

Lake County Watershed Council Area Watershed Health Indicators

Prepared for

The Oregon Watershed Enhancement Board
Salem, Oregon

Prepared by

Steve Bauer and Ed Salminen
Watershed Professionals Network
Boise, Idaho

In cooperation with

Lake Watershed Council
Lakeview, Oregon

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Introduction

The Lake County Watershed Council (LCWC) area includes lands that are located in two Oregon ecosystems, the Northern Basin and Range and the East Cascades. The eastern side, comprised of Summer Lake, Lake Abert, and Warner Lakes basins, is part of the Northern Basin and Range Ecoregion (ODFW 2006). This ecoregion is comprised of numerous flat basins separated by isolated mountain ranges. Several important mountains are fault blocks, with gradual slopes on one side and steep basalt rims and cliffs on the other side. Elevations in Lake County range from 4,100 feet to 8,450 feet. In the rain shadow of the Cascades Mountains, the Northern Basin and Range is Oregon's driest ecoregion and marked by extreme ranges of daily and seasonal temperatures. Much of the ecoregion receives less than 15 inches of precipitation per year, although mountain peaks receive higher amounts, 30-40 inches per year. Runoff from precipitation and mountain snowpack often flows into low, flat playas where it forms seasonal shallow lakes and marshes. Most of these basins contained large deep lakes during the late Pleistocene, between 40,000 and 10,000 years ago. As these lakes, which don't drain to the ocean, dried through evaporation, they left salt and mineral deposits that formed alkali flats. They are extremely important stopover sites for migratory shorebirds due to the rich source of invertebrate prey. Sagebrush communities dominate the landscape. Due to the limited availability of water, sagebrush is usually widely spaced and associated with an understory of forbs and perennial bunchgrasses such as bluebunch wheatgrass and Idaho fescue.

The Goose Lake basin is included in the East Cascades Ecoregion (ODFW 2006). The Goose Lake basin straddles the border between northeastern California and south-central Oregon. The high desert watershed encompasses 1,140 square miles of land that drains from both the west and the east into Goose Lake, a closed-basin lake system that no longer has a surface outlet to the nearby Pit River. The last recorded lake overflow occurred in 1868, when after a series of extremely wet years, the lake did contribute some surface flow into the Pit River System. Currently, a low, gravelly terrace separates the lake from a marshy meadow. Elevations within the watershed range from 8,000 feet in the Warner Mountains

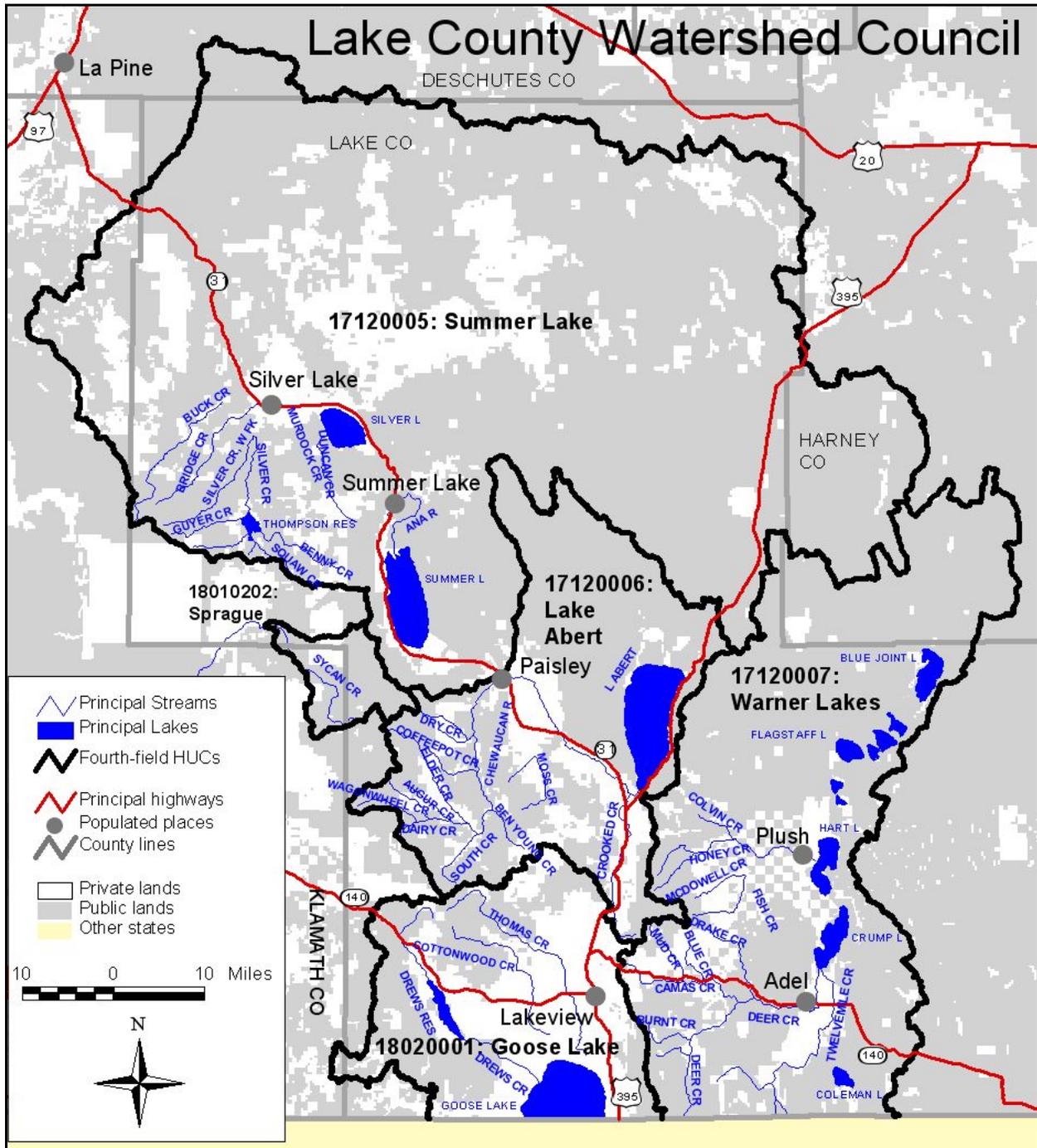
on the east side of the basin down to 4,693 feet at average lake level. Vegetation is diverse and ranges from mixed conifer forests in the Warner Mountains to sagebrush-dominated shrublands, grasslands, and marshes descending from the mountains towards the lake (Goose Lake Basin Watershed Groups 2009).

The LCWC encompasses four 4th Field HUCs (See Figure 1). Area in Oregon, total area in square miles, and miles of perennial and intermittent/ephemeral streams are shown in the table below.

Table 1. Area of subbasins and stream miles for Lake County Watershed Council

HUC4	Area in Oregon (mi ²)	Total area (mi ²)	Stream Miles (Oregon only)		
			Perennial	Intermittent/ephemeral	Total
17120005: Summer Lake	4,133	4,133	261	4,505	4,766
17120006: Lake Abert	1,030	1,030	522	1,397	1,919
17120007: Warner Lakes	1,717	1,894	490	2,198	2,689
18020001: Goose Lake	725	1,093	626	1,101	1,726

Figure 1. Principal streams and 4th Field HUCs in the Lake Watershed Council Area



Purpose and Scope

The goal of this project was to summarize limiting factors¹ that are limiting the health of watersheds. This report fulfills the Oregon Watershed Enhancement Board's legislative mandate to establish priorities that will help guide funding decisions in line with OWEB's mission to achieve healthy watersheds and sustainable communities. A decision making process for establishing priorities will necessarily involve additional factors such as cost effectiveness, willing partners and opportunities for partnerships.

The OWEB project aimed to summarize limiting factor information at the fifth field HUC scale in a consistent manner across the state. In the closed basins, data is very limited and therefore the information was summarized at the fourth field HUC scale. This report represents a summary of the information available at this time and should be revisited and updated as additional information becomes available.

¹ Limiting factor in this context is used broadly to refer to physical factors in the environment that preclude the achievement of water quality goals, fish and wildlife habitat, or sustainable water and soil resources.

Information Sources

Information on watershed conditions in these basins is contained in broad-scale evaluations or in site-specific studies of fish and wildlife populations, riparian conditions, and water quality. The following primary sources were evaluated for information in describing watershed health, however, these sources do not each contain information for every 4th field HUC in the basin. Refer to the Appendix for information on how these data sources were used in this summary.

- The Oregon Conservation Strategy (ODFW 2006) is useful in describing ecoregion scale limiting factors and current restoration strategies.
- The Oregon Native Fish Status Report (ODFW 2005) assesses the population status of native fish populations and identifies factors thought to be limiting population sustainability.
- ODFW Aquatic Habitat Inventory Data Base (ODFW 2009) provides data from standard field habitat surveys.
- Riparian Conditions: The primary information source is the Proper Functioning Condition database from BLM. (BLM 2009)
- ODEQ Water Quality Limited Stream Lists: 303(d) lists (ODEQ 2009)
- OWRD Flow Restoration Priority Areas (OWRD 2003)
- ODFW Greater Sage-Grouse Conservation Assessment and Strategy (ODFW 2005)
- Watershed Council and Agency Watershed Assessments
- Fish and wildlife studies and conservation plans

Organization of Document

The summary of limiting factors or watershed health indicators is organized in the following manner.

