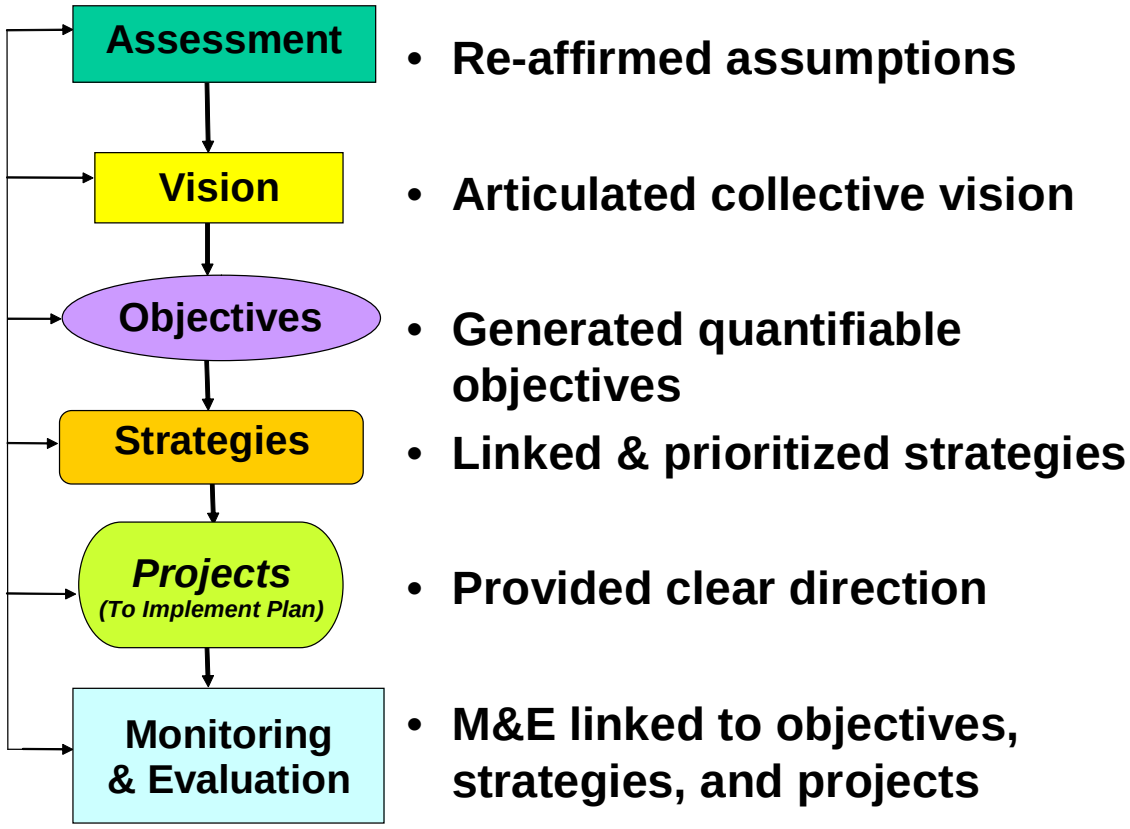

Figure 1. Flowchart of the logic path used to develop the Umatilla/Willow subbasin plan (modified from ISRP 2004).

Table 1. Scientific principles of the Council's Fish and Wildlife Program. Detailed descriptions of each principle are available in Council, 2000.

Scientific Principles
Principle 1: The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystems.
Principle 2: Ecosystems are dynamic, resilient, and develop over time.
Principle 3: Biological systems operate on various spatial and time scales that can be organized hierarchically.
Principle 4: Habitats develop and are maintained by physical and biological processes.
Principle 5: Species play key roles in developing and maintaining ecological conditions.
Principle 6: Biological diversity allows ecosystems to persist in the face of environmental variation.
Principle 7: Ecological management is adaptive and experimental.
Principle 8: Ecosystem function, habitat structure, and biological performance are affected by human actions.

5.2 Vision for the Subbasin

The vision for the Umatilla/Willow subbasin is a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species, which will support sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin and the Pacific Northwest.

This vision entails several broad goals for the subbasin that can be categorized as human use; habitat; population; and research, monitoring, and evaluation goals.

Human Use

- Provide for non-consumptive recreational, educational, aesthetic, scientific, economic, cultural, and religious uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable consumptive, ceremonial, subsistence, and recreational uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable resource-based activities to support the economies and cultures of the communities within the subbasin.

Habitat

- Protect existing high quality fish and wildlife habitat and strongholds.
- Restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts.
- Restore the health and function of ecosystems in the Umatilla/Willow subbasin to ensure continued viability of their natural resources.

Population

- Maintain and enhance the diversity, abundance and productivity of existing fish and wildlife populations within the subbasin.
- Strive for de-listing and avoidance of future listings of native fish and wildlife species in the subbasin under state and federal Endangered Species Acts.
- Restore and maintain self-sustaining populations of extirpated species consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.

Research, Monitoring, and Evaluation

- Develop a research, monitoring, and evaluation plan for the ecosystems of the subbasin that is consistent with and complements the larger regional efforts to track the status of fish and wildlife populations and their habitats as needed for appraising management actions, the results of these actions, and for evaluating other environmental changes.

5.3 Aquatic Biological Objectives and Strategies

5.3.1 Aquatic Approach and Methods

As described in Section 5.1, the development of objectives and strategies for the aquatic management plan was driven by the vision for the subbasin (Section 5.1), the current biological and ecological conditions, and the economic and social realities described in the assessment (Section 3.0). Two types of objectives were developed by the aquatic working group, numerical objectives for the number of the number of returning adults of steelhead and salmon and habitat objectives designed to improve limiting factors identified by EDT. EDT was the major methodology used to develop objectives for natural returns and to identify limiting factors from which habitat objectives and strategies were derived. In addition, objectives were developed to address passage barriers in the subbasin, which have received little attention in some areas and the impact of which is most likely underestimated by the current EDT outputs. Strategies were also developed by the aquatic working group to improve habitat and to enhance the artificial production programs in the subbasin.

5.3.2 Aquatic Objectives and Strategies

The aquatic working group developed a set of 16 qualitative management objectives that are used to guide more specific, quantitative objectives and strategies. These qualitative management objectives are:

Population and Environmental Status

1: Monitor the status and trends of fish and mussel populations, their habitats and ecosystems throughout the Umatilla Basin.

Natural Production

2: Maintain and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of fish and mussels throughout the Umatilla Basin using habitat protection and improvement.

3: Maintain, augment, and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of steelhead, Chinook, coho, and lamprey throughout the Umatilla Basin using hatchery supplementation and out-planting

4: Maintain the Birch Creek sub-population as a natural steelhead sanctuary (not supplemented).

5: Restore and maintain diverse and productive natural populations of Chinook and coho in the Umatilla Subbasin using hatchery reintroductions.

Hatchery Program

6: Develop and maintain a local brood source for steelhead and Chinook from returns to the Umatilla River.

7: Operate hatchery program to achieve subbasin smolt production, smolt to adult return, and hatchery adult return goals from the subbasin plan.

8: Achieve optimal effectiveness in the operation of the Umatilla Basin steelhead and Chinook hatchery programs while meeting production, population, and conservation objectives for natural- and hatchery-reared fishes.

9: Minimize any negative impacts of the Umatilla Basin hatchery program on natural steelhead and Chinook, and non-target populations.

Flow and Passage

10: Maintain and enhance flow for homing and passage of steelhead and Chinook through the lower Umatilla River using flow restoration and enhancement.

11: Maintain and enhance steelhead and Chinook rearing and spawning habitat in the mainstem Umatilla River with flow enhancement and protection.

12: Maintain and enhance passage of adult and juvenile steelhead and Chinook throughout the Umatilla Subbasin with passage protection and restoration.

Fisheries

13: Maintain and enhance tribal and non-tribal steelhead, Chinook, coho and lamprey fisheries compatible with production, population, and conservation objectives.

Collaboration and Communication

14: Maximize effectiveness of Umatilla Subbasin RM&E projects with collaborative study planning and implementation, synthesis of results, and results dissemination.

15: Maximize management effectiveness of Umatilla Basin fish programs using local and regional protocols in RM&E methodologies that allow exchange of compatible information among local and regional databases and fisheries management entities.

16: Maximize our understanding of the impacts of out-of-basin factors on Umatilla smolt-to-adult survival with collaborative assessments, surveys, tagging, data analysis, modeling, and results dissemination.

In addition to these qualitative management objectives, the aquatic working group also developed numeric population goals for returning adults of steelhead and salmon. These numeric goals include natural returns, hatchery returns, and harvest goals (Table 2). The potential natural production of each species (except coho) expected from the implementation of the management plan is listed as natural return objectives. The current EDT model predicts no sustainable natural production of coho based on the implementation of the habitat restoration plan so a value of ½ PFC was used instead. These expected natural production objectives assume the implementation of all habitat restoration actions including the Phase III flow enhancement project, and the maintenance of Phase I and II flow enhancement projects. Although many habitat actions are included in the management plan, it is the implementation of these flow restoration activities that provide the greatest fish benefits within a 15-year time period (the work projection period of this plan).

Other adult return objectives from past planning efforts are also included in Table 2. Since this plan is a culmination of numerous planning efforts, it is important to recognize anadromous fish objectives from previous planning documents.

Table 2. Comparison of anadromous fish objectives from various plans & processes

Species	Source Plan[1/]	Tot. Return Objective	Natural Returns	Hatchery Returns	Harvest Component
Spring Chinook	1987 USvOR	2,030	870	1,160	-
	1990 SBP	11,000	1,000	10,000	8,800
	1996 TRP	11,000	1,000	10,000	8,800
	2001 SBS	8,000	3,000	6,000	4,000
	2004 EDT[2/]	-	1,702	-	-
Fall Chinook	1990 SBP	21,000	11,000	10,000	5,400
	1996 TRP	21,000	11,000	10,000	5,400
	2001 SBS	12,000	6,000	6,000	5,000
	2004 EDT[2/]	-	4,192	-	-
Coho	1990 SBP	6,000	-	6,000	-
	1996 TRP	6,000	-	6,000	-
	2001 SBS	6,000	-	6,000	-
	2004 EDT[2/]	-	1,568	-	-
Steelhead	1987 USvOR	7,958	4,300	3,658	-
	1990 SBP	9,670	4,000	5,670	5,460
	1996 TRP	9,670	4,000	5,670	5,460
	2001 SBS	5,500	4,000	1,500	1,384
	2004 EDT[2/]	-	3,610	-	-

1/ Sources of spring chinook and steelhead return objectives are as follows:
USvOR = 1987 United States vs Oregon Subbasin Production Reports; SBP = 1990 NPPC Subbasin Plan; TRP = 1996 CRITFC Spirit of the Salmon (Tribal Restoration Plan); SBS = 2001 NPPC Subbasin Summary.
2/ EDT natural production estimates are not objectives but were derived from the PFC analysis in this plan in Section 3.6.1.2.

5.3.2.1 Natural Production Objectives and Strategies

EDT was the tool used to define the numeric objectives for natural returns shown in table 2. As stated above, to achieve these numerical objectives will require the restoration of all priority geographic areas as well as the implementation of Phase III of the Umatilla Basin Project. As shown in Section 3.6.1.1 of the Assessment, this restoration scenario produces the largest returns of all the anadromous species. On May 21, 2004 the aquatic working group developed a series of strategies designed to achieve these numeric objectives. In addition, the group developed habitat objectives for each of the priority geographic areas (as identified by EDT) and identified which strategies would work to achieve those objectives. The aquatic working group also developed a series of qualitative artificial production objectives for each geographic area. However, more quantitative objectives and strategies are listed below under the subheading *Artificial Production Objectives and Strategies.* Finally, bull trout were incorporated into this area

by area analysis. This was done to provide continuity in the plan and is defensible because many of the limiting factors impacting the anadromous focal species also are limiting to bull trout and thus the same habitat objectives and strategies will work for all of these species.

The management strategies to enhance natural production through habitat restoration are:

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects**. The Umatilla Basin Project is outlined in Section 3.1.3.2. Under one possible scenario of Phase III, summer flows in the Umatilla River will be enhanced (and water temperatures decreased) from Thornhollow Springs (RM 73.5) to the mouth. Thus, implementation of Phase III will impact flow and temperature in GAs 28, 25, 11, 9, 2, and 1.
2) **Purchase water rights from willing sellers.** Purchased water rights can come from water directly removed from the Umatilla or Willow mainstems and tributaries or from McKay and/or Willow Creek reservoirs. This water can then be left instream or released from McKay or Willow Creek reservoirs to enhance flows and decrease temperatures.
3) **Increase water conservation and irrigation efficiency.** This strategy will aid in improving streamflow by reducing the quantity of water withdrawn for agricultural, industrial or municipal purposes. Typical conservation projects include conversion of flood irrigation systems to sprinklers, piping and lining of irrigation ditch systems, decreased watering of lawns by municipalities, etc.
4) **Modify zoning and flood control planning through regulatory actions.** By working to improve zoning ordinances to prevent development of riparian areas and floodplains, better riparian function and channel-floodplain connection can be attained and/or maintained.
5) **Place large woody debris and large boulders.** Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve instream habitat. Placing large woody debris and large boulders directly increases habitat complexity and can improve habitat quantity by increasing the number of pools.
6) **Fence and plant riparian zones.** Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve riparian habitat. Fencing is installed to manage use of the riparian zone by livestock and planting of native vegetation is done to speed the recovery process once grazing or other land uses have been modified. Riparian habitat improvements can directly impact stream temperatures and sediment inputs (through stabilizing streambanks and filtering runoff).
7) **Modify channel and flood-plain function**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve form and function of stream channels. This work involves directly or indirectly returning stream channels to a functional state that is determined by the valley form, geology, soils, vegetation and climate. Specific parameters often targeted by this type of work include channel width and depth, sinuosity, slope, flood prone area, ratio of channel features, etc.

8) **Construct pool and riffle habitat using in-stream modifications**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to increase the quantity of pools and gravel dominated riffles (as opposed to cobble). Straightening and entrenchment of stream channels as is a common problem in the Umatilla Basin that leads to the reduction of pool habitat and gravel dominated riffles. Pools will be constructed by direct intervention, often concurrently with work to restore channel form a function, and the quantity of gravel dominated riffles will be improved by decreasing channel slope, reducing entrenchment and confinement, and restoring pool/riffle sequencing.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to address problems caused by roads. Roads are a source of sediment and a means of rapidly routing sediment to streams, occupy historic riparian zones, and often result in stream confinement. Maintenance, relocation or removal of roads are the primary tools for addressing the problems.
10) **Increase protective status of priority habitats**. Where habitats have high value due to their current productive capacity or general importance to particular species, they should be protected to maintain their value. This can be accomplished by easements and other kinds of natural resource protection agreements, or on public lands by varying kinds of protections authorized by statute or rule.
11) **Modify detrimental land use activities**. Change land use activities leading to degradation of habitat, thereby allowing stream attributes impacted by these activities to recover without intervention. A common example of this kind of work is riparian buffers where streamside areas are protected from uses such as livestock grazing or agricultural crops.
12) **Restore upstream or headwater attributes to improve downstream conditions**. In particular, water quality problems are cumulative in a downstream direction. Sources of water quality problems at a particular location can often be sourced to areas upstream. This is also true of large wood debris. The source of large wood debris for some reaches can be primarily from upstream reaches. Limiting factors such as fine sediment, water temperature and large wood debris should be addressed at the watershed scale as well as the reach/geographic area scale. Understanding of these problems at the watershed scale is necessary, however, to effectively work at this scale. Actions such as restoration of riparian vegetation and channel function upstream of areas limited by temperature, sediment and/or large wood should be particularly effective.
13) **Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.** Correction of passage deficiencies should be corrected wherever they exist. Table 45 is a list of known passage problems.
14) **Maintain passage efficiency through ongoing O&M activities**. Structural fixes installed to provide fish passage over irrigation dams, etc. require maintenance to operate within design criteria. All fish passage facilities should be maintained to provide optimal passage conditions.

These strategies were determined to generally be of three types: those that address ongoing causative factors, those that restore natural processes, and those that artificially enhance natural processes. Many of the strategies fit more than one of these types and many strategies address several limiting factors. The limiting factors and the types of strategies are shown in table 3.

Table 3. Management strategies (by number) and their general type and the limiting factors they address.

Limiting Factor ➔	**Habitat Quantity**	**Habitat Diversity**	**Channel Stability**	**Sediment**	**Low Flow**	**High Temper-ature**	**Passage**
Address Ongoing Causative Factors	1,2,3,4,6, 10,11	4,6,9,10,11	4,6,9,10, 11	4,6,9,10, 11	1,2,3, 4,10, 11	1,2,3,4, 10,11	1,2,3, 13,14
Restore Natural Processes	2,3,4,6,7,9, 10,11,12, 13	4,6,7,9,10, 11,12	4,7,9,10, 11,12	4,6,7,9, 10,11,12	2,3,4, 6,7, 10,11, 12	2,3,4,6,7, 10,11,12	2,3,7, 12,13, 14
Artificially Enhance Natural Processes	1,5,6,7,8	5,6,7,8	5,6,7,8	5,6,7,8	1,6,7	1,5,6,7,8	1,7,13, 14

These strategies will be implemented to achieve the numeric objectives shown in Table 2. These objectives are based upon habitat restoration of all priority geographic areas and implementation of Phase III.

Based on the EDT results, the aquatic working group determined that the important limiting factors could be addressed through habitat restoration and implementation of Phase III of the Umatilla Basin Project. Implementation of Phase III will involve increased instream flows in the mainstem from Thornhollow (RM 73.5) to the mouth and will impact GAs 1, 2, 9, 11, 25, and 28. Each of these actions should result in lower water temperatures, increased passage survival, and increased habitat quantity. Habitat restoration (based on specific habitat objectives and strategies that are outlined in the Management Plan) should also address sediment loads and habitat complexity. From this, three restoration scenarios were examined with EDT:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.
3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

The impact of each of these scenarios on the anadromous focal species was determined through EDT. EDT output provides a working hypothesis on the impact that each scenario has on the productivity and abundance of steelhead and salmon. While the results of the three scenarios are given below, the aquatic working group has adopted scenario 2 as its primary scenario and the on that the numeric goals in Table 2 are base upon. The following is the results of the EDT runs based on the three scenarios.

Working Hypotheses

Steelhead – EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

These results are shown graphically in figures 2 and 3.

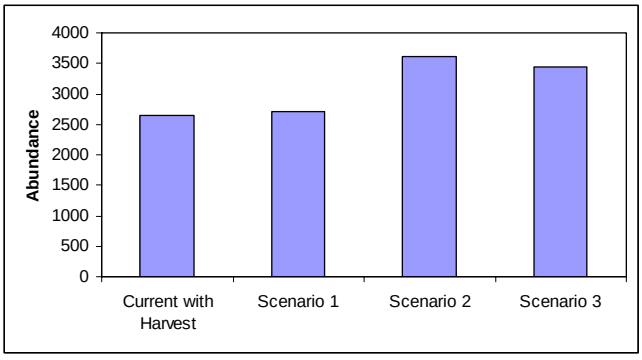

Figure 1. EDT estimate of current abundance and results showing the impacts on abundance of adult steelhead under the three restoration scenarios.

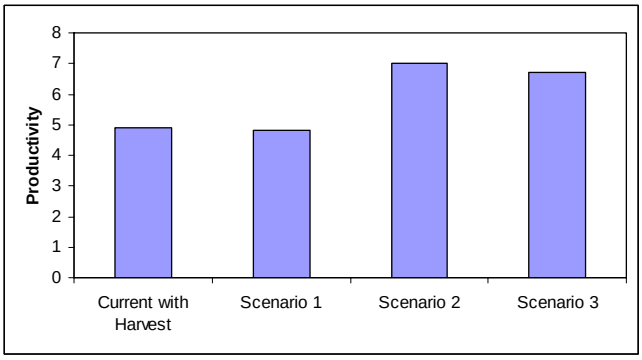

Figure 3. EDT estimate of current productivity and results showing the impacts on productivity of the steelhead population under the three restoration scenarios.

