# Alvord Lake Sub-basin Watershed Assessment

**Harney County Watershed Council**
**450 N. Buena Vista**
**Burns, OR  97720**
**(541) 573-8191**

**June, 2006**

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Publisher
Strategic Staffing Services, Inc.

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Harney County Watershed Council
Harney County Court
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## Contributors

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Pam Keller, Darren Brumback, Lesley Richmond, Jeff Rose, Tara Wilson, Rick Hall, Jim Buchanan––Burns District, Bureau of Land Management
Jack Wenderoth, Lynn Silva, Jon Sadowski—Vale District, Bureau of Land Management
Tony Svejcar, Mitch Willis, Kirk Davies, Jon Bates, Roger Sheley – Eastern Oregon Agricultural Research Center, Burns
Tim Walters, Ray Perkins—Oregon Department of Fish and Wildlife
Bryce Mertz—Harney County
Gary Page—Malheur County
June Miller—Oregon Water Resources Department, Burns
Marty Suter—Harney Soil and Water Conservation District
Fred Otley, Ed Davis, Bill Moser—Harney County Watershed Council

## Production

Harney County Watershed Council staff
Art Tassie—Council Coordinator
Cyndy Marshall—past Council Coordinator

Contractors: Strategic Staffing Services, Inc. Burns, Oregon
Scott Miles—Writer/Technical Consultant
Lynn Sirrine—Publisher

## Printing

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# Executive Summary

The 2006 Alvord Lake Sub-basin Watershed Assessment has been produced by the Harney County Watershed Council and supported by various other entities. The main purpose of this document is to discuss the components, management issues and indicators of watershed health in the Alvord Lake Sub-basin. Other parts of this document focus on describing the sub-basin, the plants and animals which are found in the sub-basin, and various other management topics.

Watershed health can be defined and assessed in various manners, and there is no exact set of components which must be universally addressed in any assessment. The Alvord Lake Sub-basin is large–approximately 1,280,000 acres. Budgetary and time restrictions on completing this report required that much of the enclosed information be obtained from data collected by various government agencies, as well as published documents. On-the-ground assessment work specifically for this report was limited, with most taking place on private lands where voluntary cooperation of individual landowners was obtained. There was also a small amount of work performed on public lands where specific data gaps relating to watershed health existed.

Three of the largest apparent threats to watershed health in the sub-basin involve invasive plants, which disrupt and replace native vegetation, causing watershed health problems: 1) Cheatgrass (*Bromus tectorum* L.) is a widely distributed, introduced annual grass, which is not classified as a noxious weed. Its effects are significant, since after disturbances such as fire it can replace desirable native species. Once on a site, cheatgrass can increase the frequency and size of later fires and its presence can make a site more susceptible to invasions by other weeds. 2) Noxious weeds are still somewhat limited in the Alvord Lake Sub-basin due to effective control efforts by government agencies and private landowners. Continued diligent efforts will be needed by all parties to keep the sub-basin relatively weed free into the future. 3) Western juniper (*Juniperus occidentalis* var. *occidentalis* Hook.) is a native tree species whose distribution and cover in the intermountain west is expanding at the expense of other vegetation components and apparent hydrological functions in its habitat. Its ecology and control measures are becoming more completely understood, but control is expensive. Though not yet a major problem in the sub-basin, it is encroaching from adjacent areas where it is very problematic.

Rangeland fires are a natural component of the Alvord Lake Sub-basin and native vegetation types in the sub-basin have evolved with fire as part of their ecology. However, the partial control of wildfire by humans in the last 75 to 100 years has allowed for rapid juniper expansion, and purposeful fires are now often used to control this species. In addition, fire can prompt noxious weed and cheatgrass invasions into some areas. Fire management and purposeful fire use will play an increasingly important role in the sub-basin, but must be carried out wisely to reduce the risk of exacerbating existing problems.

The riparian zones along perennial streams in the sub-basin appear to generally be in good condition given the results of assessments made on both public and private lands. Previous work by the Oregon Department of Environmental Quality defined some of the desired riparian vegetative conditions and stream characteristics for the sub-basin. Elevated water temperature is recognized as a concern in some sub-basin streams. Management actions to assure healthy riparian zones have been enacted in attempts to provide sufficient shade to lessen water temperature changes.