- 1) Limiting factors for key terrestrial and aquatic habitats are described at the ecoregion scale for the Northern Basin and Range Ecoregion.
- 2) Limiting factors and conservation opportunities are then stepped down to the 4th field HUC, where information is available, to include:
- 3) Recommended Conservation Actions in specific Opportunity Areas
- 4) Native Fish Populations: Status, limiting factors, and opportunities
- 5) Fish Habitat Assessments
- 6) Water Quality Summary
- 7) Riparian Conditions
- 8) Wetlands information
- 9) Uplands – primarily invasive species and noxious weeds
- 10) Issues and Opportunities identified by Watershed Councils

Ecoregion Scale Habitats and Limiting Factors

The Conservation Strategy (ODFW 2006) identifies characteristic habitat types in the ecoregion and identifies threats and recommended approaches to lessen the effect of these threats.

Conservation strategy habitats in the Northern Basin and Range Ecoregion include: sagebrush shrublands (particularly big sagebrush habitats), aspen woodlands, riparian, wetlands, and aquatic habitats. In the East Cascades ecoregion ponderosa pine woodlands are an additional strategy habitat.

Invasive species and altered fire regimes are the greatest terrestrial conservation issues in this ecoregion. As a result of altered fire regime, encroachment of juniper has displaced grasses and sagebrush, especially in the northern portions of the ecoregion. However, old-growth juniper occurs in some areas, especially in rock outcrops where grasses and sagebrush are uncommon and where fire is less of a factor, and is extremely beneficial to wildlife.

Aquatic habitats are affected by altered channel and flow conditions, obstructions, and poor riparian condition. Efforts to assess the quality of aquatic habitats are ongoing and obtaining an understanding of natural temperature and water quality dynamics in the ecoregion is a research priority.

Watershed Health Limiting Factors

These limiting factors for watershed health were identified at the broad scale for the Northern Basin and Range and East Cascades Ecoregion (Oregon Conservation Strategy, ODFW 2006).

- Invasive Species (Cheatgrass/juniper/noxious weeds).
- Altered Fire Regimes.
- Habitat Fragmentation - in non-forested areas.

- Ongoing recovery from historic overgrazing.
- Off Highway Vehicle Use/ Unmanaged Recreation.
- Water distribution – fully allocated in storage and other uses.
- Water Quality – primarily high stream temperature (applicability of state standards to desert streams is identified as a research need).
- Water Quality – Some areas may be impacted by bacteria, pollutants, and aquatic weeds.
- Aquatic Habitats – altered channel and flow conditions, migration barriers, and poor riparian conditions.
- Alterations of streams – historic ditching of stream channels in the early 1900's (Personal Communication, LCWC, 2009).

Fish Species

The closed lake basins contains a number of endemic species and fish species that are listed as threatened or endangered (ODFW 2009) as shown in the table below. The Goose Lake Basin which straddles Oregon and California contains nine native fishes. Goose Lake redband trout, Goose Lake sucker, Goose Lake Tui chub, and Goose Lake lamprey are endemic to Goose Lake, in addition Modoc Sucker occur in Goose Lake. Four of the native species are primarily stream dwelling: Pit-klamath brook lamprey, speckled dace, Pit roach, and Pit sculpin (Goose Lake Conservation Strategy (ODFW 1996). Warner Lakes has the Warner Lakes Redband Trout and the threatened Warner Sucker. The Chewaucan Redband Trout is a State sensitive species that occurs in the Lake Abert subbasin.

Table 2. State and federal listed fish species in Lake County Watershed Council

Common Name	Scientific Name	USGS HUC distribution (current)	Status
ODFW Sensitive			
Modoc Sucker	<i>Catostomus microps</i>	Goose Lake (18020001)	Sensitive - Critical
Goose Lake Redband Trout	<i>Oncorhynchus mykiss newberrii</i>	Goose Lake (18020001)	Sensitive - Critical
Warner Lakes Redband Trout	<i>Oncorhynchus mykiss newberrii</i>	Warner Lake (17120007)	Sensitive - Critical
Summer Lake Redband Trout	<i>Oncorhynchus mykiss newberrii</i>	Summer Lake (18020005)	Sensitive - Critical
Goose Lake Sucker	<i>Catostomus occidentalis lacusanserinus</i>	Goose Lake (18020001)	Sensitive - Vulnerable
Alvord Chub	<i>Gila alvordensis</i>	Alvord Lake (17120009)	Sensitive - Vulnerable
Chewaucan Redband Trout SMU	<i>Oncorhynchus mykiss newberrii</i>	Lake Abert (17120006)	Sensitive - Vulnerable
Threatened or Endangered			
Modoc sucker	<i>Catostomus microps</i>	Goose Lake (18020001)	Endangered
Foskett Speckled Dace	<i>Rhinichthys osculus ssp</i>		Threatened
Hutton Spring Tui Chub	<i>Gila bicolor ssp.</i>		Threatened
Warner Sucker	<i>Catostomus warnerensis</i>	Warner Lake (17120007)	Threatened
No Special Status			
Pit Sculpin	<i>Cottus pitensis</i>	Goose Lake (18020001)	Endemic
California Roach	<i>Lavinia symmetricus</i>	Goose Lake (18020001)	no special status
Speckled Dace	<i>Rhinichthys osculus</i>	Goose Lake (18020001)	no special status
Pit-klamath Brook Lamprey	<i>Lampetra lethophaga</i>	Goose Lake (18020001)	no special status
Goose Lake Tui Chub	<i>Gila bicolor ssp.</i>	Goose Lake (18020001)	no special status

Streamflow Restoration Priority Areas

The Water Resources Department and the Department of Fish and Wildlife jointly identified priority areas for streamflow restoration in basins throughout the state with input from OWRD watermasters (OWRD 2003). These priority areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts under the Oregon Plan for Salmon and Watersheds. Flow restoration needs for fish were identified by ODFW and flow restoration opportunities were identified by OWRD staff. These two rankings are combined to identify the priority areas. Restoring streamflows is based on voluntary local actions.

Flow restoration priorities for Lake County are shown on the OWRD website (OWRD 2003). The geographic areas overlay several 5th field HUC's so the information is shown in the table below rather than in the 4th-field HUC sections.

Table 3. Lake County Watershed Council Stream Flow Priority Areas

Streamflow Priority Area	Priority	HUC 5	HUC Name
Buck Cr > Silver L - At Marsh	Current Resources Priority	1712000501	Buck Creek
Crooked Cr > Chewaucan R - At Mouth	Current Resources Priority	1712000603	Crooked Creek
Chewaucan R > L Abert - At Mouth	Current Resources Priority	1712000604	Lower Chewaucan River
Twentymile Cr > Crump L - Above Unnamed stream	Priority	1712000701	Twentymile Creek
Deep Cr > Crump L - At Mouth	Current Resources Priority	1712000703	Crump Lake
Twentymile Cr > Crump L - At Mouth	Priority	1712000703	Crump Lake
Deep Cr > Crump L - Above Horse Cr	Priority	1712000704	Deep Creek
Honey Cr > Hart L - At Mouth	Current Resources Priority	1712000705	Honey Creek
Drews Cr > Goose L - At Mouth	Current Resources Priority	1802000101	Drews Creek
Camp Cr > Thomas Cr - At Mouth	Current Resources Priority	1802000102	Thomas Creek
Cottonwood Cr > Thomas Cr - At Mouth	Current Resources Priority	1802000102	Thomas Creek
Thomas Cr > Goose L - Above Camp Cr	Current Resources Priority	1802000102	Thomas Creek

Wetlands

The National Wetland Inventory (NWI) data was available for less than a third of the basin so NWI was not useful for the evaluation. Other sources of information such as the NRCS digital soil survey and the Oregon Natural Heritage Program were evaluated (See the Appendix), however, the most useful source of information on wetlands was the change from historic to current wetland acres summarized in the Oregon Conservation Strategy (ODFW 2006).

Table 4. Current vs. Historic Wetlands evaluated in the Oregon Conservation Strategy

Hydrologic Unit Code	Current Wetlands	Historic Wetlands	Loss	Gain
17120005: Summer Lake	7,030	19,380	12,351	
17120006: Lake Abert	3,619	8,271	4,651	
17120007: Warner Lakes	4,873	6,071	1,197	
18020001: Goose Lake	4,607	3,702		905

As indicated in the table significant wetland loss has occurred in the Summer Lake and Lake Abert 4th Field HUCs, with some apparent increase in the Goose Lake area.