Spring Chinook – EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

These results are shown graphically in figures 4 and 5.

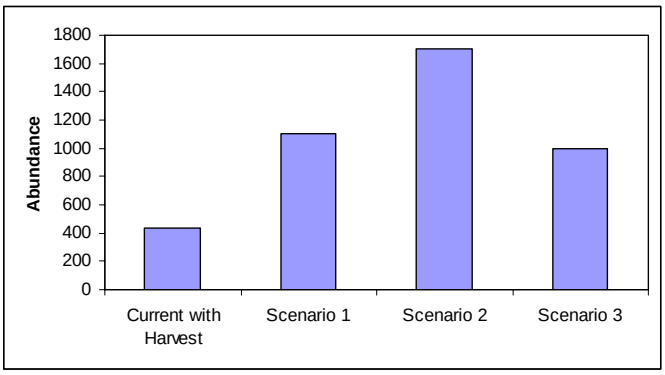

Figure 4. EDT estimate of current abundance and results showing the impacts on abundance of adult spring Chinook under the three restoration scenarios.

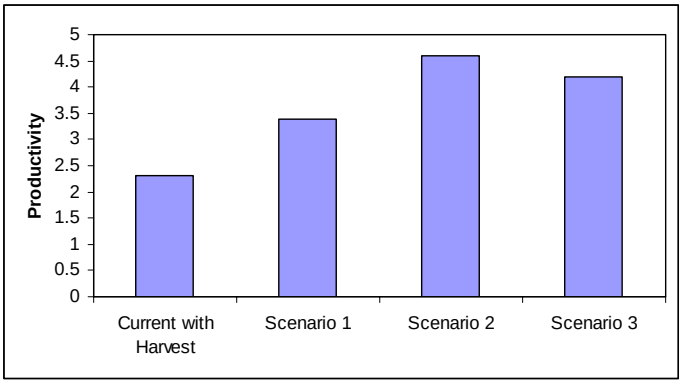

Figure 5. EDT estimate of current productivity and results showing the impacts on productivity of the spring Chinook population under the three restoration scenarios.

Fall Chinook – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

These results are shown graphically in figures 6 and 7.

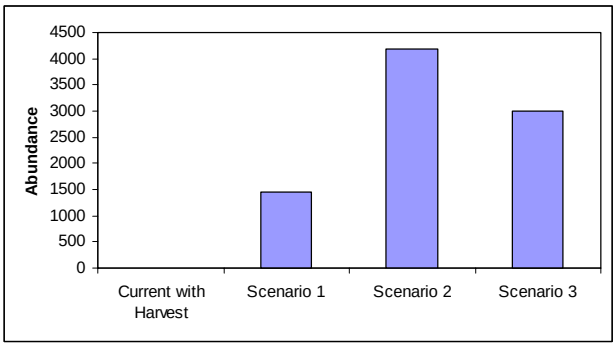

Figure 6. EDT estimate of current abundance and results showing the impacts on abundance of adult fall Chinook under the three restoration scenarios.

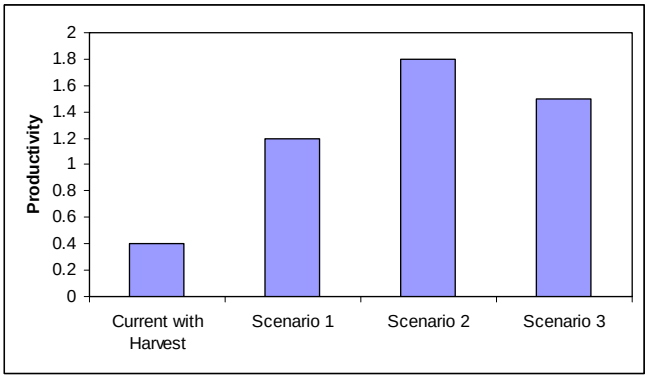

Figure 7. EDT estimate of current productivity and results

showing the impacts on productivity of the fall Chinook population under the three restoration scenarios.

Coho – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

These results are shown graphically in figures 8 and 9.

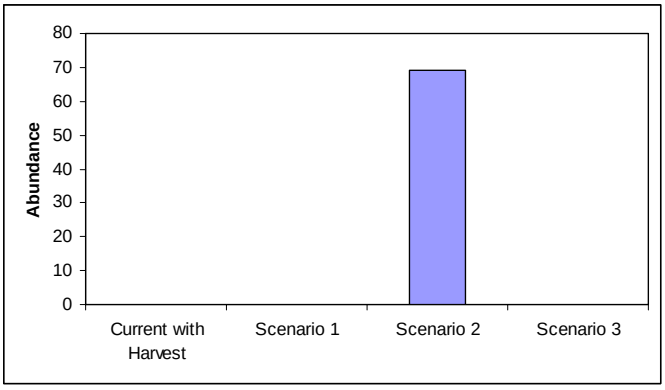

Figure 8. EDT estimate of current abundance and results showing the impacts on abundance of adult coho under the three restoration scenarios.

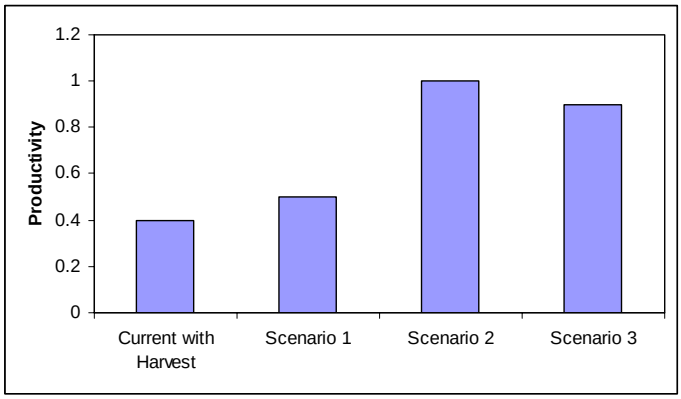

Figure 9. EDT estimate of current productivity and results

showing the impacts on productivity of the coho population under the three restoration scenarios.

EDT runs were also conducted for each priority geographic area separately (these runs assume the implementation of Phase III). For each priority geographic area specific habitat objectives are listed. In addition, the management strategies that pertain specifically to a geographic area and its habitat objectives are also shown.

Priority Geographic Area: GA2, Umatilla River, Threemile Dam to Butter Creek

Priority Fish Species: Steelhead, Spring Chinook, and Fall Chinook

Limiting Factors in Order of Priority: sediment, water temperature, obstruction, channel stability, flow, habitat quantity and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	12	11	LP	LP	LP
Restoration Ranking	LP	7	3	LP	LP

(LP = low priority)

Quantitative Habitat Objectives: 25% restoration of fine sediment, 50% restoration of water temperatures, 25% restoration of confinement, 25% restoration of maximum width, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook spawning and enhance rearing habitat for juveniles.

Working Hypothesis: The implementation of the quantitative habitat objectives and phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – no increase
Coho – no increase.

And increases in abundance of returning adults:

Steelhead – from 2,650 to 2,668
Spring Chinook – from 498 to 506
Fall Chinook – from 0 to 355
Coho – no increase

Management Strategies Listed in Order of Priority:

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
14) Maintain passage efficiency through ongoing O&M activities.
12) Restore upstream or headwater attributes to improve downstream conditions.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
4) Modify zoning and flood control planning. *Regulatory actions*
7) Modify channel and flood-plain function.

Priority Geographic Area: GA9, Umatilla River between Butter Creek and Westland Dam

Priority Fish Species: Coho**,** Spring Chinook, and Fall Chinook

Limiting Factors in Order of Priority: sediment, water temperature, channel stability, habitat diversity, and flow.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	5	HP	HP	LP
Restoration Ranking	LP	6	1	1	LP

(LP = low priority) (HP=high priority due to restoration ranking)

Quantitative Habitat Objectives: 25% restoration of fine sediment, 50% restoration of water temperatures, 25% reduction in bed scour, 25% restoration of confinement, 25% restoration of maximum width, 25% restoration of large wood, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook and coho spawning and enhance rearing habitat for juveniles.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – an increase from 1.0 to 1.2
Coho – an increase from 0.4 to 0.5

And an increase in abundance for:

Steelhead – from 2,650 to 2,667

Spring Chinook – from 498 to 529
Fall Chinook – from 0 to 1,457
Coho – no increase

Management Strategies in Order of Priority:

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
3) Increase water conservation and irrigation efficiency.
14) Maintain passage efficiency through ongoing O&M activities.
7) Modify channel and flood-plain function.
12) Restore upstream or headwater attributes to improve downstream conditions.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
4) Modify zoning and flood control planning. *Regulatory actions*
5) Place large woody debris and large boulders.

Priority Geographic Area: GA25, Umatilla River between McKay Creek and Mission Bridge

Priority Fish Species: Coho**,** Spring Chinook, and Fall Chinook

Limiting Factors in Order of Priority: water temperature, sediment, habitat diversity, channel stability, and flow.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	10	6	HP	LP
Restoration Ranking	LP	4	LP	3	LP

(LP = low priority) (HP=high priority due to restoration ranking)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 25% restoration of fine sediment, 25% restoration of large wood, 25% reduction in bed scour, 25% restoration of confinement, 25% restoration of maximum width, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook and coho spawning and enhance rearing habitat for juveniles. Continue acclimation and release of steelhead and coho salmon.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – no increase
Coho – no increase

And increases in abundance for:

Steelhead – no increase
Spring Chinook – from 498 to 509
Fall Chinook – no increase
Coho – no increase

Management Strategies in Order of Priority:

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
7) Modify channel and flood-plain function.
12) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
4) Modify zoning and flood control planning. *Regulatory actions*
11) Modify detrimental land use activities. *Volunteer through PR and education*
5) Place large woody debris and large boulders.

Priority Geographic Area: GA28, Umatilla River between Mission Bridge and Meacham Creek

Priority Fish Species: Steelhead Coho**,** Spring Chinook, fall Chinook, and Bull trout

Limiting Factors in Order of Priority: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	7	2	HP	HP*
Restoration Ranking	2	1	2	2	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 25% restoration of fine sediment, 50% increase in pools, 25% restoration of large wood.

Qualitative Artificial Production Objectives: Enhance migration and rearing of all hatchery species. Increase steelhead, spring Chinook, fall Chinook and coho spawning. Continue acclimation and release of fall Chinook and steelhead.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.3
Spring Chinook – from 2.4 to 3.4
Fall Chinook – from 1.0 to 1.3
Coho – from 0.4 to 0.7

And increases in abundance for:

Steelhead – from 2,650 to 2,958
Spring Chinook – from 498 to 1,108
Fall Chinook – from 0 to 1,887
Coho – no increase

Management Strategies in Order of Priority:

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
7) Modify channel and flood-plain function.
12) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
11) Modify detrimental land use activities. *Volunteer through PR and education*
4) Modify zoning and flood control planning. *Regulatory actions*
5) Place large woody debris and large boulders.
8) Construct pool and riffle habitat using in-stream modifications.

Priority Geographic Area: GA40, Umatilla River between Meacham Creek and the Forks.

Priority Fish Species: Steelhead**,** Coho**,** spring Chinook, fall Chinook, and Bull trout

Limiting Factors in Order of Priority: water temperature, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	2	1	1	1	HP*
Restoration Ranking	3	3	LP	7	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 75% restoration of large wood, 75% increase in pools.

Qualitative Artificial Production Objectives: Enhance migration and rearing of all hatchery species. Increase steelhead, spring Chinook, fall Chinook and coho spawning. Continue acclimation and release of spring Chinook.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.1
Spring Chinook – from 2.4 to 3.2
Fall Chinook – no increase
Coho – from 0.4 to 0.6

And increases in abundance from:

Steelhead – 2,650 to 2,702
Spring Chinook – from 498 to 645
Fall Chinook – from 0 to 173
Coho – no increase

Management Strategies in Order of Priority:

12) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
5) Place large woody debris and large boulders.
8) Construct pool and riffle habitat using in-stream modifications.
4) Modify zoning and flood control planning. *Regulatory actions*
11) Modify detrimental land use activities. *Volunteer through PR and education*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA43, South Fork Umatilla from mouth to Thomas Creek.

Priority Fish Species: Spring Chinook

Limiting Factors in Order of Priority: habitat diversity and **channel stability**. Professional judgment of managers is that water temperature is also a limiting factor in this geographic area and thus management strategies will acknowledge this additional limiting factor.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking		4			
Restoration Ranking		9			

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 75% restoration of large wood, 100% restoration of confinement, 50% restoration of bankfull width, 50% restoration of bed scour, and 50% restoration of water temperature.

Qualitative Artificial Production Objectives: Continue spring Chinook hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Spring Chinook – from 2.4 to 2.6

And increased abundance for:

Spring Chinook – from 498 to 523

Management Strategies in Order of Priority:

6) Fence and plant riparian zones.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
12) Restore upstream or headwater attributes to improve downstream conditions.
5) Place large woody debris and large boulders.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.

Priority Geographic Area: GA33, Meacham Creek from the mouth to the North Fork.

Priority Fish Species: Steelhead, spring Chinook, fall Chinook, Coho, and Bull trout

Limiting Factors in Order of Priority: water temperature, habitat quantity and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	3	3	HP	HP*
Restoration Ranking	4	2	Not listed	5	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 33% restoration of water temperature, 50% restoration of large wood, 50% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead and spring Chinook hatchery programs to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – from 2.4 to 3.2
Coho – 0.4 to 0.6

And increases in abundance for:

Steelhead – from 2,650 to 2,702
Spring Chinook – from 498 to 648
Coho – no increase

Management Strategies in Order of Priority:

7) Modify channel and flood-plain function.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
12) Restore upstream or headwater attributes to improve downstream conditions.
5) Place large woody debris and large boulders.
8) Construct pool and riffle habitat using in-stream modifications.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
4) Modify zoning and flood control planning. *Regulatory actions*

Priority Geographic Area: GA35, North Fork Meacham Creek and tributaries.

Priority Fish Species: Steelhead and spring Chinook

Limiting Factors in Order of Priority: water temperature, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	4	2	Not present	Not present	LP
Restoration Ranking	8	5	Not present	Not present	LP

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 75% restoration of water temperature, 75% restoration of large wood, 75% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead and spring Chinook hatchery programs to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.1
Spring Chinook – from 2.4 to 2.8

And increases in abundance for:

Steelhead – from 2,650 to 2,693
Spring Chinook – from 498 to 557

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
5) Place large woody debris and large boulders.
6) Fence and plant riparian zones.
8) Construct pool and riffle habitat using in-stream modifications.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA38, Meacham Creek from Sheep Creek to headwaters including Two-mile Creek.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: sediment and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	15	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of fine sediment and 75% restoration of large wood.

Qualitative Artificial Production Objectives: Continue steelhead hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:
Steelhead – no increase

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
11) Modify detrimental land use activities. *Volunteer through PR and education*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
5) Place large woody debris and large boulders.
12) Restore upstream or headwater attributes to improve downstream conditions.

Priority Geographic Area: GA32, Iskuulpa Creek from Bachelor Canyon to headwaters.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	7	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 100% restoration of water temperature, 100% restoration of fine sediment, 100% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:
Steelhead – from 4.9 to 5.1
And increased abundance for:
Steelhead – from 2,650 to 2,685

Management Strategies in Order of Priority:

6) Fence and plant riparian zones.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*

Priority Geographic Area: GA31, Iskuulpa Creek from mouth to Bachelor Canyon.

Priority Fish Species: Spring Chinook

Limiting Factors in Order of Priority: water temperature, sediment, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP[1]	HP	Not present	Not present	LP
Restoration Ranking	LP	8	Not present	Not present	LP

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)
HP[1] based on high steelhead spawning densities, professional judgment suggests that this GA should receive a high priority for protection for steelhead.

Quantitative Habitat Objectives: 100% restoration of water temperature, 100% restoration of fine sediment, 100% restoration of large wood, and 100% restoration of pools.

Qualitative Artificial Production Objectives: Continue spring Chinook and steelhead hatchery programs to restore and maintain production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Spring Chinook – from 2.4 to 2.7

And increased abundance for:

Spring Chinook – from 498 to 540

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
4) Modify zoning and flood control planning. *Regulatory actions*
5) Place large woody debris and large boulders.
6) Fence and plant riparian zones.
8) Construct pool and riffle habitat using in-stream modifications.
12) Restore upstream or headwater attributes to improve downstream conditions.

Priority Geographic Area: GA12, Birch Creek mouth to forks.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment, habitat quantity, and obstructions.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	LP	Not present
Restoration Ranking	1	Not present	Not present	LP	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,705

Management Strategies in Order of Priority:

13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.
12) Restore upstream or headwater attributes to improve downstream conditions.
11) Modify detrimental land use activities. *Volunteer through PR and education*

10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
4) Modify zoning and flood control planning. *Regulatory actions*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
5) Place large woody debris and large boulders.

Priority Geographic Area: GA15, West Birch Creek from Bear Creek to top of gorge.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment, habitat quantity, and obstructions.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	14	Not present	Not present	Not present	Not present
Restoration Ranking	5	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,674

Management Strategies in Order of Priority:

13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.
12) Restore upstream or headwater attributes to improve downstream conditions.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.

7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
5) Place large woody debris and large boulders.
4) Modify zoning and flood control planning. *Regulatory actions*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA13, West Birch Creek from mouth to Bear Creek.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment, habitat quantity, obstructions, flow and channel stability.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	6	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions, 25% restoration in flow, and 25% restoration in bed scour, 25% restoration in bankfull width, 25% restoration in channel confinement.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,720

Management Strategies in Order of Priority:

13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
12) Restore upstream or headwater attributes to improve downstream conditions.
11) Modify detrimental land use activities. *Volunteer through PR and education*
10) Increase protective status of priority habitats.

6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
5) Place large woody debris and large boulders.
4) Modify zoning and flood control planning. *Regulatory actions*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA14, Bear Creek (tributary of West Birch Creek)

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	12	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperature, 50% restoration of fine sediment, 50% restoration of large wood, and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,666

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
6) Fence and plant riparian zones.
8) Construct pool and riffle habitat using in-stream modifications.
5) Place large woody debris and large boulders.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA19, East Birch Creek from Pearson Creek to headwaters including Pearson Creek.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	9	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of large wood and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – from 4.9 to 5.1

And increased abundance for:

Steelhead – 2,650 to 2,701

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
8) Construct pool and riffle habitat using in-stream modifications.
6) Fence and plant riparian zones.
5) Place large woody debris and large boulders.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA18, East Birch Creek from California Gulch to Pearson Creek.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: sediment and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring	Fall	Coho	Bull Trout

		Chinook	Chinook		
Protection Ranking	11	Not present	Not present	Not present	Not present
Restoration Ranking	11	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of fine sediment, 50% restoration of large wood, and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,665

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
5) Place large woody debris and large boulders.
4) Modify zoning and flood control planning. *Regulatory actions*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA17, East Birch Creek from mouth to California Gulch.

Priority Fish Species: Steelhead

Limiting Factors in Order of Priority: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	10	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of temperature, 25% restoration of fine sediment, 25% restoration of large wood, and 25% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,652

Management Strategies in Order of Priority:

10) Increase protective status of priority habitats.
11) Modify detrimental land use activities. *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
5) Place large woody debris and large boulders.
4) Modify zoning and flood control planning. *Regulatory actions*
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Priority Geographic Area: GA26, Wildhorse Creek mouth to Athena.

Priority Fish Species: Coho

Limiting Factors in Order of Priority: sediment.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	Not present	Not present	HP	Not present
Restoration Ranking	LP	Not present	Not present	4	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of fine sediment.