Sage-Grouse Conservation Strategy

The Greater Sage-grouse Conservation Assessment and Strategy for Oregon (Hagan 2005) is intended to promote the conservation of greater sage-grouse and intact functioning sagebrush communities in Oregon. Although this strategy focuses on conservation of greater sage-grouse, the intent is to benefit conservation needs of other sagebrush-steppe species.

The Strategy describes **Objective 5** for the Lakeview District: Maintain or enhance sage-grouse numbers and distribution at the 2003 spring breeding population level, approximately 12,000 birds, until 2055.

Actions identified for this area include:

- 5.1. Monitor trends in sage-grouse numbers to contribute to the statewide population objective.
- 5.2. Collect movement data to evaluate connectivity with populations in California and Nevada.
- 5.3 Monitor the geographic distribution of leks.
- 5.4. If the trend indicates an annual decline in a population of >7% for more than 3 consecutive years or a decline <7% for 5 or more consecutive years, then federal and state agencies will need to consider management actions to reverse the decline or at least stabilize the population, including, evaluating harvest levels on a unit by unit basis.
- 5.5. Coordinate with land management entities to address land use issues that may be affecting populations.
- 5.6. Identify lek complexes that could serve as source populations for intra- and interstate translocation projects.
- 5.7. Identify regions within the Klamath Basin that maybe suitable for reintroduction.

Summer Lake Basin (17120005)

Conservation Opportunity Areas

Conservation Opportunity Area features, key habitats, and recommended conservation actions from the Oregon Conservation Strategy (ODFW 2006) are listed below. Location of the Conservation Opportunity Areas is shown in Figure 2.

NBR-01. Squaw Ridge area playas and sagebrush

This area is located along the western part of the ecoregion, following the high lava plains subregion from the Squaw Ridge Wilderness Study Area to just southeast of the Lost Forest Area of Critical Environmental Concern.

Key Habitats:

- Big Sagebrush Shrublands
- Wetlands
- Pine Forests

Key Species:

- Ferruginous Hawk
- Sage Grouse
- Swainson’s Hawk
- Pygmy Rabbit

Recommended Conservation Actions:

- Control spread of western juniper to maintain habitat values in sagebrush habitats
- Manage livestock grazing to promote recovery and maintenance of vernal pool (playa) wetlands

- Restore and maintain complex, continuous sage habitat
- Maintain and improve wetland habitat for waterfowl

NBR-02. Summer Lake area

This area is comprised of Summer Lake and the surrounding high desert wetlands subregion, including much of the Diablo Mountain Wilderness Study Area.

Key Habitats:

- Aquatic
- Salt Desert Scrub
- Wetlands

Recommended Conservation Actions:

- Improve water delivery system at Summer Lake Wildlife Area to improve effectiveness of wetland management
- Maintain diverse wetland habitats

The following were added by LCWC (Personal Communication, LCWC, 2009).

- Control noxious weed
- Control Western Juniper
- Improve aquatic habitat
- Eliminate fish barrier

Aquatic

A. Native Fish Status Report

Two Redband Trout Species Management Units (SMUs), Fort Rock Redband SMU and part of the Chewaucan SMU, are listed in the Native Fish Status Report (ODFW 2005).

The Fort Rock Redband Trout SMU is comprised of three populations in the Silver Lake basin: Buck Creek (HUC 1712000501) and Bridge Creek and Silver Creek (HUC 1712000502). These streams drain into Paulina marsh and Silver Lake, remnants of the basin’s large Pleistocene lake. Redband populations occupy tributaries of Paulina Marsh which has been diked, channelized, and drained for agricultural purposes. Populations are only connected during consecutive high water years, severely limiting the opportunities for the expression of a migratory life history and inter-population mixing. Lack of a migratory life history and degraded habitat impacts the potential productivity. This SMU is classified as ‘at risk’ because eighty percent of the populations meet only three of the six interim population criteria.

Foster Creek is located in the Summer Lake hydrologic unit (HUC 1712000510) southwest of the lake. Redband trout in Foster Creek are considered part of the Chewaucan SMU. The Foster Creek population has an extremely limited distribution and is limited from large water bodies and other populations.

Limiting Factors:

The primary limiting factor is connectivity between populations associated with both natural and human causes. Paulina Marsh has been drained and channelized for agricultural purposes. During normal precipitation cycles populations are isolated by a lack of connection at Paulina Marsh and impassable irrigation structures and diversions. Buck and Bridge creeks are able to connect only during extended periods of above average precipitation. In addition, a large irrigation diversion dam on Silver Creek prevents fish from moving into Silver Creek.

Table 5. Redband Trout Population Status and Limiting Factors (ODFW 2005)

Fifth Field HUC	Population Status	Limiting factors
1712000501: Buck Creek	Buck Creek: Passes the six population status criteria.	Limiting factor is primarily habitat connectivity. Secondly, there is competition with brook trout.
1712000502: Silver Lake	Silver Creek: Fails three of six population criteria: distribution, productivity, and reproductive independence.	Silver Creek: Limiting factors are connectivity, brook trout abundance, and potential interbreeding with hatchery rainbow.

1712000502: Silver Lake	Bridge Creek: Fails one population criteria: productivity.	Bridge Creek: Limiting factor is primarily habitat connectivity.
1712000510: Summer Lake	Foster Creek: Fails two of six population criteria: distribution and productivity.	Foster Creek: Limiting factor is primarily the extremely limited distribution and isolation.

B. Fish Habitat

ODFW Inventory: There are stream surveys for two streams in the ODFW Aquatic Habitat Inventory Project (ODFW 2009B) as shown in the table below. The habitat data was evaluated only for fine sediments, bank erosion, and shade. See Appendix for an explanation of how the habitat condition status was evaluated. The three factors evaluated - sediment, shade, and bank erosion - were not identified as limiting factors.

Table 6. Aquatic Habitat Limiting Factors in the Summer Lakes Basin

Stream	Stream Miles	Status	Limiting Factor	Survey Date
Bridge Creek	8.7	Adequate	none identified	1992
Buck Creek	7.9	Adequate	none identified	1990

Silver Lake Watershed Assessment: The Silver Lake Watershed Assessment (Friedrichsen 2003) evaluated habitat in Bridge Creek and Silver Creek (HUC 1712000502) watersheds and in the Buck Creek (HUC 1712000501) watershed. Aquatic habitat conditions were surveyed in Silver Creek, West Fork Silver Creek, Guyer Creek, Bridge Creek and Buck Creek for large woody debris (LWD), pool frequency, fines in spawning gravels, stream temperature and fish passage at culverts. Approximately 50% of the forested reaches are rated functioning-at-risk due to low LWD counts. Pool frequency was generally good with 95% of reaches meeting the desired pool frequency rating. Of the sites measured for spawning gravel fines 77% were evaluated as functioning-at-risk or not functioning appropriately. The report noted the importance of restoring beaver dams to aid in trapping sediment. Of the 23 culverts surveyed 83% were found to be barriers or partial barriers to fish passage.

C. Water Quality

Water Quality Limited Streams, 2004-2006 303(d) List

The following table shows only the streams from the 303(d) list (ODEQ 2009) that are currently listed as Water Quality Limited. This includes two categories on the list, “303d” and “Category 5” which require completion of a TMDL. Other categories such as “delisted” or “TMDL not needed” are not shown in this list.

Table 7. Water Quality Limited Streams identified by ODEQ

Stream	River Miles	Parameter	Season	Criteria	Status
Silver Creek	0 to 33.3	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Riparian

PFC: BLM and other agencies often use the PFC protocol (Proper Functioning Condition) for monitoring riparian areas in rangelands. We were unable to obtain any PFC data in this area.

Silver Lake Watershed Assessment : The Silver Lake Watershed Assessment (Friedrichsen 2003) determined that approximately 15% of the low gradient C and E stream channels are functioning-at-risk due to increased width-to-depth ratios. Meadows in these areas have been strongly influenced by grazing practices that have reduced riparian vegetation densities important for bank stability and low width-to-depth ratios. In addition, the legacy of beaver trapping has reduced the extent of bank saturation and groundwater storage.

Uplands

Silver Lake Watershed Assessment : The watershed was rated as functioning-at-risk due to high road densities and the high percentage of roads that are hydrologically connected to the stream network. This may alter peak flows in the stream systems and be a source of sediments to Buck Creek, Bridge Creek, and Silver Creek (Friedrichsen 2003).

Juniper encroachment is having a negative impact on the uplands. Aspen stands in this area are also dwindling from aggressive juniper and conifer encroachment (Personal Communication, LCWC, 2009).

Noxious Weeds

Lake County has identified seven weed protection areas and the threat of noxious weeds within the areas. Threats are designated as: 0) Watch for, 1) Establishing, 2) Controllable, 3) Widespread and “x”) Not detected. The Summer Lake HUC has three noxious weed areas – Summer Lake, Fort Rock Alfalfa, and Desert areas. The noxious weed threat is shown in the table below.

Table 8. Noxious Weed Threat Status Identified By Lake County Weed Management Cooperative

Weed Area	Weed name	Threat
Summer Lake Weed Area	Scotch thistle	2
Summer Lake Weed Area	Perennial Pepperweed	2
Summer Lake Weed Area	Canada thistle	3
Summer Lake Weed Area	White top	1
Summer Lake Weed Area	Halogeton	2
Summer Lake Weed Area	Medusahead	1
Summer Lake Weed Area	Yellow starthistle	1
Summer Lake Weed Area	Med sage	3
Summer Lake Weed Area	Russian knapweed	1
Summer Lake Weed Area	Musk thistle	2 or 3
Summer Lake Weed Area	Field bindweed	2
Summer Lake Weed Area	Spiny cocklebur	1
Ft. Rock Alfalfa	Russian knapweed	2
Ft. Rock Alfalfa	Spotted knapweed	2
Ft. Rock Alfalfa	Squarrose knapweed	2
Ft. Rock Alfalfa	Canada thistle	1
Desert Weed Area	Scotch thistle	1
Desert Weed Area	Perennial Pepperweed	2
Desert Weed Area	Canada thistle	2
Desert Weed Area	White top	2
Desert Weed Area	Halogeton	2
Desert Weed Area	Medusahead	0
Desert Weed Area	Yellow starthistle	0
Desert Weed Area	Med sage	2
Desert Weed Area	Russian knapweed	2
Desert Weed Area	Spotted knapweed	2
Desert Weed Area	Squarrose knapweed	2
Desert Weed Area	Musk thistle	2 or 3

Desert Weed Area	Spiny cocklebur	0
Desert Weed Area	Toadflax	1

Watershed Assessment Identified Issues and Recommendations

The following are recommendations from the Silver Lake Watershed Analysis (Friedrichsen 2003). The watershed analysis addressed the forested lands within the Buck Creek, Bridge Creek and Silver Creek watersheds. The forested land covers approximately 117,061 acres or approximately 70% of the watershed area.

1. Forest Thinning and Juniper Reduction

Forest understories in ponderosa pine and mixed conifer forests should be thinned to reduce the risk of catastrophic fire, associated soil erosion, sedimentation, and increased flows. Juniper thinning should be considered in areas of juniper encroachment to promote growth of native grasses, forbs, and shrubs.

2. Road Density

Road miles should be progressively decreased through decommissioning (obliteration or permanent closure). Emphasis should be place on those roads within 300 feet of streams or which have numerous stream crossings.

3. Riparian Enhancement

In all reaches where conifer encroachment is common, mechanically thin encroaching conifers or use prescribed fire to maintain growth of riparian grasses, shrubs, and trees.

Implement grazing management that promotes the growth of willow and improves width-to-depth ratios along C and E stream channels. Continue deferred grazing strategies or other strategies that promote late-seral riparian plant communities and bank stability.

4. Aquatic Habitat

In the short term add LWD to streams that were identified as deficit in large wood. In the long term achieve LWD recruitment by leaving buffers along forest reaches. Added wood can also be used to increase pool frequency and quality of pools.

Decommission roads with emphasis on roads within 300 feet of streams or roads with numerous stream crossings. On the remaining roads, work on proper drainage to reduce sedimentation.

5. Fish Passage

Replace existing culverts that are fish passage barriers with properly designed structures that provide for fish passage.

6. Watershed Council Project Priorities

- Thinning or removal of conifers and junipers.
- Develop a program for control and elimination of noxious weeds as a preventative step.

(The Lake County Cooperative Weed Management Area was established in 2005 to accomplish this objective. The Watershed Council has two active members on this board. The Board has taken an aggressive approach to contending with weed issues on both private and public land throughout the county. (Personal Communication, LCWC, 2009)

- The focus of riparian/instream projects will be on establishing riparian vegetation, adding LWD, improve culverts for fish passage, development of off-site water sources and changes to grazing management.
- Roads on Forest Service lands should be treated upon completion of the NEPA process. Further analysis is needed for roads on BLM and private lands.

Lake Abert Basin (17120006)

Conservation Opportunity Areas

Conservation Opportunity Area features, key habitats, and recommended conservation actions from the Oregon Conservation Strategy (ODFW 2006) are listed below. Location of the Conservation Opportunity Areas is shown in Figure 2.

NBR-03. Lake Abert-Honey Creek area

This area encompasses Lake Abert and most of the Honey Creek drainage, including the Lake Abert Area of critical environmental concern and the Abert Rim Wilderness Study Area.

Key Habitats:

- Aquatic
- Aspen Woodland
- Big Sagebrush Shrublands
- Riparian
- Wetlands

Key Species:

- Black-necked Stilt
- Juniper Titmouse
- Western Snowy Plover
- Oregon Great Basin Redband Trout
- Oregon Lakes Tui Chub
- Warner Sucker

Recommended Conservation Actions:

- Manage livestock grazing to promote recovery and maintenance of wet meadow, riparian, and aspen habitats
- Promote early detection and suppression of invasive weeds
- Restore and maintain complex, continuous sage habitat

The following were added by LCWC (Personal Communication, LCWC, 2009).

- Improve habitat for sage grouse
- Reduce juniper encroachment
- Remove fish barriers

EC – 17. Chewaucan River

Special Features:

A partnership between local leaders and Sustainable Northwest led to a forest restoration project on 50,000 acres of forested habitat in the Chewaucan River drainage.

Key Habitats:

- Aquatic
- Riparian

Key Species:

- Oregon Great Basin Redband Trout

Aquatic

A. Native Fish Status Report

The Chewaucan Redband Trout SMU is comprised of four populations (ODFW 2005).

Three populations, Chewaucan, Crooked, and Willow, are within the Lake Abert basin and

were historically connected to the Chewaucan Marsh. Lake Abert and Summer Lake are remnants of ancient Lake Chewaucan and are naturally separated by large sand dunes.

Limiting Factors:

The primary limiting factors are degraded habitats and lack of access to support migratory life history.

Table 9. Redband Trout Population Status and Limiting Factors (ODFW 2005)

Fifth Field HUC	Population Status	Limiting factors
1712000601 (02): Upper and Middle Chewaucan River.	Chewaucan River: Passes all six population criteria.	Habitat in lower Chewaucan River and Dairy Creek are severely degraded.
1712000604: Lower Chewaucan River.	Willow Creek: Fails one of six population criteria: productivity.	Lacks connectivity to habitats capable of supporting a migratory life history; habitat quality is degraded.
1712000603: Crooked Creek	Crooked Creek: Fails one of six population criteria: productivity.	Habitat is degraded and lacks connectivity to support migratory life history.

B. Fish Habitat

ODFW Inventory: There are stream surveys for three streams in the ODFW Aquatic Habitat Inventory Project (ODFW 2009B) as shown in the table below. Of these streams only one, Crooked Creek, indicated possible limitations with bank erosion. The habitat data was evaluated only for fine sediments, bank erosion, and shade. See Appendix for an explanation of how the habitat condition status was evaluated.

Table 10. Aquatic Habitat Limiting Factors in the Lake Abert Basin

Stream	Stream Miles	Status	Limiting Factor	Survey Date
Augur Creek	7.7	Adequate		1991
Bear Creek	8.2	Adequate		1992
Crooked Creek	6.0	Moderate	bank erosion	1992

Chewaucan Watershed Assessment : The Chewaucan watershed assessment (Fremont NF 1999) encompassed streams in the Upper (HUC 1712000601) and Middle (HUC 1712000601) Chewaucan watersheds. Aquatic habitats were evaluated in Bear Creek, Coffeepot Creek, Ben Young Creek, Swamp Creek, and the Chewaucan River. In the

majority of stream reaches fine sediments were found to be in an acceptable range for salmonid fish. All sites monitored for temperature within the Chewaucan study area exceeded the State temperature criteria of 17.8 degrees Celsius except for Upper Bear Creek. Temperature increases were attributed to low shade levels or stream widening. Lack of large wood was identified as a limiting factor in many stream segments.

C. Water Quality

Water Quality Limited Streams, 2004-2006 303(d) List (ODEQ)

The following table shows only the streams from the 303(d) list (ODEQ 2009) that are currently listed as Water Quality Limited. This includes two categories on the list, “303d” and “Category 5” which require completion of a TMDL. Other categories such as “delisted” or “TMDL not needed” are not shown in this list.

Table 11. Water Quality Limited Streams identified by ODEQ

Stream	River Miles	Parameter	Season	Criteria	Status
Augur Creek	0 to 2.7	Temperature	Summer	Rearing: 17.8 C	303(d)
Bear Creek	0 to 9.5	Temperature	Summer	Rearing: 17.8 C	303(d)
Ben Young Creek	0 to 8	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Chewaucan River	35.2 to 61.5	Biological Criteria	Undefined	Biocriteria: based on biological community.	303(d)
Chewaucan River	0 to 61.5	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Coffeepot Creek	0 to 10	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Little Coffeepot Creek	0 to 4.3	Temperature	Summer	Rearing: 17.8 C	303(d)
Morgan Creek	0 to 4.8	Temperature	Summer	Rearing: 17.8 C	303(d)
Shoestring Creek	0 to 7	Temperature	Summer	Rearing: 17.8 C	303(d)
South Creek	0 to 10.6	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Swamp Creek	0 to 6.2	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
West Fork Shoestring Creek	0 to 3.4	Temperature	Summer	Rearing: 17.8 C	303(d)
Willow Creek	0 to 15.3	Temperature	Summer	Rearing: 17.8 C	303(d)

Riparian

PFC: BLM and other agencies often use the PFC protocol (Proper Functioning Condition) for monitoring riparian areas in rangelands. We were unable to obtain any PFC data in this area.