Qualitative Artificial Production Objectives: Continue steelhead and coho hatchery programs to maintain and enhance production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Coho – no increase

And increased abundance for:

Coho – no increase

Management Strategies in Order of Priority:

11) Modify detrimental land use activities. *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase protective status of priority habitats.
6) Fence and plant riparian zones.
7) Modify channel and flood-plain function.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.

Special Note on Bull Trout and DBTRP

The Draft Revised Bull Trout Recovery Plan (DRBTRP) provides a comprehensive discussion of what is known about bull trout status in the Umatilla Basin as well as discussion on what biologists believe are the primary factors that limit bull trout production in the basin. The DRBTRP lists operation and maintenance of dams and other diversion structures, forest management, livestock grazing, agriculture, agricultural diversions, urbanization, flood control management as land and water management activities that depress bull trout populations. Liberal harvest regulations and fish stocking programs are also implicated in the decline of bull trout. Existing land management facilities and activities that contribute to habitat problems are cited in the DRBTRP as riparian road and railroad construction and use and associated toxic spills, riparian grazing, riparian (and to a lesser extent, upland) timber harvest, recreational and municipal water developments and withdrawals, recreational use of riparian areas, livestock water developments, channel modification for flood control, agricultural development and competition with stocked hatchery rainbow trout. While the preceding limiting factors are listed in the DRBTRP there is no linkage made between biological limiting factors and proposed actions. The DRBTRP does list prioritized actions to address factors listed for bull trout. Part of our management plan objectives is to ensure that the objectives, strategies and priorities of the DRBTRP are coordinate with the objectives, strategies, and priorities outlined in this plan.

5.3.2.2 Willow Creek QHA Management Plan

As indicated in the assessment, redband trout are the only salmonid fish species that reside in Willow Creek. Anadromous fish are blocked from spawning and rearing areas by physical passage barriers and low instream flow. While the focus of habitat restoration and protection actions described below are for redband trout, work needs to be done to assess the feasibility of restoring steelhead to Willow Creek, as they were present

historically. One of the weaknesses of the QHA done for Willow Creek is the lack on information on passage problems. Planners are aware of the location and description of a few of the barriers in the watershed, but many more exist and have not been inventoried for passage. To assess the feasibility of restoring steelhead in the watershed and to better understand the impacts of passage on redband trout, it is highly recommended that a comprehensive inventory of physical passage barriers and flow limitations be conducted. Free passage throughout the Willow Creek watershed would benefit redband trout and provide steelhead the opportunity to utilize the habitat in the basin, to the extent of the current productive capacity of the basin in terms of habitat. Therefore, passage issues, both removal and or modification of upstream barriers and diversion screening should be addressed wherever and whenever the opportunities arise. Inventory and prioritization of passage problems should be done before implementation of improvements to insure that the sites most advantageous to fish restoration are corrected first.

The major limiting factors recognized by QHA for redband trout in Willow Creek and its tributaries are:

- channel form – the condition of the channel in regard to bed scour and artificial confinement and the ability to form "normal" sequences of stream unit types (relates to habitat quantity and channel stability in table 4)
- riparian condition – condition of stream-side vegetation, land form, and subsurface water flow (relates to habitat diversity and water temperature in table 4)
- fine sediment – amount of fine sediment within the stream, especially in spawning riffles
- channel complexity – diversity/complexity of the cannel including amount of large woody debris and braided channels (relates to habitat diversity in table 4)
- pollution – introduction of toxic (acute and chronic) substances into the stream (not addressed in table 4, but addressed by strategies 1, 3, 6, 7, 8, and 9 shown below)
- obstructions – impediments to fish passage (this is addressed below under subheading *Passage Problems)*
- low flow – frequency and magnitude of low flow events

These limiting factors will be addressed with many of the same strategies used to address problems in the Umatilla subbasin geographic areas described above. Specifically the following strategies will be used to address the limiting factors in Willow Creek:

1) Modify zoning and flood control planning. *Regulatory actions*
2) Place large woody debris and large boulders.
3) Fence and plant riparian zones.
4) Modify channel and flood-plain function.
5) Construct pool and riffle habitat using in-stream modifications.
6) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
7) Increase protective status of priority habitats.
8) Modify detrimental land use activities. *Volunteer through PR and education*

9) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
11) Maintain passage efficiency through ongoing O&M activities.

Table 4. Management strategies (by number) and their general type and the limiting factors they address.

Limiting Factor ➔	**Habitat Quantity**	**Habitat Diversity**	**Channel Stability**	**Sediment**	**Low Flow**	**High Temper-ature**	**Passage**
Address Ongoing Causative Factors	1,3,7,8	1,3,6,7,8	1,3,6,7,8	1,3,6,7,8	1,7,8	1,7,8	10,11
Restore Natural Processes	1,3,4,6,7,8, 9,10	1,3,4,6,7,8, 9	1,4,6,7,8, 9	1,3,4,6,7, 8,9	1,3,4,7 ,8,9	1,3,4,7,8, 9	4,9,10, 11
Artificially Enhance Natural Processes	2,3,4,5	2,3,4,5	2,3,4,5	2,3,4,5	3,4	2,3,4,5	4,10,11

5.3.2.3 Areas for Protection

In addition to the restoration priority areas, priority geographic areas for protection were identified in the Assessment section of the subbasin plan. These are the areas that the EDT and QHA analysis suggests would have the most negative impacts on the focal species if they were allowed to degrade further. Within protection areas, actions appropriate to secure protection and/or avoid degradation include 1) conservation easements and other agreements that secure the protection of the stream and riparian zone for a significant period of time, 2) passive restoration actions, and 3) upland practices installed to prevent sediment transport the stream such as CRP, filter strips, sediment retention basins, terracing, etc. Passive restoration actions are defined as a change in land use that allows the stream and riparian zone to recover naturally from past impacts. Passive restoration includes the planting of native vegetation. These are actions that will protect the habitat on which the focal species depend on from degrading any further. In most cases, modest improvements in habitat attributes can be expected from these measures within the 10-15 year planning window. Protective actions are not limited to the priority protection areas, but may also be done in the priority restoration areas. It is the intention of the subbasin plan to limit these actions outside of the priority geographic areas. However, it is also understood and intended that factors limiting fish within a particular geographic area, such as sediment, must be addressed within the geographic area, but also upstream where significant sources exist.

5.3.2.4 Passage Problems

It was deemed necessary to include a special section on passage problems in the Umatilla/Willow subbasin because both EDT and QHA most likely have underestimated the impact of passage problems as a result of little work that has been conducted to determine the severity of known passage problems and to thoroughly survey the subbasin to identify all potential passage problems. Passage problems have been identified as: obstructions, unscreened diversions, and dry stream reaches. These problems and the strategies to address them are outlined below.

Obstructions

Passage obstructions are considered a source of potential immediate mortality to fish. Delay in passage can expose fish to habitat conditions that could be adverse to survival without the opportunity to escape. Delay in passage can also affect the ability of salmonids to successfully spawn. Fish can also be physically injured by inadequate passage facilities increasing exposure to disease or possibly causing direct mortality from the injuries. In the Umatilla basin, 38 barriers are identified in Table 45, Section 3.5.1.2. Not all of the barriers were included in the EDT analysis due to oversight. A complete inventory of passage obstructions has not been completed in non-anadromous waters of the Umatilla/Willow subbasin (McKay, Butter and Willow creeks) even though some barriers are listed in the table below. In general, the EDT analysis under estimates the impact passage obstructions due to lack of complete knowledge and by oversight when the EDT reaches were developed.

Because passage obstructions are likely to cause immediate mortality, they are considered imminent threats and should be addressed wherever they occur. The obstructions listed in Table 45, Section 3.5.1.2 need to be addressed in order of priority, high, medium or low.

McKay, Butter and Willow creeks all historically supported summer steelhead, but steelhead are not currently present due to passage obstructions and low flow problems. McKay Dam, was constructed to store water for irrigation in the 1920's completely blocks upstream passage of fish at RM 6. Until recent years, McKay Creek downstream of McKay Dam was completely de-watered when the reservoir was being filled. Butter Creek has a series of large diversion dams that block upstream passage throughout the basin. In addition, water withdrawal for irrigation is so severe that water flows out of the mouth for only a few days or weeks in any given year. Willow Creek Dam Was constructed in 1980 on Willow Creek just upstream of Heppner (RM 56) for flood control. Willow Creek Dam completely blocks upstream passage of fish. In addition, to Willow Creek Dam, numerous irrigation diversion dams exist throughout the Willow Creek watershed that block passage. The lowest barrier in Willow Creek that blocks anadromous passage exists at RM 11. Steelhead are occasionally seen holding downstream of this dam.

While the general condition of passage in these streams (McKay, Butter and Willow creeks) is understood, a thorough inventory and assessment is needed. This information can be used to pursue passage improvement for redband trout and to assess the feasibility

of restoring passage for anadromous fish. While McKay and Butter creeks were included in the EDT analysis for steelhead to gain an understanding of historic contribution of these streams, there are no current plans to pursue anadromous fish restoration in these streams. Rather, the inventory/assessment of passage and screening should be completed so that future planning efforts can make informed decisions regarding the possibility of anadromous fish restoration. The same is true for Willow Creek.

Water Diversions/Screens

Water diversions that are not screened or are inadequately screened are a well documented source of mortality to salmonids, particularly juveniles. If fish screens do not have the correct flows across the screen or if mesh size is wrong, fish may be impinged on the surface. A water diversion, pump or gravity, that is not screened or has too large mesh may physically divert the fish out of the stream and into a waterway that is not suitable for survival. The installation of screens that meet current NOAA standards is considered a priority for the Umatilla/Willow Subbasin. In addition, projects that move diversions out of salmonid bearing waters do, in effect, remove a potential source of mortality and should also be considered a priority under this management strategy.

In the portion of the Umatilla Basin currently accessible to anadromous fish, there is only one recently identified gravity diversion that is not adequately screened within anadromous fish bearing waters. There has not been an inventory of pump type diversions and it is not known to what degree that pumps are screened. This is a significant data gap and is a high priority. Inventories of diversions have not been conducted in the McKay, Butter and Willow creek watersheds, which currently do not support anadromous fish. This is a significant data gap and should be considered a high priority for protection of resident trout.

Dry Stream Reaches

There are some stream reaches within the Umatilla/Willow subbasin that go dry on a seasonal basis. Some of these may be caused by the natural hydrological regime of the area; others may be anthropogenic in origin. Anthropogenic causes can be water diversions, vegetation removal, soil removal or compaction and alteration of stream/floodplain function , which reduces the infiltration of water in the watershed. While this plan does not advocate the implementation of resources for introducing water to a section of the stream at a time of year when water historically was not present; every effort should be made to return water to areas that are de-watered due to causes mentioned above. Projects could include Phase 3 of the Umatilla Basin Water Exchange Project, water leases or purchases and water conservation. In addition, larger projects that restore the riparian areas or stream/floodplain function should be encouraged.

5.3.2.5 Artificial Production

Background: The Umatilla Basin represents one of several diverse management strategies that tribal and state fisheries managers are implementing in Northeast Oregon. The neighboring John Day Basin is managed for wild fish production only with no hatchery intervention for any species. The Grande Ronde Basin is implementing a spring

chinook hatchery program that is based on genetic conservation of a listed species. In addition there is a segregated harvest mitigation hatchery program for summer steelhead. The Umatilla Basin utilizes a third strategy which uses an integrated hatchery intervention approach to restore or enhance natural production while simultaneously providing harvest opportunity. These integrated hatchery programs typically utilize tributary returns for broodstock which is the case in the Umatilla Subbasin with the exception of coho. The management strategy in the Umatilla provides for much more harvest opportunity than the strategies in neighboring basins.

Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program, is the central production facility for the Umatilla Basin Fish Restoration Program. It is operated by ODFW and currently produces summer steelhead, spring chinook, and subyearling fall chinook salmon. A number of out of basin hatchery facilities also produce fish for the program. Bonneville Hatchery produces yearling fall chinook, Little White Salmon Hatchery produces spring chinook, and Cascade Hatchery and Lower Herman Creek Ponds produce coho salmon.

An integral part of the artificial production program in the basin includes juvenile acclimation and adult holding and spawning satellite facilities. These facilities are operated by CTUIR under the Umatilla Hatchery Satellite Facilities Operation and Maintenance project. There are five acclimation facilities; Bonifer Pond, Minthorn Springs, Imeques C-mem-ini-kem, Thornhollow, and Pendleton. The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, all juvenile salmon and steelhead released into the basin can now be acclimated. There are also three adult facilities associated with the Fish Restoration Program. Holding and spawning of broodstock occurs at Minthorn for summer steelhead, at Three Mile Dam for fall chinook, and at South Fork Walla Walla for spring chinook. Broodstock are collected and transported from the Three Mile Dam Adult Trapping and Handling Complex by the Umatilla River Fish Passage Operations project.

Recommendations: The benefits of passive and active habitat restoration strategies presented in above show that natural production alone (restoration scenario 3) in the Umatilla Basin is not going to achieve the magnitude of total adult objectives listed in past plans. Hatchery intervention will be required in order to meet the return objectives stated in Table 2. Managers will need to continue to refine the EDT outputs to clarify the balance between natural production and artificial production that will meet subbasin adult return expectations and needs.

<u>Recommended Artificial Propagation Strategies and Actions for the Umatilla Program</u>
Strategy 1: Continue to supplement the recently reintroduced spring chinook population with a hatchery program utilizing Carson stock brood returning to the Umatilla River to provide for natural production and harvest.

Action 1.1 Continue releasing 810,000 yearling spring chinook smolts from acclimation facilities into historic spring chinook habitat in the upper Umatilla River Subbasin.

Strategy 2: Continue to supplement the recently reintroduced fall chinook population with a hatchery program utilizing upriver bright stock brood returning to the Umatilla River and Priest Rapids Hatchery to provide for natural production and harvest.

Action 2.1 Continue the John Day Mitigation program release of 480,000 yearling fall chinook smolts from acclimation facilities into historic fall chinook habitat in the mid Umatilla River Subbasin.

Action 2.2 Continue the interim evaluation program release of 600,000 subyearling fall chinook smolts into historic fall chinook habitat in the mid and upper Umatilla River Subbasin. The evaluation program direct stream releases half the production into the mid Umatilla River Subbasin and half the production from acclimation facilities in the upper portion of the subbasin.

Action 2.3 Continue the outplanting of up to 1,000 fall chinook adults from Priest Rapids and/or Ringold hatcheries into historic fall chinook habitat in the mid Umatilla River Subbasin to supplement natural spawning.

Strategy 3: Continue to supplement the recently reintroduced coho population with a hatchery program utilizing early run stock brood from Bonneville Hatchery to provide for natural production and harvest.

Action 3.1 Continue the Mitchell Act program release of 1,500,000 yearling coho smolts from acclimation facilities into historic coho habitat in the mid-Umatilla River Subbasin.

Strategy 4: Continue to supplement the indigenous summer steelhead population with a hatchery program utilizing native stock brood returning to the Umatilla River to enhance natural production and provide harvest opportunity.

Action 4.1 Continue releasing of 150,000 yearling summer steelhead smolts from acclimation facilities into historic summer steelhead habitat in the mid-to-upper Umatilla River Subbasin.

5.3.2.6 Taxa of Interest

Pacific Lamprey

A Pacific lamprey restoration plan for the Umatilla Basin was developed by CTUIR in 1999. Since then, adult Pacific lamprey collected from the John Day River and the mainstem Columbia River been used to reestablish larval abundance in the Umatilla

River by outplanting them in prime natural production locations close to spawning time. The goal is to outplant 500 adults annually into the Umatilla River to begin restoration efforts. Successful spawning and juvenile production is being documented by CTUIR. Continued evaluation of adult outplanting and habitat enhancement actions will be necessary to determine and ensure success of restoration efforts.

The numerous habitat enhancement actions ongoing and proposed for salmonids are expected to benefit Pacific lamprey. A serious habitat limitation still however exists in the lower Umatilla River below Threemile Dam. Current flow enhancement programs did not initially envision adult lamprey migration needs and flows in July and the first half of August are insufficient to provide for upstream migration of lamprey. This is a period when peak migration is occurring in the mainstem Columbia River and lamprey are likely now attempting to enter the Umatilla River.

Recommended Pacific lamprey strategies and actions for the Umatilla Program
Strategy 1: Implement the Pacific lamprey restoration plan for the Umatilla Basin.

Action 1.1 Continue outplanting of adults as detailed in the Umatilla River Basin Pacific Lamprey Restoration Plan (CTUIR 1999).

Action 1.2 Determine reproductive success of adult outplants.

Action 1.3 Monitor for increases in larval abundance, juvenile outmigration and adult returns.

Action 1.4 Operate Umatilla Basin Project phase I pumps to provide instream flows for adult lamprey migration in the Umatilla River below Threemile Dam throughout the summer.

Freshwater Mussels

The CTUIR initiated a freshwater mussel research and restoration project in the Umatilla Basin beginning in 2003.

Recommended freshwater shellfish strategies and actions for the Umatilla Program
Strategy 1: Conduct initial investigations and develop a restoration plan for freshwater shellfish in the Umatilla River Basin (CTUIR).

Action 1.1 Conduct qualitative and quantitative surveys to assess shellfish populations.

Action 1.2 Survey genetic variation within and among Umatilla and selected Columbia River subbasins.

Action 1.3 Determine macrohabitat and physiochemical factors controlling distribution and abundance of shellfish.

Action 1.4 Determine the role of fish communities controlling distribution and abundance of shellfish.

Action 1.5 Develop and implement recovery plan for shellfish in the Umatilla Basin.

5.4 Terrestrial Wildlife Biological Objectives and Strategies

5.4.1 Wildlife Approach and Methods

As described in Section 5.1, the development of objectives and strategies for the terrestrial wildlife management plan was driven by the vision for the subbasin (Section 5.1), the current biological and ecological conditions, and the economic and social realities described in the assessment (Section 3.0). The biological objectives for wildlife describe the physical and biological changes within the subbasin needed to achieve the vision. For wildlife, these objectives (and their associated strategies) are primarily described in terms of changes needed in focal habitats, rather than in population-related attributes of focal or obligate species. Focal species-centered objectives and strategies are not appropriate for wildlife because of the lack of adequate information available on focal species needed to form biological objectives. Instead, the wildlife plan is composed primarily of habitat-centered objectives and strategies that focus on the ecological function of the habitat (i.e., its ability to provide the key environmental correlates identified for the focal and other obligate species in Section 3.4.2). Thus, the primary role of focal species in forming the management plan is in the use of their needs to define functional habitat and, in some cases, in the research, monitoring, and evaluation component of this plan.

Wildlife objectives and strategies were developed by the Umatilla/Willow Subbasin Terrestrial Wildlife Workgroup. See Section 2.2 for a list of members of that team. An early draft set of objectives and strategies for three habitat types (ponderosa pine, shrub-steppe, and grasslands) was presented at a public meeting on May 6, 2004 and suggestions provided at that meeting were used to revise the objectives and strategies.

Objectives and associated strategies were developed for each habitat, with the exception of General Objective 1, which applies to all eight focal habitats. This objective, which is not strictly a biological objective, was developed in response to data gaps that became apparent when conducting the subbasin assessment. Addressing these data gaps was deemed to be a high priority because the lack of knowledge presented a substantial obstacle in developing firm quantitative biological objectives for many habitats. Thus, completing General Objective 1 will be instrumental in implementing effective adaptive management in the subbasin for terrestrial wildlife species.