Chewaucan Watershed Assessment : The Chewaucan watershed assessment (Fremont NF 1999) evaluated riparian conditions in five tributaries (Bear Cr., Coffeepot Cr., Ben Young Cr. and Swamp Cr. and Chewaucan River). Conifer encroachment into the floodplain and riparian areas was identified as a common threat throughout the Chewaucan stream system.

Uplands

Chewaucan Watershed Assessment:

The Chewaucan watershed assessment (Fremont NF 1999) evaluated upland erosion sources. A high percentage of the watershed (67%) is classified as having a high or high/moderate natural erosion rate. Roads and logging contribute to sedimentation in upland areas, and soil damage has occurred from grazing in riparian areas such as springs, seeps, and wet meadows. Juniper expansion has occurred as the result of fire suppression and overgrazing in some areas.

Risk to hydrologic watershed functions based on road density was rated as follows: High Watershed Risk Rating in Bear Creek, Ben Young Creek, and Swamp Creek; Moderate in Coffeepot Creek; and Low in Chewaucan River.

Noxious Weeds:

Lake County has identified seven weed protection areas and the threat of noxious weeds within the areas. Threats are designated as: 0) Watch for, 1) Establishing, 2) Controllable, 3) Widespread and “x”) Not detected. The noxious weed threat identified in the Chewaucan Weed Area is shown in the table below.

Table 12.Noxious Weed Threat Status Identified by Lake County Weed Management Cooperative

Weed name	Threat
St. Johnswort	x
Scotch thistle	2
Perennial Pepperweed	x
Canada thistle	3
White top	2
Halogeton	x
Medusahead	2 or 3
Yellow starthistle	1
Med sage	3
Russian knapweed	2
Spotted knapweed	2
Squarrose knapweed	2
Rush Skeleton weed	x
Musk thistle	0
Leafy spurge	x
Field bindweed	3
Spiny cocklebur	x
Dyars' woad	1
Pheasant eye	x
Houndstongue	x
Toadflax	2
Sulfer cinquefoil	x
Oxeye daisy	x
St. Johnswort	x

Watershed Assessment Identified Issues and Recommendations

The Chewaucan watershed assessment (Fremont NF 1999) discussed a number of actions related to forest service and private land management to improve watershed conditions.

The recommendations are captured briefly below.

1. Road Management and Road Density

High open road density is a critical issue. Rehabilitation of existing roads and closing roads is needed to enhance hydrologic function and meet target road densities for deer and elk.

2. Juniper

Juniper that is encroaching into forest sites should be controlled through prescribed fire or mechanical methods. Encroaching populations need to be distinguished from older refugia populations that should be retained.

3. Fire

Fire can be used as a valuable tool in the Chewaucan watershed supporting vegetative management, range, hydrology, fisheries, and wildlife objectives. The objective of using fire treatments is to return vegetative communities to reference condition.

4. Stream Habitat

Adding large wood to streams identified as lacking wood was identified as the primary active restoration action for aquatic habitats.

5. Water Quality

Recommendations for improving water quality address grazing systems, management of riparian communities, using BMPS for grazing and roads, addressing soil compaction in timber units and decommissioning roads.

Warner Lakes Basin (17120007)

Conservation Opportunity Areas

Conservation Opportunity Area features, key habitats, and recommended conservation actions from the Oregon Conservation Strategy (ODFW 2006) are listed below. Location of the Conservation Opportunity Areas is shown in Figure 2.

NBR-05. Hart Mountain area

This area encompasses the Hart Mountain National Wildlife Refuge. It extends north to include the Orejana Canyon Wilderness Study Area and south just past the Guano Creek Wilderness Study Area.

Key Habitats:

- Aquatic
- Aspen Woodland
- Big Sagebrush Shrublands
- Riparian
- Wetlands

Key Species:

- Ferruginous Hawk
- Sage Grouse
- Swainson's Hawk
- Catlow Tui Chub
- Catlow Valley Redband Trout
- Sheldon Tui Chub

- Pronghorn Antelope
- Pygmy Rabbit

Recommended Conservation Actions:

- Initiate or continue wet meadow conservation and restoration efforts.
- Maintain alkaline wetland habitats.
- Maintain and restore aspen habitats.
- Maintain and restore sagebrush-steppe habitats.
- Promote early detection and suppression of invasive weeds.
- Restore and maintain complex, continuous sage habitat.
- Improve habitat for sage grouse & mule deer winter range (Personal Communication, LCWC, 2009).

NBR-04. Warner Basin

Adjacent to the Hart Mountain Refuge, this area includes the High Desert Wetlands from the Warner Wetlands south to the California border.

Key Habitats:

- Aquatic
- Riparian
- Wetlands
- Aspen Woodlands (Personal Communication, LCWC, 2009)
- Sagebrush-steppe (Personal Communication, LCWC, 2009)

Key Species:

- American White Pelican
- Black-necked Stilt

- Snowy Egret
- Western Snowy Plover
- Foskett Spring Speckled Dace
- Warner Sucker
- Warner Valley Redband Trout

Recommended Conservation Actions:

- Improve water management system to enhance wetlands at Warner Wetlands.
- Initiate or continue wet meadow conservation and restoration efforts.
- Maintain or restore riparian habitat and ecological function; ensure sufficient habitat complexity for wildlife.
- Manage livestock grazing to promote recovery and maintenance of wetland and riparian habitats.
- Promote early detection and suppression of invasive weeds.
- Protect springs as breeding sites for Warner sucker.
- Provide passage and screening for Warner sucker (Personal Communication, LCWC, 2009)
- Remove invasive Western Juniper trees (Personal Communication, LCWC, 2009)

EC-22. Warner Mountains

Located east of Lakeview along the eastern border of the ecoregion. Diverse landscape includes extensive Ponderosa pine forests, montane meadows, wetlands, sagebrush, and aspen.

Key Habitats:

- Aquatic
- Aspen

- Ponderosa Pine Woodlands
- Riparian
- Sagebrush-steppe (Personal Communication, LCWC, 2009)

Key Species:

- Great Gray Owl
- Olive-sided Flycatcher
- Sandhill Crane
- Goose Lake Redband Trout
- Warner Valley Redband Trout
- Warner Sucker (Personal Communication, LCWC, 2009)
- Sage Grouse (Personal Communication, LCWC, 2009)

Recommended Conservation Actions:

- Maintain aspen and sagebrush-steppe habitats.
- Maintain or restore riparian habitat and ecological function; ensure sufficient habitat complexity for wildlife.
- Use fire and thinning to restore and enhance ponderosa pine forests.
- Provide passage and screening (Personal Communication, LCWC, 2009).

Aquatic

A. Native Fish Status Report

The Warner Lakes Redband Trout SMU includes four populations in the interior basin of pluvial Lake Warner in Honey Creek, Lower and Upper Deep Creek, and Twentymile Creek (ODFW 2005). Distribution is widespread in perennial streams and lakes, although multiple irrigation diversions and the presence of non-native warm water fish in Warner

Lakes limits the expression of an adfluvial life history. Only three of the six interim population status criteria were met, thereby classifying this SMU as ‘at risk’.

Limiting Factors:

Degraded habitat, presence of non-native species, and barriers to movement that prevent migration limit populations in several populations as indicated in the table.

Table 13. Redband Trout Population Status and Limiting Factors (ODFW 2005)

Fifth Field HUC	Population Status	Limiting factors
1712000705: Honey Creek	Honey Creek: Passes six of six population status criteria.	Barriers to movement and the presence of non-native species in Warner Lakes may limit the expression of adfluvial life history.
1712000704: Deep Creek	Lower Deep Creek: Fails three of six population status criteria: Distribution, abundance, and productivity.	Degraded habitat; barriers to movement and the presence of non-native species in Warner Lakes may limit the expression of adfluvial life history.
1712000704: Deep Creek	Upper Deep Creek: Passes six of six population status criteria.	Good habitat conditions – no limiting factors identified.
1712000701: Twentymile Creek	Twentymile Creek: Fails one of six population status criteria: Productivity.	Lacks adfluvial life history; habitat in lower reaches is severely degraded.

B. Fish Habitat

ODFW Inventory: There are stream surveys for seven streams in the ODFW Aquatic Habitat Inventory Project (ODFW 2009B) as shown in the table below. The habitat data was evaluated only for fine sediments, bank erosion, and shade. See the Appendix for an explanation of how the habitat condition status was evaluated. Increased fine sediment in riffles and limited shade were identified as limiting factors in some streams as indicated in the table.