Biological objectives for each focal habitat type generally fall into one of three categories: protection, enhancement, and conversion. Protection objectives relate to increasing the legal or administrative protection of the habitat. Protected status in this plan corresponds to the definitions used for gap analyses generated by IBIS. Those definitions (Table 5) are consistent with four categories described in the USGS Gap Analysis Program Handbook (personal communication: C. Langhoff, NWHI, April 2004). It is important to note that protection, as used in this plan, does not preclude active management. In fact, the higher the protection, the more likely it is that management would prohibit activities that degrade or destroy habitat and would encourage practices that would mimic natural disturbances. Thus, there may be some overlap between objectives related to protection and those that address enhancement. However, enhancement objectives focus exclusively on maintaining or increasing the ecological function of focal habitats, especially with respect to focal and other obligate species. Finally, objectives related to conversion or restoration seek to increase the amount of focal habitat in the subbasin by converting it or restoring it from some other habitat type.

Table 5. Definitions used for gap analyses generated by IBIS. Definitions are from the Gap Analysis Program Handbook (http://www.gap.uidaho.edu/handbook/Stewardship/) and are derived from Scott et al. 1993, Edwards et al. 1994, and Crist et al. 1996.

Protected Status	**Definition**
High	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Medium	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Low	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
None	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Where possible, objectives within each habitat type are prioritized. A biological objective priority is listed under each objective, with "1" being the highest priority. When objectives are equally important or cannot be prioritized to a greater degree because of a lack of information, they receive the same priority ranking. In addition, each set of strategies associated with an objective is also prioritized to the extent possible, using the same notation described for objectives.

One of the primary considerations in ranking objectives and strategies is the Council's directive to "build from strength" (i.e., efforts to improve wildlife habitat begins with protecting and supporting the most productive habitat first). As such, general prioritization rules used include:

1) Increase protection of highest quality land first (to some minimal protection status), then concentrate on lower quality land.
2) Strategies that provide long-term protection will be a higher priority than strategies that provide shorter-term protection, all other factors being equal.
3) Strategies that meet multiple objectives are higher priority than strategies that benefit a limited number of objectives.
4) Strategies that provide benefits for aquatic and terrestrial focal species will be higher priority than strategies that only benefit terrestrial wildlife.

Although multiple alternative strategies were considered for every objective, strategies rejected are not specifically listed under each objective because they generally fell into three categories: 1) strategies that were not consistent with the economic, political, or social realities of the subbasin (as outlined in Section 3.1), 2) strategies that were believed to have a low chance of success, and/or 3) strategies that were not as efficient at producing results as the strategies eventually selected. For example, for shrub-steppe and grassland habitats, strategies specifically target low-yielding agricultural land for conversion through enrollment in cooperative programs and other methods rather than targeting agricultural lands that may include high-yield, economically valuable croplands. Subbasin planners believe both strategies are essentially equally as effective, and by focusing on low-yielding agricultural lands, subbasin planners take into account the economic, social, and political realities of the subbasin, which makes the strategy more likely to be implemented.

As discussed above, adaptive management plays a central role in the Umatilla/Willow wildlife plan, and is, in fact, built into the objectives. The completion of General Objective 1 will provide important information that can be used to refine and modify the biological objectives and strategies for each focal habitat, as needed. Additional information gained though research, monitoring, and evaluation (Section 5.5) will also be used to continually update the plan throughout its life.

5.4.2 Wildlife Objectives and Strategies

This section presents the biological objectives and strategies for each habitat type, following a brief review of the limiting factors, key environmental correlates, and an overview of the objectives for each habitat type. A justification section is associated with

each biological objective and explains why a particular target was chosen (or why it was impossible to generate a target) and provides a rationale for prioritization. In addition, the justification describes the information from the subbasin assessment that was used to support the objectives and strategies. It should be noted that while the appropriate section of the assessment is cited, literature citations that appear in the assessment are not repeated in the management plan for the sake of brevity. Table 6 provides an overview of General Objective 1 and Tables 7-14 summarize the biological objectives and strategies for each focal habitat.

Table 6. Summary of General Objective 1, which applies to all eight focal habitat types in the Umatilla/Willow subbasin. See text for more description and justification.

General Objective 1: Complete a comprehensive review by 2007 of focal habitat types and their focal and obligate species in the Umatilla/Willow subbasin that can be used to guide habitat protection, enhancement, and conversion/restoration activities.	**Objective Priority:** 1
Strategy 1: Refine and field-truth data on the location, size, and spatial distribution of each of the focal habitat types existing in the subbasin. ***Strategy Priority:*** 1 **Strategy 2:** For each focal habitat type, determine the quality of all existing habitat in the subbasin and its ecological function as related to the habitat needs of selected focal species and other obligate species. ***Strategy Priority:*** 1 **Strategy 3:** Refine and update currently available data on the protected status of each focal habitat. ***Strategy Priority:*** 1 **Strategy 4:** Increase knowledge about focal and obligate species distribution, status, habitat needs, limiting factors, and general ecology. ***Strategy Priority:*** 1 **Strategy 5:** Identify areas not currently supporting focal habitats that, if converted to the focal habitat, would enlarge remnant size or enhance connectivity between two or more extant remnants. ***Strategy Priority:*** 1 **Strategy 6:** Identify areas that are spatially isolated from extant remnants of focal habitat that could be rehabilitated to provide new reservoir habitats for selected focal species and other obligate species. ***Strategy Priority:*** 1 **Strategy 7:** Use data obtained by Strategies 1-6 to create GIS overlays with areas prioritized for protection, enhancement, or conversion/restoration for each focal habitat type. ***Strategy Priority:*** 2 **Strategy 8:** Use adaptive management to refine or modify protection, enhancement, and conversion objectives for focal habitat types based on information provided by the completion of Strategies 1-7 ***Strategy Priority:*** 2	

Table 7. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for mixed conifer forest habitat in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

MIXED CONIFER	
Focal Species: Pileated Woodpecker	
Limiting Factors: harvest, altered fire regimes, ponderosa pine encroachment, development, insect outbreaks, exotic plant invasion	
Biological Objective 1: Protect, at a medium or high level, all mature mixed conifer forest stands in the subbasin by 2020.	**Objective Priority:** 1
Strategy 1: Work with tribal and public land managers to administratively or legislatively protect to the desired level all mature conifer forest under their jurisdiction. ***Strategy Priority:*** 1 **Strategy 2:** Protect mature conifer forest habitat on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 50% of the degraded mixed conifer habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Pileated Woodpecker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 2 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce negative impacts on vegetation. ***Strategy Priority:*** 2 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of mixed conifer habitat. ***Strategy Priority:*** 1	

Table 8. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for ponderosa pine habitat in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

PONDEROSA PINE	
Focal Species: White-headed Woodpecker	
Limiting Factors: fire suppression/fir invasion, stand-replacing fire, harvest, exotic weed invasion, livestock grazing	
Biological Objective 1: Protect, at a medium or high level, all old growth ponderosa pine in the subbasin by 2020.	**Objective Priority:** 1
Strategy 2: Protect old growth ponderosa pine habitat on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 1:** Work with tribal and public land managers to administratively or legislatively protect to the desired level all old growth ponderosa pine forest under their jurisdiction. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 50% of the degraded or converted ponderosa pine habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the White-headed Woodpecker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 2 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce negative impact on vegetation. ***Strategy Priority:*** 2 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of ponderosa pine dominated habitat. ***Strategy Priority:*** 1	

Table 9. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for quaking aspen forest in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

QUAKING ASPEN FOREST	
Focal Species: Red-naped Sapsucker	
Limiting Factors: Intensive grazing by livestock and native ungulates, fire suppression, invasion of coniferous species	
Biological Objective 1: Protect, at a medium or high level, all aspen habitat in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Work with tribal and public land managers to administratively or legislatively protect to the desired level all quaking aspen forest under their jurisdiction. ***Strategy Priority:*** 1 **Strategy 2:** Protect quaking aspen forest on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance all quaking aspen forest by 2015.	**Objective Priority:** 1
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Red-naped Sapsucker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices that prevent the recruitment of aspen. ***Strategy Priority:*** 1 **Strategy 3:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 1	
Biological Objective 3: Convert a minimum of 100 acres of former aspen forest habitat in the Umatilla/Willow subbasin back to aspen forest by 2020.	**Objective Priority:** 2
Strategy 1: Identify areas, that if converted back to aspen forest, would increase patch size and/or decrease the isolation of remnant patches of aspen forest. ***Strategy Priority:*** 1 **Strategy 2:** Use cooperative habitat programs, public education, and technical silvicultural support to convert these areas to aspen forest. ***Strategy Priority:*** 2	

Table 10. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for western juniper woodlands. See text for more description and for justification of prioritization and selected targets.

WESTERN JUNIPER WOODLANDS	
Focal Species: Ferruginous Hawk	
Limiting Factors: agricultural conversion, altered fire regimes, overgrazing, exotic plant invasions	
Biological Objective 1: Protect, at a medium or high level, all mature juniper in the subbasin by 2020.	**Objective Priority:** 1
Strategy 1: Protect isolated mature juniper trees and stands on private lands in shrub-steppe and grassland habitats to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers to administratively or legislatively protect to the desired level all isolated mature juniper trees and stands in shrub-steppe and grassland habitats. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 25% of degraded juniper habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Ferruginous Hawk, their prey, and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 1 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce the negative impact on mature juniper and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 1 **Strategy 5:** In conjunction with Strategies 1-4, educate the public about the ecological importance of mature juniper habitat to increase local support of enhancement projects. ***Strategy Priority:*** 1	

Table 11. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for shrub-steppe habitat. See text for more description and for justification of prioritization and selected targets. The "five critical areas" are areas in the Umatilla/Willow subbasin (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon) that contain not only most of the existing low-elevation shrub-steppe habitat in the subbasin, but also the largest and highest quality remnants of that habitat.

SHRUB-STEPPE HABITAT	
Focal Species: Sage Sparrow	
Limiting Factors: agricultural conversion, exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, overgrazing by livestock	
Biological Objective 1: Protect, at a medium or high level, all shrub-steppe habitat in the five critical areas by 2010.	**Objective Priority:** 1
Strategy 1: Work with public land and TNC managers to administratively or legislatively protect all shrub-steppe in the five critical areas, as needed. ***Strategy Priority:*** 1 **Strategy 2:** Protect shrub-steppe habitat on private lands in the five critical areas to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Maintain and **enhance** all high-quality shrub-steppe habitat in the five critical areas by 2010.	**Objective Priority:** 1
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Where ecologically appropriate, seed shrub-steppe areas. ***Strategy Priority:*** 2 **Strategy 4:** Where ecologically appropriate, increase bare ground. ***Strategy Priority:*** 2	
Biological Objective 3: Enhance all degraded shrub-steppe habitat in the five critical areas by 2020.	**Objective Priority:** 2
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of the site and employ practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with Strategies 1-3, provide aid to private landowners in enhancing degraded shrub-steppe with management, technical, and financial assistance. ***Strategy Priority:*** 1	

Table 11 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for shrub-steppe habitat. The "five critical areas" are areas in the Umatilla/Willow subbasin (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon) that contain not only most of the existing low-elevation shrub-steppe habitat in the subbasin, but also the largest and highest quality remnants of that habitat.

SHRUB-STEPPE HABITAT (CONTINUED)	
Biological Objective 4: Protect, at a medium or high level, up to 50,000 acres of shrub-steppe outside of the five critical areas by 2020.	**Objective Priority:** 3
Strategy 1: Protect habitat on private lands outside of the five critical areas to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers to administratively or legislatively protect shrub-steppe habitat outside of the five critical areas, as needed. ***Strategy Priority:*** 2	
Biological Objective 5: Enhance 25,000 acres of degraded shrub-steppe habitat targeted for protection in Objective 4 by 2020.	**Objective Priority:** 3
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of the site and employ practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with Strategies 1-3, aid private land owners in enhancing degraded shrub-steppe with management, technical, and financial assistance. ***Strategy Priority:*** 1	
Biological Objective 6: Convert 25,000 acres of low-yielding agricultural land or CRP lands into functional shrub-steppe habitat by 2020.	**Objective Priority:** 3
Strategy 1: Encourage the conversion of lands currently enrolled in CRP into shrub-steppe habitat by providing technical assistance and financial incentives, within the conditions allowed under CRP contracts. ***Strategy Priority:*** 1 **Strategy 2:** Identify and prioritize agricultural lands that could increase shrub-steppe remnant size or establish connectivity between remnants, and work to 1) enroll them in conservation programs (such as CRP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of sites to be converted and conduct practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** Encourage Congress and NRCS to alter CRP requirements in ways that favor the conversion and maintenance of CRP lands into shrub-steppe habitats. ***Strategy Priority:*** 3	

Table 12. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for grasslands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

INTERIOR GRASSLANDS	
Focal Species: Grasshopper Sparrow	
Limiting Factors: agricultural conversion, exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, altered fire regimes.	
Biological Objective 1: Protect, at a medium or high level, 20,000-40,000 acres of grassland habitat in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect functional grasslands on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with tribal and public land managers who have native or ecologically functional interior grasslands under their jurisdiction to administratively or legislatively increase protected status to the desired level. ***Strategy Priority:*** 2	
Biological Objective 2: Maintain and/or **enhance** the 20,000-40,000 acres of grassland habitat targeted for protection in Objective 1 by 2020.	**Objective Priority:** 1
Strategy 1: Support the full funding and implementation of integrated weed management plans in the subbasin. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce negative impacts on grassland vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Reestablish native plant communities where practical and cost effective. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with strategies 1-3, aid private landowners in maintaining and enhancing grasslands with management, technical, and financial assistance. ***Strategy Priority:*** 1	
Biological Objective 3: Enhance the ecological function and duration of benefits of over 200,000 acres of grassland habitat currently enrolled in CRP, EQIP, and WHIP in the subbasin as well as lands that will be enrolled in the future.	**Objective Priority:** 2
Strategy 1: Provide additional technical assistance and financial incentives to actively manage grasslands enrolled in CRP, EQIP, or WHIP to meet goals beyond the basic requirements of those programs. ***Strategy Priority:*** 1 **Strategy 2:** Work with the NRCS to increase the minimum conservation practice requirements of CRP. ***Strategy Priority:*** **2** **Strategy 3:** Work with the NRCS and other public policy makers to develop recommendations to the U.S. Congress that they modify the Farm Bill so that CRP contracts are extended from 10 to 20 years. ***Strategy Priority:*** 2	

Table 12 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for grasslands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

INTERIOR GRASSLANDS (CONTINUED)	
Biological Objective 4: Convert 15,000 acres of non-native annual grassland or low yielding dryland agricultural land not currently enrolled in conservation programs to native grasslands by 2020 and work to provide long-lasting protection to those converted grasslands.	**Objective Priority:** 3
Strategy 1: Identify and prioritize agricultural lands that could increase existing grassland remnants or establish connectivity between grassland remnants, and work to 1) enroll them in conservation programs, 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with the NRCS to alter the CRP bid point allocation to reflect ecological need as assessed in the habitat mapping conducted in General Objective 1. ***Strategy Priority:*** 2	

Table 13. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for herbaceous wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

HERBACEOUS WETLANDS	
Focal Species: Columbia spotted frog	
Limiting Factors: habitat conversion, draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant invasions, livestock grazing, exotic amphibians (primarily the bullfrog)	
Biological Objective 1: Protect, at a medium or high level, all herbaceous wetlands in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect herbaceous wetlands on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. In addition, promote the use of existing federal and state incentive programs (e.g., WRP) to protect herbaceous wetlands ***Strategy Priority:*** 1 **Strategy 2:** Work with tribal and public land managers to administratively or legislatively increase protected status of all herbaceous wetlands under their jurisdiction. ***Strategy Priority:*** 2 **Strategy 3:** In conjunction with Strategies 1 and 2, educate private landowners and the general public about the ecological importance of herbaceous wetlands and existing regulations that protect wetlands. ***Strategy Priority:*** 1	
Biological Objective 2: Enhance and/or **maintain** all existing herbaceous wetlands in the subbasin by 2015.	**Objective Priority:** 1
Strategy 1: Restore natural hydrologic function where it has been disturbed by agricultural or developmental activities. ***Strategy Priority:*** 1 **Strategy 2:** Develop and implement techniques to reduce or eliminate bullfrogs. ***Strategy Priority:*** 1 **Strategy 3:** Reduce exotic plant species encroachment into remaining wetlands. ***Strategy Priority:*** 1 **Strategy 4:** Apply techniques to mimic natural disturbance regimes necessary to maintain native wetland vegetation and function. ***Strategy Priority:*** 1 **Strategy 5:** Enhance degraded, naturally-occurring wetland habitat on public or private land using moist soil techniques to establish permanent open-water refuge with a minimum water level as habitat for Columbia spotted frogs. ***Strategy Priority:*** 1	

Table 13 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for herbaceous wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

HERBACEOUS WETLANDS (CONTINUED)	
Biological Objective 3: Convert or create 1,000 acres of additional herbaceous wetland habitat in the subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Restore wetland habitat in areas identified as formerly having naturally-occurring wetland habitat. ***Strategy Priority:*** 1 **Strategy 2:** Create new wetland habitat in association with or connected to extant naturally-occurring wetlands in the subbasin. ***Strategy Priority:*** 2 **Strategy 3:** In conjunction with Strategies 1 and 2, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

Table 14. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for riparian wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

RIPARIAN WETLANDS	
Focal Species: Great Blue Heron, Yellow Warbler, and the American beaver	
Limiting Factors: agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, hydropower, transportation corridors, recreational activities	
Biological Objective 1: Protect, at a medium or high level, all remaining riparian wetlands in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect riparian wetlands on private lands to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., CREP, EQIP, WRP, WHIP) to protect riparian areas. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers who have riparian wetlands under their jurisdiction to ensure that those lands are administratively or legally protected to the desired level. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance and maintain all existing riparian wetlands in the subbasin by 2015.	**Objective Priority:** 1
Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and other riparian vegetation. ***Strategy Priority:*** 1 **Strategy 2:** Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1 **Strategy 3:** Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1 **Strategy 4:** Where necessary, plant native vegetation in areas where progress towards Strategies 1 and 2 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

Table 14 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for riparian wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

RIPARIAN WETLANDS (CONTINUED)	
Biological Objective 3: Convert or restore 2,000 acres of non-functioning riparian area into ecologically functional riparian habitat by 2020.	**Objective Priority:** 2
Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and/or other riparian vegetation. ***Strategy Priority:*** 1 **Strategy 2:** Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1 **Strategy 3:** Where necessary, plant native hydrophilic vegetation in areas where progress towards Strategies 1 and 2 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2 **Strategy 4:** Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

GENERAL OBJECTIVE 1

The first objective (General Objective 1) in the terrestrial wildlife portion of the plan is a general objective that encompasses all eight focal habitat types in the Umatilla/Willow subbasin. Although not a biological objective in the sense of providing a quantitative expression of biological and physical changes needed to address limiting factors, General Objective 1 is included in the terrestrial wildlife management plan because it forms the most necessary and integral step towards achieving the remaining objectives for each focal habitat type.

General Objective 1: Complete a comprehensive review by 2007 of each of the eight focal habitat types in the Umatilla/Willow subbasin that can be used to guide habitat protection, enhancement, and restoration/conversion activities. Knowledge generated can be used to refine objectives, strategies, and prioritizations via adaptive management.