Table 14. Aquatic Habitat Limiting Factors in the Warner Lakes Basin

Stream	Stream Miles	Status	Limiting Factor	Survey Date
Camas Creek	3.8	Limiting	sediment, shade, bank erosion	1998
Dismal Creek	8.5	Adequate		1990
Fifteenmile Creek	6.2	Moderate	sediment, shade	1998
Honey Creek	5.6	Moderate	sediment, shade	2007
Mosquito Creek	8.0	Adequate		1990

Snyder Creek	6.0	Moderate	sediment, shade	2007
Twelvemile Creek	6.6	Moderate	shade	2007

Deep Creek Watershed Assessment: The Deep Creek Watershed Assessment completed by Forest Service and BLM evaluated 17 streams in the watershed (Fremont NF 1998). Aquatic habitats were evaluated with respect to temperature, pool frequency, LWD, unstable banks, and sediment (fines in potential spawning habitat). High stream temperatures were a consistent limiting factor throughout the watershed and were the primary factor responsible for rating Lower Deep Creek as a high risk for cumulative effects. Low LWD frequency, limited deep pool frequency, and unstable banks were identified as limiting factors in some stream systems.

C. Water Quality

Water Quality Limited Streams, 2004-2006 303(d) List

The following tables show only the streams from the 303(d) list (ODEQ 2009) that are currently listed as Water Quality Limited. Other categories such as “delisted” or “TMDL not needed” are not shown in the tables.

Table 15. Water Quality Limited Streams identified by ODEQ in Deep Creek Watershed

1712000704: Deep Creek					
Stream	River Miles	Parameter	Season	Criteria	Status
Deep Creek	0 to 38	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
North Fork Deep Creek	0 to 2.9	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Burnt Creek	0 to 9	Biological Criteria	Undefined	Biocriteria: based on aquatic species support	303(d)
Camas Creek	0 to 18.7	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Dismal Creek	0 to 7.7	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Drake Creek	0 to 12	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Parsnip Creek	0 to 10.9	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Polander Creek	0 to 2.6	Temperature	Summer	Rearing: 17.8 C	303(d)
Porcupine Creek	0 to 4	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Table 16. Water Quality Limited Streams identified by ODEQ in Honey Lake Watershed

1712000705: Honey Lake					
Stream	River Miles	Parameter	Season	Criteria	Status
Fifteenmile Creek	0 to 6.6	Silver	Year Around	Table 20 Toxic Substances	303(d)
Fifteenmile Creek	0 to 6.6	Temperature	Summer	Rearing: 17.8 C	303(d)
Honey Creek	0 to 25.6	pH	Summer	pH 7.0 to 9.0	Cat 5: TMDL Needed
Honey Creek	0 to 25.6	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Horse Creek	0 to 5	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Horse Creek	0 to 5.8	Temperature	Summer	Rearing: 17.8 C	303(d)
Little Honey Creek	0 to 7.4	Temperature	Summer	Rearing: 17.8 C	303(d)
Snyder Creek	0 to 13	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Twelvemile Creek	0 to 17.3	Arsenic (tri)	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed
Twelvemile Creek	0 to 13	Silver	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed
Twelvemile Creek	13 to 17.3	Silver	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed
Twelvemile Creek	0 to 5.1	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Twelvemile Creek	5.8 to 11.2	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed
Twentymile Creek	0 to 28.9	Arsenic	Year Around	Table 20 Toxic Substances	303(d)
Twentymile Creek	0 to 28.9	Arsenic (tri)	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed
Twentymile Creek	0 to 28.9	Dissolved Oxygen	Year Around (Non-spawning)	Cool water: Not less than 6.5 mg/l	Cat 5: TMDL Needed
Twentymile Creek	0 to 28.9	Silver	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed

1712000705: Honey Lake					
Stream	River Miles	Parameter	Season	Criteria	Status
Twentymile Creek	0 to 28.9	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Riparian

PCF: BLM and other agencies often use the PFC protocol (Proper Functioning Condition) for monitoring riparian areas in rangelands. We were unable to obtain any PFC data in this area.

Deep Creek Watershed Assessment: Riparian conditions were considered some of the most impacted land types in the watershed due to legacy effects of early grazing (Fremont NF 1998). Much of the damage to riparian woody vegetation, such as the loss of cottonwood and willow, occurred in the first half of this century when there was little or no livestock management of public lands. Current grazing management is slowly correcting much of the damage done to riparian areas on public lands. About 66% of public land stream reaches are excluded from grazing and 25% are only being grazed early in the spring every other year. For most private land, riparian condition, trend and management is unknown. Fire suppression has also affected the vegetative component of the riparian zones by allowing encroachment of shade tolerant conifers into aspen and cottonwood.

Uplands

Deep Creek Watershed Assessment:

Effects on peak flow and erosion were evaluated in the watershed assessment (Fremont NF 1998). Increased peak flows were resulting from current conditions assessed in 1998. Increased drainage efficiency from roads and compacted soil are estimated to be the primary causes for increased peak flows. Clear-cut openings are a small part of the watershed (less than 12%), and are not considered a factor in peak flows. Comparative risk to hydrologic function was rated on the basis of changes to canopy cover and road densities. The watershed risk was rated moderate to high in approximately 30% of the

streams evaluated in the basin (17 stream systems, which included Mud Creek, Lower Camas Creek, Horse Creek, Burnt Creek, and Willow Creek.

Noxious Weeds:

Lake County has identified seven weed protection areas and the threat of noxious weeds within the areas. Threats are designated as: 0) Watch for, 1) Establishing, 2) Controllable, 3) Widespread and “x”) Not detected. The noxious weed threat identified in the Warner Weed Area is shown in the table below.

Table 17. Noxious Weed Threat Status Identified By Lake County Weed Management Cooperative

Weed name	Threat
Scotch thistle	2
Perennial Pepperweed	2 or 3
Canada thistle	3
White top	2
Halogeton	2 or 3
Medusahead	1
Yellow starthistle	1
Med sage	3
Russian knapweed	2
Spotted knapweed	0
Squarrose knapweed	0
Rush Skeleton weed	0
Musk thistle	0
Leafy spurge	0
Field bindweed	2
Spiny cocklebur	1
Dyars' woad	x
Pheasant eye	x
Houndstongue	x
Toadflax	x
Sulfer cinquefoil	x
Oxeye daisy	x
St. Johnswort	x

Watershed Assessment Identified Issues and Recommendations

1. Water Quality

Implement the Water Quality Management Plan for Deep Creek by implementing changes to grazing management, restoring riparian vegetation, using BMPs for grazing and roads management, decompacting soils in logged units, and planting willows and cottonwoods to provide shade.

2. Floodplain Restoration using Beaver

Enhance floodplain by improving beaver habitat along both perennial and intermittent streams, which will encourage willow, aspen and cottonwood development within the floodplain.

3. Restoration and Improvement Projects

Proposed projects include controlling erosion and stabilizing stream channels in Camas Creek, controlling downcutting, and restoring floodplain function in Willow Creek, treating bank erosion in Dismal Creek and introducing large wood to Mud Creek.

4. Riparian Habitat Conservation Areas (RHCAs)

Manage RHCAs to meet interim riparian management objectives identified in the Inland Native Fish Strategy.

5. Fisheries

Review existing culverts that are fish barriers to determine if they should remain or be removed.

6. Large Woody Debris (LWD)

Achieve at least the 50th percentile identified in reference reaches. Work with silviculture to develop uneven-aged stands within RHCAs for all streams where historic cutting has occurred or where forest health is of concern.

7. Channel Morphology

Restore streams to the desired natural channel morphology. Rosgen stream channel types G and F should be moved toward channel types C and E, as appropriate. Reduce bank erosion, and improve site conditions for meadow riparian vegetation by raising water table levels through stream channel restoration.

8. Pool Habitat

Implement habitat management and restoration treatments that help achieve at least the 50th percentile of reference for pool frequency and deep pools.

Goose Lake Basin (18020001)

Conservation Opportunity Areas

Conservation Opportunity Area features, key habitats, and recommended conservation actions from the Oregon Conservation Strategy (ODFW 2006) are listed below. Location of the Conservation Opportunity Areas is shown in Figure 2.

EC-20 Thomas Creek

Thomas Creek is the largest tributary of Goose Lake.

Key Habitats:

- Aquatic
- Riparian

Key Species:

- Goose Lake Lamprey
- Goose Lake Redband Trout
- Goose Lake Sucker
- Goose Lake Tui Chub
- Modoc Sucker
- Pit Roach
- Pit Sculpin
- Pit-klamath Brook Lamprey

EC-21 Goose Lake

Special Features:

- Several fish species here are endemic to Goose Lake.
- Ducks Unlimited has been working with private landowners to restore or enhance nine miles of stream and 3,000 acres of wetland, riparian and grassland habitats.
- The lake provides breeding habitat for more than a dozen waterbirds, and receives heavy use by migrating waterfowl.
- The LCWC has also been working with private landowners to enhance over fifteen miles of stream (Personal Communication, LCWC, 2009).

Key Habitats:

- Aquatic
- Riparian
- Wetlands

Key Species:

- Waterfowl
- Goose Lake Lamprey
- Goose Lake Redband Trout
- Goose Lake Sucker

Recommended Conservation Actions:

- Maintain riparian, wet meadow habitats and emergent wetlands.

The following were added by LCWC(Personal Communication, LCWC, 2009).

- Promote early detection and suppression of invasive weeds.
- Provide passage and screening.

- Reduce encroaching juniper.
- Improve riparian conditions where streams have straightened and realigned.

Aquatic

A. Native Fish Status Report

The Goose Lake Redband Trout SMU is comprised of thirteen populations. Spawning and resident fish distribution is fragmented and limited to headwater and mid-order streams. Abundance of redband trout fluctuates with instream flows and habitat quality. Migratory redband trout are present when rearing conditions in Goose Lake are adequate, though irrigation activities and degraded habitat quality hinder movement between the lake and the spawning grounds. Eighty percent of the populations meet three of the six interim criteria, thereby classifying this SMU as ‘at risk’ (ODFW 2005).

Limiting Factors:

The primary limiting factors for these populations are very limited distribution and low abundance, and degraded habitat in some streams.

Table 18. Redband Trout Population Status and Limiting Factor (ODFW 2005)

Fifth Field HUC	Population Status	Limiting factors
1802000104 : Goose Lake West Shore		
Fall Cr.	Fails three of six population status criteria: distribution, abundance, productivity.	Extremely limited distribution; low abundance; no connection to habitat capable of support a migratory life history.
Dry Cr.	Passes six of six population status criteria.	No limiting factors identified.
1802000101: Drews Creek		
Lower Drews Cr.	Fails three of six population status criteria: distribution, abundance, productivity.	Limited distribution and abundance, degraded habitat quality
Upper Drews Cr.	Fails two of six population status criteria: distribution and productivity.	Limited distribution, habitat degraded.

Fifth Field HUC	Population Status	Limiting factors
1802000102: Thomas Creek		
Antelope Cr.	Fails three of six population status criteria: distribution, abundance, productivity.	Limited distribution and abundance, degraded habitat quality
Muddy Cr.	Fails three of six population status criteria: distribution, abundance, productivity.	Limited distribution and abundance.
Cottonwood Cr.	Passes six of six population status criteria.	Habitat not limiting, brook trout present.
Thomas-Bauer's Complex	Passes six of six population status criteria.	Habitat in lower reaches degraded.
Deadman Cr.	Fails one of six population status criteria: productivity.	Limited distribution and abundance; passage to and from Goose Lake is questionable.
1802000103: Goose Lake East Shore		
Crane Cr.	Passes six of six population status criteria.	No limiting factors identified.
Cogswell Cr.	Fails one of six population status criteria: productivity.	Limited distribution and abundance.
Tandy Cr.	Fails three of six population status criteria: distribution, abundance, productivity.	Limited distribution and low abundance; no connection to Goose Lake due to irrigation diversion dams.
Kelley Cr.	Fails one of six population status criteria: productivity.	Limited distribution and abundance.

B. Fish Habitat

ODFW Inventory: There are stream surveys for ten streams in the ODFW Aquatic Habitat Inventory Project (ODFW 2009B) as shown in the table below. The habitat data was evaluated only for fine sediments, bank erosion, and shade. See the Appendix for an explanation of how the habitat condition status was evaluated. Increased fine sediment in riffles and bank erosion were identified as limiting factors in some streams as indicated below.

Table 19. Aquatic Habitat Limiting Factors in the Goose Lake Basin

Stream	Stream Miles	Status	Limiting Factor	Survey Date
Bauer's Creek	7.3	Adequate		1991
Cogswell Creek	6.0	Moderate	sediment, bank erosion	1994
Cogswell Creek (North Fork)	6.0	Moderate	bank erosion	1994
Cox Creek	5.3	Moderate	sediment, bank erosion	1993
Crane Creek	6.7	Moderate	bank erosion	1994

Stream	Stream Miles	Status	Limiting Factor	Survey Date
Drews Creek	5.0	Moderate	sediment, bank erosion	1994
Kelley Creek	6.8	Moderate	bank erosion	1994
North Fork Crane Creek	6.3	Moderate	bank erosion	1994
Thomas Creek	7.1	Adequate		1993
Thomas Creek Tributary A	7.0	Moderate	sediment, bank erosion	1993

Drews Creek Watershed Assessment: An ecosystem analysis on the Drews Creek watershed (HUC 180200010101) was completed primarily on forest service land in 2006 (Duck Creek Associates 2006). The following briefly summarizes the findings in relation to habitat limiting factors.

In Quartz Creek summertime stream temperatures were considered close to reference conditions. Summertime stream temperatures are impaired in Middle Drews Creek and Lower Hay Creek due to modification of channel types and associated low riparian shade levels. Water temperature in Fish Creek is close to reference in Fish Creek but higher than reference in Dog Creek. Summertime stream temperatures are impaired in Lower Drews Creek/Antelope Creek due to channel alterations, low riparian shade, and water withdrawals.

Habitat evaluations completed in upper Drews Creek and Quartz Creek indicated that aquatic habitat was limited by surface fines, LWD frequency, pool width/depth ratio and large pool frequency.

Estimates of consumptive water use indicate that water withdrawals have a large impact on summertime stream flows in some locations. Consumptive water use and water management impacts are very high in the Lower Drews Creek/Antelope Creek HUC.

Goose Lake Fishes Conservation Strategy: The Goose Lake strategy (ODFW 1996) provides details of limiting factors by stream system for water quality and quantity, in-channel habitat, riparian condition and upland habitat.

C. Water Quality

Water Quality Limited Streams, 2004-2006 303(d) List

The following table shows only the streams from the 303(d) list (ODEQ 2009) that are currently listed as Water Quality Limited. Other categories such as “delisted” or “TMDL not needed” are not shown.

Table 20. Water Quality Limited Streams identified by ODEQ

Stream	River Miles	Parameter	Season	Criteria	Status
Bauer’s Creek	0 to 11.2	Temperature	Summer	Rearing: 17.8 C	303(d)
Camp Creek	0 to 14.3	Temperature	Summer	Rearing: 17.8 C	303(d)
Cox Creek	0 to 15.2	Temperature	Summer	Rearing: 17.8 C	303(d)
Dent Creek	0 to 6.1	Temperature	Summer	Rearing: 17.8 C	303(d)
Drews Creek	25.1 to 39.8	Temperature	Summer	Rearing: 17.8 C	303(d)
East Branch Thomas Creek	0 to 4.9	Iron	Year Around	Table 20 Toxic Substances	303(d)
East Camp Creek	0 to 4.9	Temperature	Summer	Rearing: 17.8 C	303(d)
Hay Creek	0 to 12.8	Temperature	Summer	Rearing: 17.8 C	303(d)
North Fork Cox Creek	0 to 4.5	Temperature	Summer	Rearing: 17.8 C	303(d)
Quartz Creek	0 to 5.7	Temperature	Summer	Rearing: 17.8 C	303(d)
Shingle Mill Creek	0 to 3.9	Temperature	Summer	Rearing: 17.8 C	303(d)
Thomas Creek	12 to 35.9	Biological Criteria	Undefined	Biocriteria: based on aquatic species support	303(d)
Thomas Creek	0 to 35.9	Dissolved Oxygen	Year Around (Non-spawning)	Cool water: Not less than 6.5 mg/l	Cat 5: TMDL Needed
Thomas Creek	0 to 35.9	Iron	Year Around	Table 20 Toxic Substances	Cat 5: TMDL Needed
Thomas Creek	0 to 35.9	Temperature	Year Around (Non-spawning)	Redband or Lahontan cutthroat trout: 20.0 degrees C	Cat 5: TMDL Needed

Riparian

PFC: BLM and other agencies often use the PFC protocol (Proper Functioning Condition) for monitoring riparian areas in rangelands. We were unable to obtain any PFC data for this area.

Drews Creek Watershed Assessment : A coarse scale assessment of the riparian vegetation was completed using aerial photos for the principal streams in the watershed (Duck Creek Associates 2006). The principal stream systems (approx. 75 miles) were divided approximately equally between four major groups: forested (29%), woody meadows (23%), grass meadows (21%), and dry meadows (17%). There is an apparent disconnect with mesic riparian vegetation in the lower reaches, which is attributed to the higher incidence of F-type channels that were historic C and E type channels. Large woody debris recruitment is generally low from conifers for the principal streams. Stream shading is generally low in the lower reaches of Drews Creek. Stream shade has likely decreased through time due to a decline in woody riparian species due to agriculture, development, and livestock grazing.