Strategy 1: Refine and field-truth data on the location, size, and spatial distribution of each of the focal habitat types existing in the subbasin. ***Strategy Priority:*** 1

Strategy 2: For each focal habitat type, determine the quality of all existing habitat in the subbasin and its ecological function as related to the habitat needs of selected focal species and other obligate species (see Table 6). ***Strategy Priority:*** 1

Strategy 3: Refine and update currently available data (such as that provided by IBIS) on the protected status of each focal habitat. ***Strategy Priority:*** 1

Strategy 4: Increase knowledge about focal and obligate species distribution, status, habitat needs, limiting factors, and general ecology. ***Strategy Priority:*** 1

Strategy 5: Identify areas not currently supporting focal habitats that, if converted to the focal habitat, would enlarge remnant size or enhance connectivity between two or more extant remnants. ***Strategy Priority:*** 1

Strategy 6: Identify areas that are spatially isolated from extant remnants of focal habitat that could be rehabilitated to provide new reservoir habitats for selected focal species and other obligate species. ***Strategy Priority:*** 1

Strategy 7: Use data obtained by Strategies 1-6 to create GIS overlays with areas prioritized for protection, enhancement, or restoration for each focal habitat type. ***Strategy Priority:*** 2

Strategy 8: Use adaptive management to refine or modify protection, enhancement, and conversion objectives for focal habitat types based on information generated from the completion of Strategies 1-7. ***Strategy Priority:*** 2

Justification: Section 3.2.4.2 in the assessment describes the limitations of data concerning focal habitats in the subbasin. The most obvious of these limitations is the lack of information on the quality of most focal habitat and its ecological function with regard to the selected focal species and other obligate species. The limitations of current data on protected status of each habitat type are also discussed in Section 3.2.4.2. Because of its importance in guiding the biological objectives for each focal habitat type, General Objective 1 is a short-term objective with an anticipated date of completion of 2007. However, it should be noted that taking action on strategies associated with other objectives should not wait until the completion of General Objective 1 because much can be done with the current state of knowledge. Completing General Objective 1 will enhance existing efforts by providing the necessary information to form an integrated plan for each wildlife habitat that will be guided not only by opportunities that present themselves but also by a more holistic understanding of the protected status and condition of each habitat in the subbasin. Strategies 1-6 are of the highest priority because Strategies 7 and 8 are dependent upon their completion.

MIXED CONIFER FOREST

Limiting Factors: Although the area of mixed conifer forest in the Umatilla/Willow subbasin appears to have doubled since c. 1850, the quality of this habitat is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion (see Section 3.5.2). These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-tolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees. All of these factors are believed to be responsible for significant reductions in the Pileated Woodpecker and other mixed conifer obligate species.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for the Pileated Woodpecker and other mixed conifer obligates are:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and a high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and an understory of smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 2,000 acres

Overview of Objectives: The objectives for mixed conifer habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – mature mixed conifer stands. Although the amount of mature forest that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of degraded mixed conifer habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the Pileated Woodpecker and other obligate species.

Biological Objective 1: Increase the protected status of all mature (i.e., dominant trees from 100-300 years old) mixed conifer forest stands in the subbasin with no or low level protection to medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to focal and other obligate species and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Work with tribal and public land managers who have mature mixed conifer forest under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 1
>
> **Strategy 2:** Protect existing mature mixed conifer forest on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 2
>
> **Justification:** This objective cannot be quantified until the completion of General Objective 1 because it is not known how much mature mixed conifer forest exists in the subbasin, and how much of it is currently protected. As discussed in Section 3.2.4.2, less than 10% (<14,000 acres) of all mixed conifer forest in the subbasin is under medium or high level protection. All mature mixed conifer forest is targeted because 1) most (> 70%) mixed conifer is publicly owned, and therefore may be relatively easy to protect, 2) managers suspect that the amount of mature mixed conifer in the subbasin is small, 3) mature mixed conifer provides the habitat characteristics needed by the Pileated Woodpecker and other obligate mixed conifer forest species, and 4) mature forest dominated by trees at least 100 years old cannot be quickly replaced once destroyed. If information provided by further study, including the completion of General Objective 1, shows that this target is unrealistically high, then it will be decreased as necessary. This biological objective is the highest priority for mixed conifer habitat because it "builds from strength" in the sense of protecting the most productive habitat first. Within this objective, Strategy 1 is a higher priority than

Strategy 2 because most mixed conifer is under the control of government agencies (see Section 3.2.4.2).

Biological Objective 2: Enhance up to 50% of degraded mixed conifer habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that 1) are currently at high or medium level protection, 2) are large (>2,000 acres, if possible) and contiguous, 3) have the potential to restore connectivity, 4) add to existing protected areas, and/or 5) allow for the introduction of fire management strategies.
Objective Priority: 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to functional habitat for the Pileated Woodpecker and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 2

Strategy 3: Modify livestock grazing practices, as necessary, to protect the recruitment of shrubs, saplings, and understory vegetation***.*** ***Strategy Priority:*** 2

Strategy 4: Ensure that natural ecological processes that are necessary for a functional habitat for focal and obligate species, such as fire and the retention of prone woody material, are allowed to proceed. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of mixed conifer habitat. ***Strategy Priority:*** 1

Justification: A target of up to 50% was selected because managers assume that most of the more than 160,000 acres of mixed conifer in the subbasin is degraded at some level, and improving habitat on 80,000 acres by 2020 seems to be within the realm of possibility, if adequate funding is provided. Targeting tracts greater than 2,000 acres was selected to maximize the likelihood of meeting the requirements of Pileated Woodpeckers (see Section 3.2.4.2). This objective is ranked second to Objective 1 because it builds outward from old growth areas protected through Objective 1 to enhance, restore and build connectivity in remaining mixed conifer habitat. Strategy 1 is one of the highest priorities for this objective because it is believed to be an efficient way to address one of the most limiting factors in this habitat type -- altered fire regimes. Strategy 4 also addresses this limiting factor, but may be more difficult to implement with regard to fire. Strategy 5 is also of high priority because cooperative programs and public education are likely to make Strategies 1-4 more successful.

PONDEROSA PINE FOREST

Limiting Factors: Although the area of ponderosa pine forest in the Umatilla/Willow subbasin appears to have increased by over 10% since c. 1850, the quality of this habitat is believed to have declined due to mixed forest encroachment, altered fire regimes and stand-replacing fires, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities (see Section 3.5.2). Two of the major factors responsible for habitat loss and degradation of functional ponderosa pine forest are harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees. All of these factors are believed to have contributed to significant declines in the White-headed Woodpecker and other ponderosa pine obligate species.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional ponderosa pine habitat are:

- large patches (> 800 acres) of open mature/old growth-dominated ponderosa pine
- canopy closures between 30-50%
- 2.5 snags per acre, with each snag > 24 inches dbh
- sparse understory vegetation

Overview of Objectives: The objectives for ponderosa pine habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – old growth ponderosa pine. Although the amount of old growth forest that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of degraded ponderosa pine habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the White-headed Woodpecker and other obligate species.

Biological Objective 1: Increase the protective status of all old growth ponderosa pine habitat with mature, seed-producing trees in the subbasin with no or low level protection to medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the White-headed Woodpecker and other obligate species and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Protect existing old growth ponderosa pine on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 1

Strategy 2: Work with tribal and public land managers who have old growth ponderosa pine habitat under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2

Justification: This objective cannot be quantified until the completion of General Objective 1 because it is not known how much old growth ponderosa pine currently exists in the subbasin, and how much of it is currently protected. As discussed in Section 3.2.4.2, only 2% of all ponderosa pine in the subbasin is believed to be under high or medium level protection. All old growth is targeted for protection because 1) managers suspect that the amount of old growth remaining in the subbasin is small, 2) old growth ponderosa pine is the only stage that provides the habitat characteristics needed by the White-headed Woodpecker and other obligate ponderosa-pine species, and 3) old growth forest cannot be quickly replaced once destroyed. This biological objective is the highest priority for ponderosa pine habitat because it "builds from strength" in the sense of protecting the most productive habitat first. Within this objective, Strategy 1 is a higher priority than Strategy 2 because most ponderosa pine is privately owned (see Section 3.2.4.2).

Biological Objective 2: Enhance up to 50% of degraded or converted ponderosa pine habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that are 1) currently at high or medium level protection, 2) large (> 800 acres, if possible) and contiguous, 3) have the potential to restore connectivity, 4) add to existing protected areas, and/or 5) allow for the introduction of fire management strategies.
Objective Priority: 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to and maintain functional habitat for the White-headed Woodpecker and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 2

Strategy 3: Modify livestock grazing practices, as necessary, to protect the recruitment of shrubs, saplings, and understory vegetation***. Strategy Priority:*** 2

Strategy 4: Ensure that natural ecological processes that are necessary for a functional habitat for focal and obligate species, such as fire and the retention of prone woody material, are allowed to proceed. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of ponderosa pine dominated habitat. ***Strategy Priority:*** 1

Justification: A target of up to 50% was selected because managers assume that most of the more than 160,000 acres of ponderosa pine in the subbasin is degraded at some level, and improving habitat on 80,000 acres by 2020 seems within the realm of possibility, if adequate funding is provided. Targeting tracts greater than 800 acres was selected to maximize the likelihood of meeting the requirements of the White-headed Woodpecker (see Section 3.2.4.2). This objective is ranked second to Objective 1 because it builds outward from old growth areas protected through Objective 1 to enhance, restore and build connectivity in remaining ponderosa pine habitat. Strategy 1 is one of the highest priorities for this objective because it is believed to be an efficient way to address one of the most limiting factors in this habitat type -- altered fire regimes and the invasion of mixed conifer. Strategy 4 also addresses this limiting factor, but may be more difficult to implement with regard to fire. Strategy 5 is also of high priority because cooperative programs and public education are likely to make Strategies 1-4 more successful.

QUAKING ASPEN FOREST

Limiting Factors: Quaking aspen habitat is extremely limited in the Umatilla/Willow subbasin and is believed to be greatly reduced from historical conditions (see Section 3.2.4). As indicated in the assessment (see Section 3.5.2), the major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species. These factors are believed to be responsible for significant reductions in Red-naped Sapsucker and other species highly dependent on quaking aspen forest.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional aspen habitat are:

- > 1.5 snags per acre
- trees > 39 feet in height and > 10 inch dbh
- patch size > 10 acres
- an abundance of trees with shelf fungus

Overview of Objectives: The objectives for quaking aspen forest habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks

to roughly double the total amount of quaking aspen forest in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Red-naped Sapsucker and other obligate wildlife species.

Biological Objective 1: Increase the protected status of all aspen habitat in the subbasin with no or low level protection to medium or high level protection by 2010.
Objective Priority: 1

> **Strategy 1:** Work with tribal and public land managers who have quaking aspen habitat under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 1
>
> **Strategy 2:** Protect existing quaking aspen habitat on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 2
>
> **Justification:** This relatively short-term objective cannot be quantified until the completion of General Objective 1 because it is not known how much quaking aspen habitat exists in the subbasin and how much of it is currently protected. As discussed in Section 3.2.4.2, the habitat is believed to be extremely rare in the subbasin; IBIS reports only 46 acres for the Umatilla/Willow subbasin and data generated by CTUIR scientists suggest that an additional 32 acres exists on CTUIR land. Thus, all quaking aspen is targeted for protection by 2010 because 1) it is very rare, 2) this forest type has experienced a significant reduction across the western United States thereby making each aspen stand important to maintaining the genetic integrity of the species, and 3) it provides habitat characteristics preferred by the Red-naped Sapsucker and other obligate aspen forest species. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining aspen habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing aspen is believed to occur on tribal or government controlled land.

Biological Objective 2: Enhance all aspen forest in the Umatilla/Willow subbasin by 2015.
Objective Priority: 1

> **Strategy 1:** Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to functional habitat for the Red-naped Sapsucker and other obligate species. ***Strategy Priority:*** 1
>
> **Strategy 2:** Modify livestock grazing practices that prevent the recruitment of aspen. ***Strategy Priority:*** 1

Strategy 3: Ensure that natural ecological processes, such as fire and the retention of decaying woody material, that are necessary for a functional habitat for the Red-naped Sapsucker and other aspen obligate species are allowed to proceed. ***Strategy Priority:*** 1

Justification: Because of the rarity and importance of aspen habitat in the subbasin, all aspen forest is targeted for enhancement by 2015 with the assumption that all of the habitat is degraded at some level. All strategies are of equal priority because all are considered to be necessary in addressing limiting factors for aspen habitat and individual aspen stands may vary with regard to which limiting factor is most problematic.

Biological Objective 3: Convert a minimum of 100 acres of former aspen forest in the Umatilla/Willow subbasin back into aspen forest habitat by 2020. Conversion of tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas will be the highest priority.
Objective Priority: 2

Strategy 1: Use existing data on potential aspen sites and new data generated from the completion of General Objective 1 to identify areas that, if converted back to aspen forest, would increase patch size and/or decrease the isolation of remnant patches of aspen forest.

Strategy 2: Use cooperative habitat programs, public education and technical silvicultural support to convert these areas to aspen forest.

Justification: A target of 100 acres is selected because a preliminary study on CTUIR land alone has identified approximately 60 acres of habitat that appears to be suitable as aspen forest habitat (and, in fact, probably supported aspen forest in the past; see Section 3.2.4). As more data are generated from the completion of General Objective 1, this target may increase. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing aspen stands, but seeks to add new habitat to existing aspen forest in ways that should maximize size and connectivity.

WESTERN JUNIPER WOODLAND

Limiting Factors: Juniper woodlands are found in two general areas of the subbasin: 1) on the foothills of the Blue Mountains in a mid-elevation transitional zone between ponderosa pine and grasslands/shrub-steppe habitats (see Figure x), and 2) as isolated trees or patches at lower elevations in shrub-steppe habitat. Unlike neighboring subbasins, such as the John Day subbasin, the invasion of juniper found in transitional zones into grasslands of the Umatilla/Willow subbasin is not a serious problem. Although the current distribution of mid-elevation transitional zone juniper woodland in the Umatilla/Willow subbasin compared to historical conditions is unclear (see Section

3.2.4.2), it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe are believed to be decreasing markedly (see Section 3.2.4.2), due to the same factors affecting shrub-steppe and grasslands, with the most important of these being agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions. All of these factors are believed to be responsible for significant reductions in wildlife species such as the Ferruginous Hawk, which are highly dependent on functional western juniper.

Desired Functional Condition/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional western juniper habitat are:

- isolated, mature juniper trees with a density > one per square mile
- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Overview of Objectives: The objectives for western juniper forest are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – mature juniper trees or stands in shrub-steppe and grassland habitats. Although the amount of mature juniper that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of mature juniper woodland habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the Ferruginous Hawk, its prey, and other obligate species.

Biological Objective 1: Increase the protected status of all mature juniper associated with shrub-steppe and grassland habitats in the subbasin with no or low level protection to medium or high level protection by 2020.
Objective Priority: 1

> **Strategy 1:** Protect isolated mature juniper trees and stands of mature juniper in shrub-steppe and grassland habitats on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with public land managers who have isolated mature juniper trees and stands in shrub-steppe and grassland habitats under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2
>
> **Justification:** This objective cannot be quantified until the completion of General Objective 1 because it is not known how much mature juniper habitat is associated with shrub-steppe and grassland in the subbasin and how much of it is

currently protected. Confidence in IBIS data on current distribution of this juniper type is low because of the inability to map patch sizes less than 250 acres. Data are not available from Kagan et al. (2000) either, because they were unable to use satellite imagery to map current mature juniper habitat. However, Kagan et al. (2000) report an estimate that irrigated agriculture has led to clearing 50-75% of these juniper stands. Some of the last substantial patches occur on the Boardman Bombing Range and in western canyons of the subbasin. Thus, all mature juniper associated with shrub-steppe is targeted for protection because 1) it is believed to be rare and 2) it provides habitat characteristics preferred by the Ferruginous Hawk and other obligate juniper species. This objective is of the highest priority for juniper habitat because is assures protection of the last remaining mature juniper occurring in shrub-steppe habitat in the subbasin. Strategy 1 is of a higher priority than Strategy 2 because most remaining mature juniper on shrub-steppe is believed to be on private lands.

Biological Objective 2: Enhance 50% of degraded juniper habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that 1) are currently at high or medium level protection, 2) improve mature juniper associated with shrub-steppe, 3) protect large and contiguous tracts, 4) increase habitat connectivity, and/or 5) add to existing protected areas.
Objective Priority: 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices that lead to functional habitat for the Ferruginous Hawk, their prey, and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 1

Strategy 3: Modify livestock grazing practices, as necessary, to prevent damage of existing mature juniper and decrease spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 4: Ensure that natural ecological processes, such as fire, that are necessary for a functional habitat for the Ferruginous Hawk, its prey, and other obligate species are allowed to proceed. ***Strategy Priority:*** 1

Strategy 5: In conjunction with Strategies 1-4, educate the public about the ecological importance of mature juniper habitat to increase local support of enhancement projects. ***Strategy Priority:*** 1

Justification: A target of 25% was selected given the limited knowledge of the amount and condition of juniper habitat in the subbasin. Confidence in the estimate of 36,495 acres of juniper woodland in the subbasin is fairly low; subbasin planners believe the amount may be significantly less. Improving habitat on up to 9,000 acres by 2020 is possible with adequate funding. Strategies

are of equal priority because the severity of limiting factors is believed to vary from stand to stand.

SHRUB-STEPPE

Limiting Factors: Although the area of shrub-steppe habitat in the Umatilla/Willow subbasin appears to have more than doubled since c. 1850 (see Table x; Figure x), the quality of this habitat is believed to have declined significantly (see Section 3.4.2). Major factors affecting both low and higher elevation shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing (see Section 3.5.2). These factors result in habitat loss, fragmentation, and degradation. Historically, the single largest factor responsible for shrub-steppe habitat loss in the Umatilla/Willow subbasin is conversion to agriculture. Remaining shrub-steppe habitat continues to be threatened by agricultural conversion, but of even greater concern is the proliferation of exotic weeds. Cheatgrass is especially problematic, as described in Section 3.1.1.9, because it increases the frequency and severity of range fires, which can lead to the replacement of sagebrush, bitterbrush, and other native shrubs with cheatgrass. The invasion of exotic plants is facilitated by the loss of cryptogamic crusts resulting from soil disturbances associated with tillage and inappropriate livestock grazing practices. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also negatively affect obligate species in this habitat. The effects of non-native species are magnified by habitat fragmentation. Additionally, shrub-steppe habitats in proximity to agricultural, recreational, and residential areas may be subject to high levels of human disturbance. All of these factors are believed to be responsible for significant reductions in shrub-steppe obligate species, such as the Sage Sparrow.

Desired Functional Conditions/Critical Environmental Correlates: Characterizing very specific critical environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). Sound management will take into account site conditions, and thus the inherent capability of the site to support a particular type of shrub-steppe community and wildlife assemblage. However, general ranges of critical environmental correlates that support the Sage Sparrow and most other obligate shrub species (e.g., Loggerhead Shrike, Burrowing Owl, Sage Thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height > 3 feet.
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Overview of Objectives: Shrub-steppe habitat in the Umatilla/Willow subbasin is found both at low-elevations, where it occurs primarily on silt and sand loam soils of the lower subbasin, and at higher-elevations, where it is primarily associated with the foothills of the Blue Mountains (see Section 3.2.4.2). Approximately 115,000 acres of shrub-steppe in the subbasin is believed to be low-elevation shrub-steppe (primarily big sagebrush steppe and bitterbrush). Five critical areas (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon; see Section 3.2.4.2 for description) contain not only a large portion of this existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. In contrast, the estimated 124,480 acres of higher-elevation shrub-steppe (primarily rigid sage/sandberg bluegrass) are generally dispersed in small fragments, primarily on private land.

The objectives for shrub-steppe habitat take into account the differences between these two general types of shrub-steppe habitat that occur in the subbasin, and are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, they are arranged so that they protect relatively healthy and productive habitats first, and then expand to adjacent habitats that have a high likelihood of sustaining healthy populations by reconnecting or improving habitat. Thus, the first three objectives relate to protecting, maintaining, and enhancing all of the low-elevation shrub-steppe in the five critical areas. The first objective relates to protecting all the estimated 50,000 acres of shrub-steppe habitat on the five critical sites, to prevent its further destruction. The second, equally important, objective is to enhance and maintain all ***high quality*** shrub-steppe habitat in those five areas. The third objective targets the enhancement of the remaining degraded shrub-steppe in the five critical areas. The fourth, fifth, and sixth objectives, all of equal priority, seek to protect and enhance a portion of the estimated shrub-steppe habitat outside of the five critical areas, and convert agricultural and CRP areas into shrub-steppe. Specifically, the fourth objective targets the protection of approximately 25% of the remaining shrub-steppe that occurs outside the five critical areas, and the fifth objective relates to enhancing about half of that area. The sixth objective aims to increase shrub-steppe habitat in the subbasin by approximately 10% through the conversion of low-yielding agricultural lands or CRP land. As with objectives for other habitats, an adaptive management approach will be used to modify shrub-steppe objectives and strategies as additional information is obtained through the completion of General Objective 1 and through research, monitoring, and evaluation.

Biological Objective 1: Ensure that all shrub-steppe habitat remaining within each of the five critical areas in the Umatilla/Willow subbasin is under medium or high level protection by 2010.
Objective Priority: 1

> **Strategy 1:** Work with public land and TNC managers in the five critical areas to ensure that all shrub-steppe habitat in these areas is administratively or legislatively protected at a medium or high level. ***Strategy Priority:*** 1

Strategy 2: Protect existing shrub-steppe habitat on private land in the five critical areas by using cooperative agreements, conservation easements, and/or fee title acquisition where appropriate. ***Strategy Priority:*** 2

Justification: All shrub-steppe habitat in these five critical areas is targeted for protection because, as described in Section 3.2.4.2, these areas have the majority of all high quality, low-elevation shrub-steppe habitat in the Umatilla/Willow subbasin. The total acreage of existing shrub-steppe habitat in these five areas will not be known until the completion of General Objective 1, but probably does not exceed 50,000 acres. Currently, less than 10% of this area is estimated to be under high or medium protection. This biological objective and Biological Objective 2 are the highest priority objectives for shrub-steppe habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begin with protecting and supporting the most productive habitat first). Within Objective 1, Strategy 1 is a higher priority than Strategy 2 because most of the land in these five areas is controlled by government agencies or TNC (see Section 3.2.4.2).

Biological Objective 2: Maintain and/or enhance all high-quality shrub-steppe habitat remaining within each of the five critical areas in the Umatilla/Willow subbasin by 2010. ***Objective Priority:*** 1

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Where ecologically appropriate, and where native perennial grasses and herbaceous plants are absent, seed shrub-steppe areas where competition from non-native annual grasses and plants has been addressed. ***Strategy Priority:*** 2

Strategy 4: Where ecologically appropriate, employ practices that encourage bare ground (e.g., dunes) in sand and silt-loam soils. ***Strategy Priority:*** 2

Justification: All high quality shrub-steppe habitat in these five critical areas is targeted for maintenance and/or enhancement because, as described in Section 3.2.4.2, these areas have the largest remaining high quality remnants of low-elevation shrub-steppe habitat in the Umatilla/Willow subbasin. The total acreage of existing high quality shrub-steppe habitat in these five areas will not be known until the completion of General Objective 1, but it is estimated to be relatively small. Even though a large portion of the shrub-steppe habitat in these five areas is owned or managed by the federal government, it continues to undergo permanent loss through degradation by exotic plants, altered fire regimes, and

various other land practices (e.g., inappropriate livestock grazing practices). This objective focuses specific efforts toward maintaining and improving shrub-steppe within those critical sites by enhancing and maintaining the highest quality remaining "core" areas first. Thus, this biological objective and Biological Objective 1 are the highest priority objectives for shrub-steppe habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begins with protecting and supporting the most productive habitat first). Of the strategies associated with Biological Objective 2, Strategies 1 and 2 are the highest priority because removal of exotic plants and protection from damaging livestock practices are necessary first steps before either Strategy 2 or Strategy 3 can be undertaken. Strategies 2 and 3 are ranked equally because either one or the other will be employed, depending on the ecological potential of the site.

Biological Objective 3: Enhance all existing degraded shrub-steppe habitats and re-establish shrub-steppe dominance on all ecologically appropriate sites within the five critical areas by 2020. Priority will be placed on sites that are adjacent to or provide connectivity with remaining high quality areas identified by the completion of General Objective 1.
Objective Priority: 2

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: For all degraded shrub-steppe habitat in the five critical areas, identify the ecological potential of each habitat microsite (e.g., basin big sage with bare soil or dune understory, Wyoming big sage with cryptogamic crust understory, bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential.
Strategy Priority: 2

Strategy 4: In conjunction with Strategies 1-3, provide management, technical, and financial assistance to enhance degraded shrub-steppe habitat on privately owned lands adjacent to, or with potential connectivity to, shrub-steppe habitat in the five critical areas. ***Strategy Priority:*** 1

Justification: This biological objective focuses on working outward from protected and enhanced core areas to enhance, restore, and build connectivity in adjacent and nearby shrub-steppe habitats. Objective 3 is ranked second relative to Objectives 1 and 2, and should be undertaken once efforts have been made to protect, maintain, and enhance the highest quality remaining "core" areas, as outlined in Objectives 1 and 2. Of the strategies associated with Objective 3,

Strategies 1 and 2 are of higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the restoration of sites. Strategy 4 is also of high priority because it essentially aims to encourage private landowners to engage in Strategies 1-3.

Biological Objective 4: Increase the protected status of up to 50,000 acres of shrub-steppe habitat outside of the five critical areas with little protection to medium or high level protection by 2020. Protection priorities, guided by the completion of General Objective 1 and existing information, will be based on the current habitat status and potential ecological function of the habitat with regard to focal and other obligate species and will target tracts that 1) are large (> 300 acre tracts, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 3

Strategy 1: Protect existing shrub-steppe habitat on private land at the desired level by using cooperative agreements, conservation easements, and/or fee title acquisition where appropriate. ***Strategy Priority:*** 1

Strategy 2: Work with public land managers who have shrub-steppe habitat in their jurisdiction to ensure that all of it is administratively or legislatively protected at a medium or high level. ***Strategy Priority:*** 2

Justification: This objective (and Objectives 5 and 6) are ranked third for prioritization for shrub-steppe objectives. Shrub-steppe habitat existing outside of the five critical areas is highly fragmented, generally occurs in small patches, and is primarily in private ownership. Increasing protected status of 50,000 acres would benefit approximately 25% of the remaining shrub-steppe that occurs outside the five critical areas and would be a significant step towards protecting a biologically significant portion of the remaining shrub-steppe acreage. The target is believed to be feasible with adequate funding. Tracts greater than 300 acres are a high priority for protection because 300 acres is the minimum size capable of supporting the Sage Sparrow. Strategy 1 is a higher priority than Strategy 2 because most of shrub-steppe habitat outside the critical areas is privately owned.

Shrub-Steppe Biological Objective 5: Develop and implement specific management actions to maintain and/or enhance up to 25,000 acres of the shrub-steppe targeted for protection in Biological Objective 4 by 2020. Priority will be placed on sites that are adjacent to or provide connectivity with remaining high quality areas identified by the completion of General Objective 1.
Objective Priority: 3

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Identify the ecological potential of each habitat microsite to be restored (e.g., basin big sage with bare soil or dune understory, Wyoming big sage with cryptogamic crust understory, bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential. ***Strategy Priority:*** 2

Strategy 4: Provide private landowners with management, technical, and financial assistance as they work to enhance shrub-steppe habitat using Strategies 1-3. ***Strategy Priority:*** 1

Justification: Although managers realize that 25,000 acres is an ambitious goal, it was chosen because it would enhance approximately 50% of the shrub-steppe that is targeted for protection under Objective 4. Of the strategies associated with Objective 4, Strategies 1 and 2 are of a higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the restoration of sites. Strategy 4 is also of high priority because most of the land targeted for enhancement is privately owned, and thus, there is a great need to provide assistance to private landowners engaging in Strategies 1-3.

Shrub-Steppe Biological Objective 6: Convert 25,000 acres of low yielding agricultural land or CRP land into functional shrub-steppe habitat by 2020, resulting in an enhanced minimum parcel size of 300 acres, where possible.
Objective Priority: 3

Strategy 1: Encourage the conversion of lands currently enrolled in CRP into shrub-steppe habitat by providing technical assistance and financial incentives to actively manage those stands towards shrub-steppe habitats (e.g., by using prescribed burning, reseeding, light cultivation, herbicide treatments, managed grazing) within the conditions allowed under CRP contracts ***Strategy Priority:*** 1

Strategy 2: Use information produced through implementation of General Objective 1 to identify and prioritize agricultural lands that could increase shrub-steppe remnant size or establish connectivity between remnants of extant shrub-steppe land, and work to 1) enroll them in conservation programs (such as CRP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1

Strategy 3: Identify the ecological potential of habitat microsites to be converted (e.g., basin big sage with bare soil or dune understory, or Wyoming big sage with

cryptogamic crust understory, or bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential. ***Strategy Priority:*** 2

Strategy 4: Encourage Congress and the NRCS to alter CRP requirements in the following ways: 1) change CRP bid point allocations to enhance the enrollment acreages of lands that are adjacent to existing shrub-steppe or lands that would provide connectivity between remnants of extant shrub-steppe, 2) require that enrolled tracts that are either adjacent to extant shrub-steppe or that provide connectivity between remnants of shrub-steppe are converted to shrub-steppe habitat rather than grassland only, and 3) increase the duration of CRP contracts from 10 years to 20 years. ***Strategy Priority:*** 3

Justification: A total of 25,000 acres is targeted because this would increase the amount of shrub-steppe habitat in the subbasin by approximately 10%. This should make a significant contribution towards increasing the size of existing remnants and improving connectivity between remnants. However, this target will be refined following the completion of General Objective 1, which will provide much-needed information about the spatial distribution, ownership, and protection of existing shrub-steppe remnants that will inform opportunities to restore additional shrub-steppe habitat. A minimum of 300 acres is targeted because it is the minimum size capable of supporting the Sage Sparrow. Strategy 1 is of a high priority because it builds from strength by working to improve lands that are currently in a conservation program. Strategy 2 is also an equally high priority because it is a necessary step for implementing Strategy 3. Strategy 4 is the lowest priority because the chance of successfully implementing it may be low.

INTERIOR GRASSLAND

Limiting Factors: Approximately 75% of interior grasslands in the Umatilla/Willow subbasin have been lost since c. 1850 (see Table x; Figure x). As indicated in the assessment (see Section 3.5.2), major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and exotic weeds, such as cheatgrass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic plants is facilitated by the loss of cryptogamic crusts, resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance. All of these factors are believed to be

responsible for significant reductions in grassland obligate species, such as the Grasshopper Sparrow.

Desired Functional Conditions/ Key Environmental Correlates

For Native Grasslands

- native bunchgrass cover > 15% and comprising > 60% of total grassland cover
- tall bunchgrass (> 10 inches tall)
- native shrub cover < 10%

For Non-Native and Agricultural Grasslands (e.g. CRP lands)

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

Landscape Level

- patch size > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions

Overview of Objectives: The objectives for interior grassland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance 5-10% of the best grassland habitat in the subbasin. Objective 3 seeks to enhance roughly 50% of the subbasin's grasslands – those enrolled in CRP and other conservation programs. Finally, Objective 4 targets the conversion of 15,000 acres of non-native annual grassland or low yielding dryland agricultural land into functional grassland in ways that build from existing, good quality grassland and increase the likelihood of sustaining healthy populations of the Grasshopper Sparrow and other grassland obligate species.

Biological Objective 1: Increase the protected status of 20,000-40,000 acres of existing native grasslands with low or no protection into medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the Grasshopper Sparrow and other obligate grassland species and will target tracts that 1) are large (> 100 acres, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Protect functional grasslands on private lands at the desired level with cooperative agreements, conservation easements, and fee title acquisition, where appropriate. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with tribal and public land managers who have native or ecologically functional interior grassland under their jurisdiction to ensure that those grasslands are administratively or legally protected to the desired level. ***Strategy Priority:*** 2

Justification: The target range of 20,000-40,000 acres represents 5-10% of existing native grasslands and is believed to be an achievable target that would not compromise the economic welfare of the subbasin. This target will be refined through adaptive management based on research associated with General Objective 1. This biological objective and Biological Objective 2 are the highest priority objectives for interior grassland habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begin with protecting and supporting the most productive habitat first). Within Objective 1, Strategy 1 is a higher priority than Strategy 2 because most of the land in grassland habitat is privately owned (see Section 3.2.4.2).

Biological Objective 2: Maintain or enhance the 20,000-40,000 acres of grassland habitat targeted for protection in Objective 1 by 2020.
Objective Priority: 1

Strategy 1: Support the full funding and implementation of integrated weed management plans in the subbasin. ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce negative impacts on grassland vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Reestablish native plant communities where practical and cost effective. ***Strategy Priority:*** 2

Strategy 4: In conjunction with Strategies 1-3, aid private landowners in maintaining and enhancing grassland with management, technical, and financial assistance. ***Strategy Priority:*** 1

Justification: This objective would enhance all of the high quality grasslands protected under Objective 1. Of the strategies associated with Objective 2, Strategies 1 and 2 are of a higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the improvement of ecological function. However, Strategy 3 will be an important step in places where exotic vegetation is prevalent; if native vegetation is not planted after exotic vegetation is removed, exotic vegetation will quickly regenerate. Strategy 4 is also of high priority because most of the land targeted for enhancement is privately owned, and thus, there is a great need to provide assistance to private landowners engaging in Strategies 1-3.

Biological Objective 3: Enhance the ecological function and duration of benefits of over 200,000 acres of grassland habitat currently enrolled in CRP, EQIP, and WHIP in the subbasin as well as lands that will be enrolled in the future.
Objective Priority: 2

Strategy 1: Provide additional technical assistance and financial incentives to actively manage grasslands enrolled in CRP, EQIP, or WHIP to meet goals beyond the basic requirements of those programs, so that ecological function with regard to the Grasshopper Sparrow and other obligate grassland species is maximized. ***Strategy Priority:*** 1

Strategy 2: Work with the NRCS to improve the ecological function of agricultural lands enrolled in CRP by increasing the minimum conservation practice requirements so that they enhance ecological function with respect to the Grasshopper Sparrow and other obligate grassland species. ***Strategy Priority:*** 2

Strategy 3: Work with the NRCS and other public policy makers to develop recommendations to the U.S. Congress that they modify the Farm Bill so that CRP contracts are extended from 10 to 20 years. ***Strategy Priority:*** 2

Justification: Although this objective is prioritized second relative to Objectives 1 and 2 for grasslands, it takes advantage of a substantial opportunity for improving grassland condition in the subbasin by addressing over 50% of interior grassland in the subbasin, which are currently enrolled in CRP, EQIP, WHIP, and other conservation programs. Enrollment in these programs is expected to increase in the future. Thus, improving the ecological function and duration of benefits on these lands will have a positive impact on a majority of grasslands in the subbasin. Strategy 1 is the highest priority because the chance of successfully implementing it is believed to be higher than Strategies 2 and 3.

Biological Objective 4: Convert 15,000 acres of non-native annual grassland or low yielding dryland agricultural land not currently enrolled in conservation programs into native grasslands by 2020, and work to provide long-lasting protection to those converted grasslands. Conversion of tracts that 1) are large (> 100 acres, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas will be the highest priority.
Objective Priority: 3

Strategy 1: Use information produced through implementation of General Objective 1 to identify and prioritize agricultural lands that could increase existing grassland remnants or establish connectivity between grassland remnants, and work to 1) enroll them in conservation programs (such as CRP, WHIP, or EQIP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1

Strategy 2: Work with the NRCS to alter the CRP bid point allocation to reflect ecological need as assessed in the habitat mapping conducted in General Objective 1. This would increase the likelihood that habitat identified as ecologically significant in the subbasin would be enrolled into CRP, and would enhance the size, distribution and connectivity of ecologically functional parcels. . ***Strategy Priority:*** 2

Justification: A total of 15,000 acres is targeted because this would increase the amount of grassland habitat in the subbasin by approximately 5%. Although this is a relatively small addition, it should make a significant contribution by targeting lands that could increase the size of existing high quality remnants and improving connectivity between these remnants. However, this target will be refined following the completion of General Objective 1, which will provide much-needed information about the spatial distribution, ownership, and protection of existing grasslands that will inform opportunities to restore additional grassland habitat. A minimum of 300 acres is targeted because it is the minimum size capable of supporting the Grasshopper Sparrow. Strategy 1 is of a higher priority than Strategy 2 because the chance of successfully implementing it is believed to be higher.

HERBACEOUS WETLANDS

Limiting Factors: As discussed in Section 3.4.2, existing information on herbaceous wetlands in the subbasin is limited. However, evidence suggests that most herbaceous wetlands in the subbasin have been destroyed or degraded (see Section 3.2.4). As indicated in the assessment (see Section 3.5.2), major factors affecting herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing. The limiting factors have led to the decline of herbaceous wetland obligate species, such as the Columbia spotted frog.

Desired Functional Conditions/ Key Environmental Correlates:
As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional herbaceous wetlands are:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges, rushes and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (< 24 inches)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

Overview of Objectives: The objectives for herbaceous wetland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and

enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks to roughly double the total amount of herbaceous wetland in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Columbia spotted frog and other obligate species.

Biological Objective 1: Ensure that all existing herbaceous wetlands in the Umatilla/Willow subbasin are protected by 2010 at a medium or high level, to the extent possible. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the Columbia spotted frog and other obligate species.

> **Strategy 1:** Work with private landowners to protect existing naturally-occurring herbaceous wetlands on private land with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., WRP) to protect herbaceous wetlands. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with tribal and public land managers who have naturally occurring herbaceous wetlands under their jurisdiction to ensure they are administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2
>
> **Strategy 3:** In conjunction with Strategies 1 and 2, educate private landowners and the general public about the ecological importance of herbaceous wetlands and existing regulations that protect wetlands. ***Strategy Priority:*** 1
>
> **Justification:** All herbaceous wetlands are targeted for protection in this relatively short-term objective because, as discussed in Section 3.2.4.2, only 4,670 acres are estimated to exist in the Umatilla/Willow subbasin. Despite the fact that federal, state, and county regulations are aimed at limiting the destruction of wetlands (see Section 4.2), less than 15% of the subbasin's herbaceous wetland habitat is currently classified as being in medium or high level protected status. Thus, all herbaceous wetland habitat is targeted for protection by 2010 because it is rare and supports obligate wildlife species such as the Columbia spotted frog. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining herbaceous wetland habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing herbaceous wetland habitat is believed to occur on private lands.

Biological Objective 2: Enhance and/or maintain all existing herbaceous wetlands in the subbasin by 2015. Enhancement and maintenance will be guided by the completion of General Objective 1, and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Restore natural hydrologic function where it has been disturbed by agricultural or developmental activities. ***Strategy Priority:*** 1

Strategy 2: Develop and implement techniques to reduce or eliminate bullfrogs. ***Strategy Priority:*** 1

Strategy 3: Reduce exotic plant species encroachment into remaining wetlands. ***Strategy Priority:*** 1

Strategy 4: Apply techniques to mimic natural disturbance regimes necessary to maintain native wetland vegetation and function. ***Strategy Priority:*** 1

Strategy 5: Enhance degraded, naturally-occurring wetland habitat on public or private land using moist soil techniques to establish permanent open-water refuge with a minimum water level as habitat for Columbia spotted frogs. ***Strategy Priority:*** 1

Justification: Because of its rarity and importance in the subbasin, all herbaceous wetland habitat is targeted for maintenance and/or enhancement by 2015. All strategies are of equal priority because all are considered to be necessary in addressing limiting factors for herbaceous wetlands and individual sites may vary with regard to which limiting factor is most problematic.