Uplands

Drews Creek Watershed Assessment : Sediment inputs under current conditions were evaluated in the watershed assessment (Duck Creek Associates 2006) by modeling sediment inputs in comparison to reference conditions. Sediment inputs were estimated as follows: Quartz Creek – similar to reference, Middle Drews – 6 times greater than reference, Lower Hay Creek - 3 times greater than reference, Drews Reservoir HUC – 1.5 times greater than reference, Lower Drews Creek/Antelope Creek – approximately 30 times greater than reference. Primary sources were riparian roads, cropland, forest harvest, and grazing.

Noxious Weeds:

Lake County has identified seven weed protection areas and the threat of noxious weeds within the areas. Threats are designated as: 0) Watch for, 1) Establishing, 2) Controllable,

3) Widespread and “x”) Not detected. The noxious weed threat identified in the Goose Lake Weed Area is shown in the table below.

Table 21. Noxious Weed Threat Status Identified By Lake County Weed Management Cooperative

Weed name	Threat
Scotch thistle	2 or 3
Perennial Pepperweed	2
Canada thistle	3
White top	2
Halogeton	x
Medusahead	2
Yellow starthistle	1
Med sage	3
Russian knapweed	1
Spotted knapweed	2
Squarrose knapweed	2
Rush Skeleton weed	x
Musk thistle	2
Leafy spurge	
Field bindweed	x
Spiny cocklebur	x
Dyars' woad	x
Pheasant eye	1
Houndstongue	0
Toadflax	2
Sulfer cinquefoil	1
Oxeye daisy	1 or 2
St. Johnswort	x

Watershed Assessment Identified Issues and Recommendations

Recommendations relative to restoration actions from the Drews Creek watershed assessment (Duck Creek Associates 2006) are summarized briefly below.

- 1) Implement active channel restoration in Quartz Creek, Drews Creek, Dent Creek, Hay Creek, Dog Creek, Horseshoe Creek, and Dog Mountain Creek.
- 2) Use passive restoration to restore stream channels in the low gradient reaches in Drews Creek.
- 3) Restore and maintain refugia for fish species in the event of drought.

- 4) Mitigate sedimentation to streams due to roads in the upper tributaries.
- 5) Restore LWD recruitment potential in reaches identified with low LWD.
- 6) Remove fish-blocking culverts on fish bearing streams.
- 7) Restore and enhance forests, grasslands, and riparian meadows using tools such as prescribed burning, thinning, and juniper eradication.

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Appendix – Notes on Information Sources

ODEQ 303(d) List

Oregon’s 303(d) list is maintained as part of the 2004/2006 Integrated Report². The 303(d) list contains several categories of streams including stream segments that have been delisted. For the purpose of this assessment we list only those water bodies that are active on the list. This includes three categories: 1) Category 5: Water quality limited, 303(d) list, TMDL needed, 2) Category 4A: Water quality limited, TMDL approved, and 3) stream bodies listed only as “303(d)”.

Oregon Native Fish Status Report

The Oregon Native Fish Status Report describes the current conservation status of native fishes based on interim criteria defined in Oregon’s Native Fish Conservation Policy [OAR 635-007- 0507]. The purpose of the Native Fish Conservation Policy (NFCP) is to ensure conservation and recovery of native fish in Oregon. The policy focuses on naturally-produced fish. This assessment focuses on groups of populations from a common geographic area with similar genetic and life history characteristics called Species Management Units (SMUs). SMUs are groups of populations from a common geographic area that share similar life history, genetic, and ecological characteristics. Populations within an SMU are locally adapted to the specific conditions encountered in their native streams.

The status report is an interim assessment intended to flag acute problems and help identify priorities for more detailed conservation planning evaluations. Risk, as used in this report, refers to the risk to the conservation of a unique group of populations (e.g. SMU), not the risk of extinction. Interim criteria were based on six biological characteristics related to species performance. These include existing populations, habitat use distribution, abundance, productivity, reproductive independence, and hybridization. Each of these attributes was evaluated for every population based on benchmark values

² <http://www.deq.state.or.us/wq/assessment/rpt0406.htm>

related to species viability, persistence probability, and conservation risks. Criteria for individual SMUs were met when at least 80% of existing constituent populations met the standard.

ODFW Aquatic Inventories Project

Oregon Department of Fish and Wildlife (ODFW) Aquatic Inventories Project³ assesses aquatic habitat using standard protocols. The habitat surveys provide a large number of possible habitat variables. For the purpose of this assessment we focused on variables that could be applied and interpreted across a large diverse landscape in the sagebrush desert stream systems. To accomplish this objective we selected native redband trout, *Oncorhynchus mykiss gairdneri*, as a representative indicator species and interpreted the variables based on habitat ratings adapted from Zoellick and Cade⁴ (2006).

Zoellick and Cade (2006) evaluated abundance of redband trout relative to five site-specific variables (stream shading, bank cover, bank stability, fine sediment, and adult cover habitat). They found that stream shade explained most of the variation in trout abundance and therefore stream shade was recommended as the primary habitat variable to evaluate in sagebrush desert streams. In these landscapes, livestock grazing is a potential issue so we included bank stability and fine sediments as habitat measures to evaluate.

The ODFW habitat survey measures three variables that are comparable to variables used by Zoellick and Cade. These variables are shown in the table below with the stream rating based on the BLM habitat rating referenced in Zoellick and Cade. We assigned numeric scores to indicate the degree of effect on aquatic habitat: 1) Limiting, 2) Moderate, and 3) Adequate. The ODFW habitat data is reported by stream reach. Habitat ratings were calculated for each stream reach, and then the overall average rating calculated for the stream. The resulting rating provides an overall indication of stream habitat conditions.

³ <http://oregonstate.edu/dept/ODFW/freshwater/inventory/index.htm>

⁴ B.W. Zoellick and B.S. Cade. 2006. Evaluating redband trout habitat in sagebrush desert basins in southwestern Idaho. N.A. J. Fisheries Management 26: 268-281.

BLM Variable (Zoellick & Cade 2006)	ODFW Metric	Unit	Limiting (1)	Moderate (2)	Adequate (3)
Percent Stream Shade (solar pathfinder)	SHADE	% shade	< 40	40 - 60	> 60%
Bank Stability (% eroding bank)	BANKEROSI	% eroding banks	> 20%	> 11 - 20%	< 11%
Percent Fine Sediment (Wolman Pebble Count or ocular)	RIFSNDOR	% riffle fines	> 25%	15 - 25%	< 15%

Proper Functioning Condition Assessment

Proper Functioning Condition (PFC) refers to the BLM method⁵ of assessing riparian areas. Riparian wetlands are considered to be functioning properly when the riparian area is dissipating stream energy, filtering sediment, capturing bedload, aiding floodplain development, improving water retention, stabilizing streambanks, and providing diverse habitats. The PFC assessment results in a rating of 1) PFC, 2) Functional – at risk, or 3) Nonfunctional.

Data obtained from BLM was summarized for each stream by percent of stream miles placed into each category.

Noxious and Invasive Weeds

Information on noxious weeds was provided by Grace Haskins, the Lake County Cooperative Weed Management Area Coordinator. The BLM “Weeds” geodatabase⁶, did not have information currently for this area. The statewide weed database, Weedmapper⁷, contains information on weed distribution but we could not access the spatial data in a useable format. The Cooperative Weed Management program is divided into seven weed protection areas. Threats are designated as: 0) Watch for, 1) Establishing, 2) Controllable, 3) Widespread and “x”) Not detected.

⁵ Bureau of Land Management. 1998. Riparian area management: a user guide to assessing proper functioning condition and the supporting science for lotic areas. Technical Reference 1737-15, National Applied Science Center, Denver, CO.

⁶ <http://www.blm.gov/or/gis/data-details.php?data=ds000117>

⁷ <http://www.weedmapper.org/>

Wetlands

We evaluated several sources of information to get an indication of wetland loss/gain or alteration.

National Wetlands Inventory (NWI) digital data⁸: Used to identify the current (1980's) locations of wetlands, wetland types, and wetland disturbances

Natural Resources Conservation Service (NRCS) digital soil survey data⁹: Used to identify hydric soils, which may indicate locations of current or historic wetlands

Oregon Natural Heritage Program (ONHP) historic vegetation data set¹⁰: Used to identify historic wetland locations in areas lacking NWI and or soils data

National Land Cover Database (NLCD)¹¹: Used to identify current wetland locations in areas lacking NWI and or soils data

However, these sources did not provide adequate coverage or sufficiently comparable information for interpretation. The most useful source of information on wetlands was the change from historic to current wetland acres summarized in the Oregon Conservation Strategy (ODFW 2006).

⁸ <http://www.fws.gov/wetlands/>

⁹ <http://soildatamart.nrcs.usda.gov/>

¹⁰ http://www.oregon.gov/DAS/EISPD/GEO/docs/metadata/historic_vegetation.htm

¹¹ <http://seamless.usgs.gov/>

Figure 2. Lake County Conservation Opportunity Areas and Strategy Habitats (ODFW 2006).