Biological Objective 3: Convert or create 5,000 acres of additional herbaceous wetland habitat in the subbasin by 2020.
Objective Priority: 2

Strategy 1: Restore wetland habitat in areas identified by the implementation of General Objective 1 as formerly having naturally-occurring wetland habitat. Restored wetlands would be created either through joint management projects with private and public landowners on their properties or through the enhancement of properties acquired as habitat mitigation areas in the subbasin. ***Strategy Priority:*** 1

Strategy 2: Create new wetland habitat in association with or connected to extant naturally-occurring wetlands in the subbasin. New wetlands would be created either through joint management projects with private and public landowners on their properties or through the enhancement of properties acquired as habitat mitigation areas in the subbasin. ***Strategy Priority:*** 2

Strategy 3: In conjunction with Strategies 1 and 2, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1

Justification: A target of 5,000 acres is selected because this would roughly double the amount of herbaceous wetland in the subbasin. As more data are generated from the completion of General Objective 1 and other research, this target may be modified. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing herbaceous wetlands but seeks to add new habitat. Strategy 1 is of higher priority than Strategy 2 because restoring former wetlands is a higher priority than creating new ones, all other factors being equal. Strategy 3 is also of high importance because it should aid in implementing Strategies 1 and 2.

RIPARIAN WETLANDS

Limiting Factors: As discussed in Section 3.4.2, between 86-99% of the historically-occurring riparian habitat in the subbasin is believed to have been destroyed. Although this habitat type makes up a small portion of the total area of the subbasin, it is disproportionately important in terms of providing valuable habitat for a multitude of wildlife species. As indicated in the assessment (see Section 3.5.2), major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. Hydropower, agricultural, urban, and transportation corridor development have led to habitat loss through conversion and channelization, have resulted in the separation of the floodplain from the stream, and have contributed to the degradation and fragmentation of remaining riparian habitat. Most of the extensive cottonwood galleries once found in riparian wetlands of the subbasin have been harvested. Existing riparian wetlands also continue to be degraded by exotic plant invasions and livestock grazing. These factors are believed to have negatively impacted species dependent on functional riparian areas, including the Great Blue Heron, the Yellow Warbler, and the American beaver.

Desired Functional Conditions/ Key Environmental Correlates
As described in Section 3.4.2, the desired functional conditions or key environmental correlates for riparian wetlands are:

- 40-60% tree canopy closure of cottonwood or other hardwood species
- multi-structure/age tree canopy (including trees 6 inches dbh and mature/decadent trees)
- woody tree groves > 1 acre and within 800 feet of water, where applicable
- vegetation within 328 feet of shoreline
- 40-80% native shrub cover, with more than 50% of shrub species being hydrophilic
- multi-structured shrub canopy > 3 ft tall

Overview of Objectives: Many of the objectives and strategies associated with the aquatic management plan that are aimed at improving riparian conditions will also benefit terrestrial wildlife. Thus, the terrestrial management plan focuses particularly on objectives and strategies for riparian habitat needs associated with wildlife that may not

be addressed in the aquatic plan. The objectives for riparian wetland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks to roughly double the total amount of functional riparian habitat in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Great Blue Heron, Yellow Warbler, American beaver, and other obligate species.

Biological Objective 1: Ensure that all existing riparian wetlands in the Umatilla/Willow subbasin are protected at a medium or high level by 2010, with the following wetlands receiving the highest priority (listed in order of importance): 1) riparian areas with mature hardwood trees, especially cottonwoods, 2) areas with the highest ecological function with regard to the focal and obligate species, and 3) riparian areas adjacent to high priority river reaches, as identified through EDT modeling. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Protect riparian wetlands on private lands with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., CREP, EQIP, WRP, WHIP) to protect riparian areas. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with public land managers who have riparian wetlands under their jurisdiction to ensure that those wetlands are administratively or legally protected at the desired level. ***Strategy Priority:*** 2
>
> **Justification:** All existing riparian wetlands are targeted for protection in this relatively short-term objective because, as discussed in Section 3.2.4.2, only approximately 1,440 acres are estimated to exist in the Umatilla/Willow subbasin. Despite the fact that federal, state, and county regulations are aimed at limiting the destruction of wetlands (see Section 4.2), less than 1% of the subbasin's riparian wetlands are currently classified as being in medium or high level protected status. Thus, all riparian wetland habitat is targeted for protection by 2010 because it is rare, and supports a wide variety of wildlife species, including riparian obligate species such as the Great Blue Heron, the Yellow Warbler, and the American beaver. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining riparian wetland habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing riparian wetlands are believed to occur on private lands.

Biological Objective 2: Enhance and/or maintain all existing riparian wetlands in the subbasin. Riparian wetlands receiving the highest priority (listed in order of importance) are those: 1) with mature hardwood trees, especially cottonwoods, 2) with the highest ecological function with regard to the focal and obligate species, and 3) adjacent to high priority river reaches, as identified through EDT modeling. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and/or other riparian vegetation. ***Strategy Priority:*** 1

Strategy 2: Protect existing mature cottonwoods and other hardwood trees from herbivory by native wildlife (e.g., beavers), as necessary. ***Strategy Priority:*** 1

Strategy 3: Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1

Strategy 4: Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1

Strategy 5: Where necessary, plant native hydrophilic vegetation in areas where progress towards Strategies 1-4 is sufficient to allow native plants to survive.
Strategy Priority: 2

Justification: Because of its rarity and importance in the subbasin, all riparian wetland habitat is targeted for maintenance and/or enhancement by 2015. Strategies 1-4 are of equal priority because all are considered to be necessary in addressing limiting factors for riparian wetlands and individual sites may vary with regard to which limiting factor is most problematic. Strategy 5 is of lower priority than Strategies 1-4 only because Strategy 5 can only succeed if efforts towards Strategies 1-4 have been sufficient to allow native plants to survive. However, the importance of Strategy 5 cannot be underestimated; as described in Section 3.1.1.9, the problem of exotic weeds in riparian areas in the subbasin is widespread and severe. If native riparian vegetation is not planted in places where exotic vegetation has been removed, exotic vegetation will quickly regenerate. Thus, Strategy 5 will ensure that time and money devoted to the control of exotic vegetation in riparian areas are not wasted.

Objective 3: Convert or restore 1,500 acres of non-functioning riparian area into ecologically functional riparian habitat. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that have the potential to restore connectivity, and/or add to existing high quality areas.

Objective Priority: 2

Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and other riparian vegetation. ***Strategy Priority:*** 1

Strategy 2: Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1

Strategy 3: Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1

Strategy 4: Where necessary, plant native vegetation in areas where progress towards Strategies 1-3 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1

Justification: A target of 1,500 acres is selected because this would roughly double the amount of functional riparian habitat in the subbasin. As more data are generated from the completion of General Objective 1 and other research, this target may be modified. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing riparian wetlands but seeks to add new habitat. Strategies 1-3 are of equal priority because all are considered to be necessary in addressing limiting factors for riparian habitats and individual sites may vary with regard to which limiting factor is most problematic. Strategy 4 is of lower priority than Strategies 1-3 only because Strategy 4 can only succeed if efforts towards Strategies 1-3 have been sufficient to allow native plants to survive. However, implementing Strategy 4 is integral to ensuring that time and money devoted to the control of exotic vegetation in riparian areas are not wasted. Strategy 5 is also of high importance because it should aid in implementing Strategies 1-4.

5.5 Consistency with CWA and ESA Requirements

In the Umatilla/Willow subbasin, the federal Clean Water Act is implemented largely through the State's preparation of water quality standards, Total Maximum Daily Loads (TMDLs), and the TMDL implementation processes of designated management agencies. The ODEQ has identified streams throughout the subbasin that are water-quality limited for a variety of factors. Two of these -- sediment load and water temperature – are the most pervasive limiting factors to steelhead and salmon identified in this subbasin plan. Thus, there is a great congruence between the needs of the subbasin as outlined by the

TMDL and the needs of the focal species as outlined in this plan. Managers will be working closely with ODEQ staff to coordinate efforts to address both TMDL needs and fishery needs.

The plan is consistent with ESA in that the primary criteria for listing a focal species was its ESA status. Thus, the two threatened fish species in the subbasin, bull trout and summer steelhead, are given high priority for habitat restoration.

5.6 Research Monitoring and Evaluation

The assessment and EDT modeling exercises described in this plan depict the Umatilla Subbasin as a complex ecosystem with many interconnected components. The explanation of spatial and temporal variability of these components is the focus of UMEP; an informal network of fish and wildlife projects, including state, federal, tribal, and academic institutions, that operate at a variety of scales. The task is complicated because most projects operate at a single species or species assemblage scale, whereas spatial and temporal variability operate at the ecosystem, subbasin, and sub-watershed scales. The purpose of this section is to outline a holistic approach to ecosystem-based Research, Monitoring, and Evaluation (RM&E) that will facilitate adaptive restoration of Umatilla fish and wildlife.

The process used to develop fish and wildlife assessments and management plan objectives and strategies was based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Province scale. Attention was focused on the size and condition of core habitat/geographic areas at a subbasin scale, maintaining physical connections between core areas, and providing buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most fish and wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal fish and wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation and restoration of fish and wildlife resources.

Similarly, working hypotheses for focal habitat types and focal species were developed based on factors the environmental factors that affect them. Working hypotheses are statements that assist subbasin planners and their communities to clearly articulate a quantifiable program based on the most productive restoration actions in a given habitat type or geographic area. The basis for the hypothesis is the proximate or ultimate factors affecting habitats; i.e. the limiting factors. The relationship subbasin planners attempted to address in this process is one between management objectives, management strategies, and recommended (desired future) habitat conditions necessary to meet habitat and/or fish and wildlife objectives and goals.

The relationship between habitats and populations, the biological response summarized in each working hypothesis, must be tested in terms of project implementation (the quantity of habitat restored and extent of its restoration), followed by monitoring and evaluation of

the population response. Ultimately, adaptive management is used to respond to the outcomes of these "tests" of working hypotheses. Each test is used to revise models of the Umatilla system, redefine priorities for restoration, and update biological objectives. At the same time the impacts of natural stochasticity and determinism, continued anthropogenic disturbance, and supplementation/reintroduction must be accounted for. The assessment and inventory synthesis cycle is illustrated in Figure 10. Movement through the cycle is summarized below:

1. Document and compare historic and current conditions of focal habitats to determine the extent of change.
2. Review habitat needs of focal and other obligate fish and wildlife species/assemblages to assist in characterizing the "range" of recommended future conditions for focal habitats. Combine species habitat needs with desired ecological/habitat objectives to determine recommended future habitat conditions.
3. Determine the factors that affect habitat conditions and species (limiting factors) and compare to current and recommended future habitat conditions to establish needed future action/direction.
4. Develop strategies to address habitat "needs" and identify "road blocks" to obtaining biological goals.
5. Review strategies and compare to existing projects, programs, and regulatory statutes (Inventory) to determine the level at which existing inventory activities address or contribute towards amelioration of factors that affect habitat conditions and species assemblages.
6. Develop goals and objectives to address strategies that define the key components of the management plan.

Post subbasin planning algorithms (Research, Monitoring and Evaluation) are described in 7 through 9 below.

7. Projects are approved, based on management plan strategies, goals, and objectives, and implemented.
8. Habitat and species response to habitat changes are monitored at the project, geographic area, sub-watershed, and subbasin scale, and compared to anticipated results.
9. Adaptive management principles are applied as needed, which leads back to the "new" current conditions restarting the cycle.

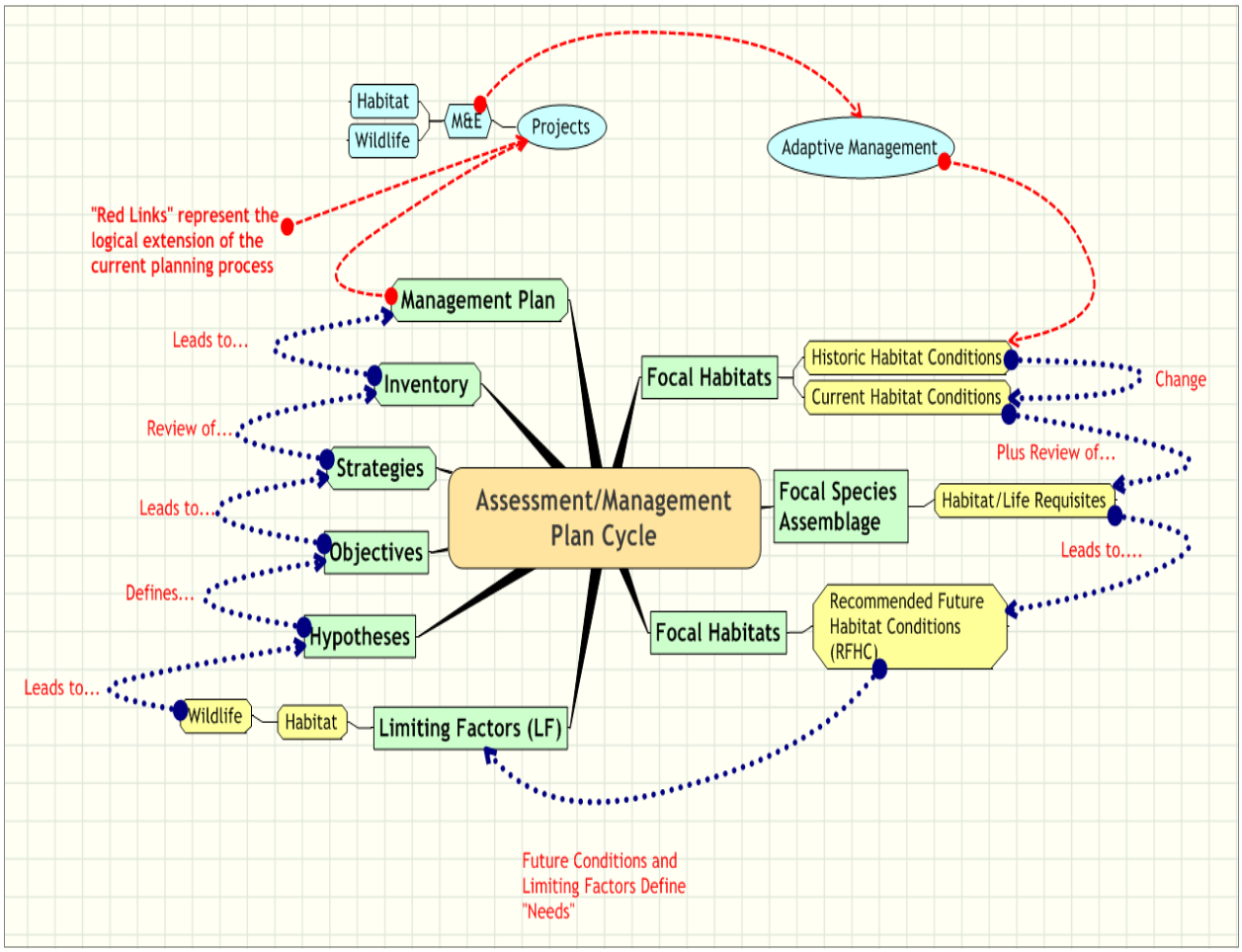

Figure 10. Adaptive Management Process

The Research Monitoring and Evaluation (RME) Plan lays out the framework that will allow for evaluation of the efficacy of implemented strategies in achieving corresponding focal habitat objectives for the subbasin, as per post subbasin planning algorithms 8 and 9. The RME plan emphasizes cooperative efforts among managers and stakeholders, and is designed to:

- evaluate success of management strategies, via monitoring of fish and wildlife species and their environments (The results of focal species monitoring and evaluation efforts are expected to function as potential performance measures to monitor and evaluate the results of implementing management strategies and actions on focal habitats).

- determine if management strategies undertaken are achieving recommended range of habitat management conditions, via monitoring and assessment of habitat conditions over time

- allow for evaluation of the assumptions and working hypotheses upon which the management plan is based, by quantifying the correlation between focal habitat management conditions and focal species population trends

- Finally, the Adaptive Management portion of this RM&E plan outlines a strategy that will allow managers to adjust and/or focus management activities within the subbasin, based upon monitoring and evaluation data. The feedback loop thus formed will facilitate development of future iterations of the subbasin management plan.

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific population and habitat surveys, to simple enumeration of land use projects commented upon by cooperating agencies. Summaries of other ongoing RM&E activities in the basin that are not focused on subbasin planning under the NPCC Fish and Wildlife Program are appended for informational purposes.

Implementation of the Subbasin Plan is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an "Implementation Oversight Committee", to track and guide RM&E and reporting activities included in the plan.

The core monitoring activities will be conducted at three qualitative levels of intensity:

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit over a period of time, with a view to quantifying changes over time. Changes must be distinguished from background noise. In general, Tier 1 monitoring does not establish cause and effect relationships (i.e., is not research) and does not provide statistical inductive inferences to larger areas or time periods (ISRP 2003). On a programmatic scale (the NPPC Fish and Wildlife Program) we believe that HEP analysis (U.S. Fish and Wildlife Service 1980a) falls into this category. Particularly for projects that endeavor to mitigate a finite ledger of HUs associated with losses from a specific hydropower project, HEP adequately meets the monitoring needs, at a programmatic level, to ensure mitigation goals are being achieved. Consequently, HEP will remain an integral part of our overall monitoring strategy. GIS will be used to geo-reference Tier 1 data.

Tier 2 (statistical) monitoring provides statistical inferences to parameters in the study area as measured by certain data collection protocols (i.e., the methods in a report). These inferences apply to areas larger than the sampled sites and to time periods not studied. The inferences require both probabilistic selection of study sites and repeated visits over time. Individual Tier 1 proposals can support larger Tier 2 statistical monitoring projects such as the Oregon Plan by using the same field methods and methods to select study sites that contribute information to Tier 2 statistical monitoring. Most large projects should implement sampling designs that allow Tier 2 statistical monitoring or contribute data to statistical monitoring (ISRP, Comments on the Clearwater Plan, 2003). Most of the methods outlined in the M&E plan fall into this level of monitoring. A purposeful

effort was made to select methods that are widely employed in field biology or to adopt appropriate monitoring protocols from national monitoring programs to maximize the utility of the data collected.

Tier 3 (research) monitoring is for those projects or groups of projects whose objectives include establishment of mechanistic links between management actions and salmon or other fish or wildlife population response. Tier 3 research monitoring requires the use of experimental designs incorporating "treatments" and "controls" randomly assigned to study sites (ISRP 2003). Individual Tier 1 and Tier 2 proposals can support Tier 3 research by adopting overlapping protocols.

5.6.1 Aquatic Research, Monitoring, and Evaluation Approach

Decades of management have made clear that the complex nature of restoration requires an RM&E approach that is both descriptive and explanatory in nature. It is essential but insufficient to say that a population is in decline when mechanistic solutions are required. The RM&E approach must document the rate of population change and the various factors that have influenced its trajectory, and it must be able to explain the interactions between causal factors and observed results. The approach UMEP has adopted has been under development for decades, and is being put to use in a management setting throughout the Columbia Basin. The ecosystem-based approach to management has received congressional review (EPAP 1999), and is heavily represented in both the federal RM&E standards that are currently under development (Jordan et al. 2003), and the Endangered Species Act RM&E strategies that are currently being implemented (USACOE et al. 2003). Collectively the EPAP report, federal Columbia Basin standards, and ESA strategies share at least 3 core scientific principles:

1. Due to the natural and anthropogenic complexity of the Umatilla and Columbia basins, only a ***systems monitoring*** approach can adequately inform fisheries management.
2. Due to the overwhelming importance of ecological interactions in the Umatilla and Columbia basins, only an ***ecosystem*** monitoring approach can adequately inform fisheries management.
3. Due to the complexity of research and monitoring tasks, only a ***regionally integrated*** ecosystem monitoring approach can adequately inform fisheries management.

Ecosystem-Based RM&E programs tend to be more complex to implement than traditional single species programs, but they are exponentially more informative. They address the population-scale phenomena of traditional fisheries M&E programs, the cause-effect relationships developed from critical uncertainties research, and the ecological components of a restoration program. They require a more efficient and well structured monitoring and evaluation effort. The trade-off is that greater planning and scrutiny are required, but that more powerful results can be produced, and therefore

managers can be better informed. The mathematical goal of the approach is to produce statistically sound estimates of all significant processes that govern production, including direct and indirect interactions between fish and their systems. To be effective the approach must address attributes at several scales (from (Link 2002, TWS 2002):

1. Single Species Metrics a. Abundance b. Distribution c. Habitat d. Growth Rates e. Length-Frequency Relationship f. Fecundity and Productivity g. Population Trajectories h. Genetics i. Harvest **2. Community Metrics** a. Diversity b. Multi-Species Interaction Rates c. Competitive Interaction Rates d. Natural Mortality	**3. Food Web Metrics** a. Food Web Structure b. Connectivity c. Food Chain Length d. Link Density e. Omnivory and Cannibalism f. Predator/Prey Ratios **4. Aggregate Metrics** a. Flux b. Ascendancy c. Capacity d. Efficiency e. Guild Composition f. Guild Production	**5. Systems Analysis Metrics** a. Exergy b. Emergy c. Ecosystem Production d. Ecosystem Mass e. Resilience f. Persistence g. Resistance h. Stability i. Free Energy j. Information Content

The achievement of ecosystem-based RM&E does not require that all aspects of the system be actively monitored in the field on a continual basis. On the contrary, the logistical objective of an ecosystem-based approach is to identify and monitor only the most important limiting factors that are currently affecting restoration; irrespective of their source or nature (Karr and Chu 1999). Many of these metrics can be derived from other monitoring programs, or can be assessed with regular monitoring activities. Other components must be assessed directly using novel monitoring techniques or short-term studies. The remaining metrics, especially the aggregate and systems metrics, can be addressed in the evaluation process and provide substantial information on the overall success of fisheries programs using common currencies. The key is to determine which performance measures explain the largest components of variance in production, and to carefully research or monitor these using an appropriate sampling, analysis, and evaluation design. The power of this ecosystem approach was demonstrated in the assessment and management planning process through the application of EDT. By adopting EDT as the simulation standard for the Umatilla, the set of physical, chemical,

and biological monitoring requirements can be easily defined, as can the integrated ecosystem approach to sampling and analysis.

Ecosystem-Based Sampling Design

The co-managers have adopted an ecosystem approach to determining the information needs associated with the qualitative management objectives and quantitative desired future conditions outlined in the management plan. EDT defines a set of population, habitat, and ecological information needed to effectively quantify production and productivity throughout the subbasin. The RM&E plan includes a list of performance metrics that must be monitored, along with their spatial scale and sampling effort needed to meet EDT modeling requirements.

The development of a spatially explicit sampling design is essential due to the limiting factors that operate at a variety of spatial scales. The EDT management unit is the geographic area, whereas the population viability unit is the subbasin. Detecting habitat changes at the geographic area scale is relatively straightforward, whereas connecting habitat changes and the biological response (i.e. testing the working hypotheses) is another matter. The restoration of a geographic area's habitat conditions should, in theory, result in increased spawner and juvenile utilization, but not independently of the aggregate forcing functions acting at the subbasin scale. Increased redd densities, for example, may be indicative of better sediment characteristics or total spawner escapement. The resolution of these spatial complexities requires a complex sampling regime that operates at the geographic area, sub-watershed, and subbasin scales using regionally integrated techniques.

Several parallel efforts are underway to refine a tributary RM&E design that will provide sufficient statistical power to discriminate between habitat, hatchery, harvest and hydrological impacts by addressing these metrics in tandem with a number of confounding factors. The general approach has been thoroughly outlined and is currently adoptable because it is based on first principles and a large body of research. The sampling design recognizes the impacts of spatial and temporal hierarchies on statistical analysis, and provides for natural and anthropogenic observational and treatment-reference experiments (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). The general approach is to:

- Conduct long-term monitoring and evaluation of habitat and environmental conditions at the reach or geographic area scale.
- Conduct effectiveness monitoring of habitat restoration actions at the reach and watershed scales.
- Conduct long-term monitoring of sub-population and ecological conditions of fishes at the reach or geographic area scale.
- Conduct long-term monitoring of population attributes at the subbasin scale.

Habitat and hatchery actions tend to be limited in spatial scope and intensity by political, fiscal, or land-owner restrictions that are not easily overcome. Detecting the benefits of

these actions on the spatial or temporal scale of their implementation is therefore not usually possible. The complex and dynamic nature of fish communities, and the confounding factors of ecological, harvest, hydrological, and hatchery interactions can easily swamp management impacts in the absence of a proper monitoring design (Rose 2000). If met the general design requirements presented above will allow information collected at different spatial and temporal scales to be analyzed and evaluated at the watershed or subbasin scale. This presents a nearly direct link between management actions and population responses.

Reach Scale Sampling

A number of attributes show tremendous variance at the reach scale. In-stream and riparian conditions tend to vary across meters and kilometers, resulting in a patchwork of essential fish habitat. Individual fish from all life-stages respond to these surroundings, make choices, and experience the environment accordingly. This interface of environment, behavior, and ecology defines the spatial scale for monitoring spawner success, juvenile sub-populations, and their surroundings. These variables will be sampled using a modified Environmental Monitoring and Assessment Program (EMAP) approach. Sampling effort will be stratified throughout each watershed at the reach scale, and the results will be aggregated accordingly. Similarly the direct impacts of habitat restoration will be quantified at the reach scale, and the response of sub-populations to these micro-scale changes will be evaluated at an aggregated spatial scale (geographic areas or the subbasin as a whole).

Watershed or Geographic Area Scale Sampling

The subbasin plan provides a set of working hypotheses, via which the efficacy of various restoration actions can be tested using Tier 1 and Tier 2 sampling designs. The predicted treatments were described above as desired future conditions. The actual habitat, hatchery, and harvest treatments each watershed will receive during each five year observation period will depend in part on the achievement of certain social, fiscal, and political barriers that are outside the control of the RM&E program. However, the working hypotheses can still be tested at the watershed or geographic area scale because the hypotheses themselves can be quantitatively tailored to the actual treatment each system receives.

Reach-scale attributes will be aggregated to the watershed or geographic area scale. In addition a number of variables including land-use characteristics, temperature, hatchery releases, and discharge will be sampled at the watershed scale. Several juvenile sub-population metrics will be collected at the reach scale, but will actually be sampled at the aggregated watershed scale. Growth rates, survival, and ecological interactions are features where variance at the micro-scale might be misleading due to the movements of fish across a number of reaches. Therefore, although these metrics will be sampled during reach-scale abundance and distribution studies, the sampling regime will be designed around watershed-scale comparisons.

Subbasin Scale Sampling

Several population and environmental metrics will be sampled at the subbasin scale, including several population production criteria such as population growth, length-frequency distributions, and the like. As outlined in the research agenda, most Tier 3 research will be conducted or evaluated at the subbasin scale including the relative reproductive success of spawners, and the connectivity of populations. A number of other reach and watershed-scale metrics will be aggregated to the subbasin scale. This will allow population viability criteria to be evaluated for the entire Umatilla Subbasin, while evaluating contributing factors at the reach, geographic area, or watershed scale. In additional several environmental attributes, such as total discharge and flow regimes, will be monitored or aggregated to the subbasin scale. This level of monitoring will allow for regional comparisons of relative performance. This study design is empowered by the variety of treatments that the John Day, Walla Walla, and Grande Ronde Subbasins receive associated with the assortment of hatchery, habitat, and harvest programs that they host. By incorporating regional standards in reach, watershed, and subbasin scale sampling each spatial aggregate can be analyzed and evaluated comprehensively, and the results will be comparable throughout the Columbia Plateau.

Ecosystem-Based Analysis and Evaluation

The relationships between focal populations and the variables that limit production are complex, confounded by mortality and movement, and masked by error in the sampling process (Williams 1999). Even in the case of hatchery releases or flow enhancement where direct control is possible, the impacts of actions may be masked by natural variance in the system, and the causes of these patterns may not be readily apparent. For example, it would be foolish to analyze the productivity of hatchery reared ESA listed STS without including the impacts of resident fish on population structure (Currens and Schreck 1995, Kostow 2003) and natural mortality (Beamesderfer et al. 1996). Any number of similarly confounding multi-species relationships could be defined, and some were highlight in section.

The watershed concept has been used to successfully address these complexities in tributaries (Moring and Lantz 1975, Ringler and Hall 1975, Hall 1977, Beschta and Taylor 1988, Hicks et al. 1991, Stednick and Kern 1994, Nakamoto 1998, Tschaplinski 2000, Thompson and Lee 2002, Bilby et al. 2003, Regetz 2003). These studies suggest that by aggregating several performance metrics to the watershed scale it will be possible to analyze and evaluate the impacts of management in the face of natural and anthropogenic stochasticity.

Ecosystem-based analysis of the factors that impact production at the watershed scale is quite different from more traditional population-focused inferential analysis. If certain design criteria are met, ecosystem-based analysis and evaluation can be used to discern confounding factors from important forcing functions such as management actions (Carpenter and Kitchell 1993). The current conditions of the Umatilla Subbasin have been assessed with considerable detail, and substantial “pre-treatment” information has

been compiled (Contor 2003, CTUIR and ODFW 2004). Therefore the system is suitable for ecosystem-based association analysis at the watershed scale.

Variability in natural and anthropogenic characteristics mean that small differences in the treatments each watershed receives can influence the detection of their impacts over short time periods (Rosenbaum 2002). The intent of extending the analysis and evaluation period to five years is to discern treatment impacts from natural and anthropogenic stochasticity. This analysis and evaluation approach provides a framework for concurrent Tier 1, 2, and 3 evaluation based on long-term monitoring, short-term experiments, and system simulations. This "polythetic" approach can provide answers where other linear approaches fail to do so (Kitchell et al. 1988), and requires several parallel but distinct analysis paradigms.

Associative Analysis

Association analysis is the process of determining whether or not two or more measures relate to each other in an observational, before/after, or treatment/control experiment. Traditional inferential statistics including ANOVAs, t-Tests, regression, and principle components analysis all utilize the associative paradigm. The general equations for associative analysis of any variable X are the probability functions;

Equation 1.

$$\mu = \sum x \bullet P(x)$$

Equation 2.

$$\sigma^2 = \sum [(x - \mu)^2 \bullet P(x)]$$

Equation 3.

$$\sigma = \sqrt{[\sum x^2 \bullet P(x)] - \mu^2}$$

where P is the probability of encountering any given value of x, is the mean of that probability function, is the variance, and ^{2} is its standard deviation. These general equations are the foundation of probabilistic and inferential statistics, and have general applicability in the assessment of any quantitative association. This holds true whether the association is between a probabilistic distribution and a category, as in an analysis of variance, or in the association between observed data and a best fit line, as in the sum of squares estimate.

Reach, watershed, and subbasin-scale measures will be analyzed using inferential statistics to determine patterns of strong inference such as correlation, cross-correlation, or independence. These patterns will be used to infer cause-effect relationships between management actions and confounding factors where these are statistically plausible.

Trend Analysis

The trend analysis paradigm shares some features with associative analysis with one critical difference. Trend analysis recognizes the linear nature of time series; that no point in time can ever being experienced again, and that no co-occurrences in time can be fully independent of each other. Changes over time can result from the interactions of associated variables, but can also stem from serial dependency, seasonality, and temporal stochasticity. There are two major foci of time series analysis; to identify the correlates of a variable represented by a series of observations, and to predict the future values of that variable. The management intent of trend analysis is to quantify the deterministic components that underlie ecological function against the back-drop of spurious relationships. Trend analysis is generally conducted as an autocorrelative function; the serial correlation coefficients and standard errors of temporal lags in covariates for variable x:

Equation 4

$x_t = \xi + \phi_1 * x_{(t-1)} + \phi_2 * x_{(t-2)} + \phi_3 * x_{(t-3)} + \ldots + \varepsilon$

Where:

ξ is a constant (intercept), and

ϕ_1, ϕ_2, ϕ_3 are the autoregressive model parameters

Watershed and subbasin-scale variables, including aggregated reach-scale variables, will be analyzed using trend analysis, as will all continuous functions such as those attained from fixed sampling stations. The stability, resilience, and resistance of populations to disturbance will be quantified. Detrending, filtering, transfer functions, and intervention analysis will be applied. For each spatial scale and set of performance metrics we will ask "Did the system change?", and if so "What were the most statistically plausible factors?" In addition we will use autocorrelation to build potentially predictive models of change.

Geostatistical Analysis

Geostatistical analysis is used to assess the spatial variability of a variable or variables, and then to utilize that variability and co-variability as an estimator or predictor of a variable such as population density (Petitgas 2001). Geostatistical analysis recognizes the potential spatial co-variation of metrics that can be intended, confounding, or predictive. Changes across space can result from the spatial distribution of variables such as the extent of clustering, or it can result from underlying co-variation with habitat or among species. In a stream-network spatial variability can also result from contingency and dependency on up-stream or down-stream factors. Geostatistical analysis relies on the estimation of spatial means, called the zone mean, rather than the process mean used in inferential statistics. The mean (Z) is derived from

Equation 5

$$Z_v = \frac{1}{V}\int_V z(x)dx$$

for any variable x, and its covariate v. The calculation of the estimate and estimator variance is exponentially more complex, and depends on the realization of an expectation function, covariogram, and variogram. The use of these spatial means to develop geostatistical or geospatial estimates of random or deterministic functions is perhaps not more complex, but more complicated because the precise method (or kriging forma) depends on the realized variogram and covariogram functions. The reader is referred elsewhere for fascinating discussions regarding the kriging decision tree (Demyanov et al. 2001, Lloyd and Atkinson 2001) and the application of results (Rendu 1980, Warren 1998, Barbaras et al. 2001).

Habitat, population, and environmental variables will be analyzed to determine their spatial co-variation. The relationship between population and habitat metrics will be used to conduct a geostatistical expansion of fish observations throughout each watershed. This expansion will be used to generate geostatistical stock assessment estimates (Petitgas 2001). We will apply geostatistical analysis in parallel with associative and trend analysis to determine the spatial, temporal, and nominal co-variation of performance metrics, treatment actions, and confounding factors.

Structural Analysis

Structural analysis is used to assess the general response of systems to treatments and natural permutations. Structural analysis can be qualitative or quantitative depending on the scale of investigation. Species diversity, community structure, connectivity, and link density are all structural variables that describe the ordered or un-ordered set of components that make up a system. Structural analysis is quantitative and qualitative; categorical and continuous. There are no strict mathematical examinations of structure, but the assessment of species/guild, links/trophic level, percent omnivory, etc. are all useful. We will assess the structure of each Umatilla watershed, included supplemented watersheds, using diversity indices, food web diagrams, and indices of community structure. We will aggregate these performance metrics to the subbasin scale to analyze changes in the Umatilla Subbasin through time. We will apply structural analysis in parallel with associative, trend, and geostatistical analysis to infer relationships between and among structural performance metrics, treatment actions, and confounding factors.

Functional Analysis

Functional analysis is used to quantify the mass and energetic changes of complex systems. Functional analysis is principally quantitative in nature, and relies heavily on system simulations. Single species, community, food web, aggregate, and ecosystem metrics can all be addressed using functional analysis. At the individual scale ecological function is most often depicted as:

Equation 6

$$Consumption = \mathrm{Re}spiration + Waste + Growth$$

At the aggregate scale of communities, ecosystems, reaches, or watersheds, ecological function is best represented as:

Equation 7

$$\mathrm{Pr}oduction =$$

$$harvest + predation\_mortality + biomass\_accumulation + migration + other\_natural\_mortality$$

or the delay-difference version:

Equation 8

$$dB_i/dt = g_i \sum_j C_{ji} - \sum_j Cij + I_i - (M_i + F_i + e_i)B_i$$

Where the biomass (B) of pool i, equals the net growth efficiency (g), biomass immigration (I), non-predation mortality/metabolic rate (M), harvest mortality (F), and emigration (e) adjusting the biomass over time (C) for each species ji and ij interaction (Walters et al. 1999). That equation can be further expanded to represent life stages, and would need to be for salmonids.

Performance metrics such as the natural mortality of hatchery reared smolts, consumption rates of all fishes, and the aggregate energetic metrics can all be quantified using functional simulations. We will analyze the performance of the Umatilla Subbasin using a holistic model of fish and their system. We will develop estimates of the function of each watershed and the Umatilla Subbasin as a whole. We will generate estimates of several ecological parameters that will not be sample in-situ. We will apply functional analysis in parallel with associative, trend, geostatistical, and structural analysis to infer relationships between and among single species and aggregate metrics of the Umatilla.

Evaluation

The polythetic approach to analysis will provide a robust framework for evaluation. UMEP will address qualitative and quantitative RM&E objective using a suite of univariate and multivariate statistics and simulations. The impacts of management actions will be evaluated in the context of natural and out-of-basin factors. Progress towards each management objective will be evaluated in terms of the realization of management actions the system receives and the biological response observed.

5.6.2 Terrestrial Wildlife Research, Monitoring, and Evaluation Approach

Organization of the Draft RME Plan Methodologies (Appendix H) is as follows:

Existing Data Gaps and Research Needs

- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address.
- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort

Monitoring and Evaluation: Ecological Trend, Focal Habitats and Species Monitoring Methodology

- Ecological Trend Monitoring (Plant Community, Land Birds, Herpetofauna, Small Mammals)
- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed
- Other Research, Monitoring and Evaluation Efforts in the Subbasin including those from managed species plans.

EXISTING DATA GAPS AND RESEARCH NEEDS

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in Table 11.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 11. Data Gaps and Research Needs, Umatilla/Willow Subbasin, as identified during subbasin planning.

RESEARCH NEEDS AND DATA GAPS	**STRATEGY TO ADDRESS**	**AGENCY/ PERSONNEL**
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected focal or other obligate species/assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale, high quality habitat data including structural KEC data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current data, current CREP, WHIP program/field delineations and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refinement of recommended management conditions for all habitats	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Local population/distribution data for focal species	Species Monitoring, Spatial data collection, and GIS analysis	Subbasin managers
Evaluate the role of management treatments to maintain/improve habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers
ADD ALL DATA GAPS AND RESEARCH NEEDS FROM ASSESSMENT HERE.		

MONITORING AND EVALUATION: ECOLOGICAL TREND, FOCAL HABITAT, AND SPECIES MONITORING METHODOLOGY

Recommended monitoring and evaluation strategies for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established

by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b) and *Sampling Vegetation for Monitoring Plant Communities* (Johnson, C.G. Jr., USDA Forest Service, Area 3 – Malheur, Umatilla, and Wallowa-Whitman National Forests, May 1998).

A common thread in the monitoring strategies which follow is the establishment of permanent roadside and off-road census stations to monitor bird population and habitat changes (See Land Bird Monitoring Section Below), small mammal census to track abundance, diversity and trends (see Small Mammal Monitoring Section below), herptofauna census to track presence/absence and abundance (see Herptofauna Monitoring section below).

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions and target wildlife population responses at the project level.

Specific methodology for selection of Project Level Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest.

The monitoring program is established for protected and managed habitats to monitor focal species population and habitat changes and evaluate success of efforts. Project monitoring will key in on factors effecting focal habitat attributes as defined in the working hypotheses for each focal habitat and the recommended range of management conditions (KEC's) defined in the plan.

Sampling design includes locating permanent survey transects within focal habitats in protected and managed habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service and used extensively within the Columbia Basin to plan and track terrestrial mitigation actions pursuant to the NPCC Fish and Wildlife Program. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, establishment of permanent plant community, avian, small mammal and herptofauna monitoring sites within focal habitats both on and off protected and managed habitat areas will provide information on long-term viability of obligate/focal wildlife species. Structural habitat conditions will be monitored at avian monitoring sites every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
Draft Focal Habitat and Species monitoring methodologies are contained in Appendix H.

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