Stream sediment sources were assessed for a limited number of non-roaded stream miles, at numerous stream crossings (bridges, culverts and fords) and in settings where roads ran directly adjacent to channels. The general conclusion was that significant amounts of stream sediment are not produced at road/stream interfaces. Instead, stream sediment apparently is the product of natural stream channel movement (i.e. cutting and filling) and/or the result of historic or current management practices which may enhance erosion.

There are many special status animal species in the sub-basin whose survival and population viability are dependent on watershed health. We discuss four of these in greater depth than we do other special status animal and plant species: 1) The Lahontan cutthroat trout is believed to be native to Willow and Whitehorse Creeks. It has also been successfully introduced to other streams in the sub-basin. Population sizes of this species appear dependent on healthy habitat and on the extent of stream reaches with adequate water, which can vary with even short term climate changes. 2) The Borax Lake chub is a small minnow restricted to the Borax Lake ecosystem (size ~10 acres) south of Alvord Lake. The possible manipulation of surface flows from Borax Lake, its highly restricted range and specialized habitat put this species at risk. Additionally geothermal energy exploration was once proposed in the area, but due to a federal land use decision, that is currently not a threat on public lands. 3) The Alvord chub is a minnow which inhabits marshes, creeks, and springs in the sub-basin. It is a sister taxon of the Borax Lake chub, but is now isolated both geographically and genetically from the Borax Lake chub. 4) The western subspecies of the Greater sage-grouse is a special status bird species which regularly lives in the sub-basin year around. This species has disappeared from five U.S. states and one Canadian province. While its population is thought to now be stable in Oregon, management efforts are underway to conserve the sagebrush-grassland communities it uses throughout each year.

Other sections of this report document and discuss: 1) the incorrect mapping of the extent of perennial stream reaches in the sub-basin, and 2) two situations, on alluvial fans and in irrigated hay meadows, where human control of stream water has appeared to benefit fish and riparian habitat in and along sub-basin streams.

Livestock grazing is the most extensive land use in the Alvord Lake Sub-basin. This report contains a brief history of grazing management and a short discussion of inventory, evaluation and monitoring methods used for rangelands. The ecological status (seral stage of the vegetation) of public lands in the sub-basin is presented, using data which is about 20 and 10 years old (Burns and Vale Bureau of Land Management Districts, respectively). For other inventory, evaluation or monitoring information, which may be based on specific management objectives, readers should consult the two Bureau of Land Management district offices.

The situations on alluvial fans and in irrigated hay meadows illustrate a reoccurring theme of this assessment. Human alteration of the natural environments of the Alvord Lake Sub-basin has provided some apparent benefits—for example extending stream surface flow and increasing the amount of riparian vegetation. However, we do not know all of the resulting impacts of those alterations. Negative impacts may be occurring which are not yet visible or understood. Proper future management of the sub-basin will require a broad understanding of all sub-basin components and their interactions.

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# Chapter 1 - Introduction

This chapter is a short introduction to the Harney County Watershed Council, the Alvord Lake Sub-basin, and this watershed assessment report.

## HARNEY COUNTY WATERSHED COUNCIL

The Harney County Watershed Council (HCWC) addresses issues and concerns about watershed health in the Malheur Lakes Basin, which is made up of seven sub-basins (Map 1, page 3). HCWC provides a framework for education, coordination, and cooperation among interested parties for the development and implementation of watershed plans and activities beneficial to the people and the environment.

Photo courtesy of BLM

### Mission

The Council recognizes that local economic and ecological prosperity is dependant upon the current and future availability and quality of water. Therefore, the Harney County Watershed Council is committed to this three-part goal:

1. Determine the health of individual watersheds or watershed segments.
2. Retain the health of high quality watersheds.
3. Restore and enhance those watersheds, or portions thereof, that can be improved.

### Malheur Lakes Basin Watershed Assessments

The purpose of a watershed assessment is to provide a factual basis for watershed management plans. The assessments serve as a planning tool for the HCWC and others. Some assessments are grant funded and developed under contract with the Oregon Watershed Enhancement Board (OWEB) using the guidelines in the OWEB Assessment Manual.

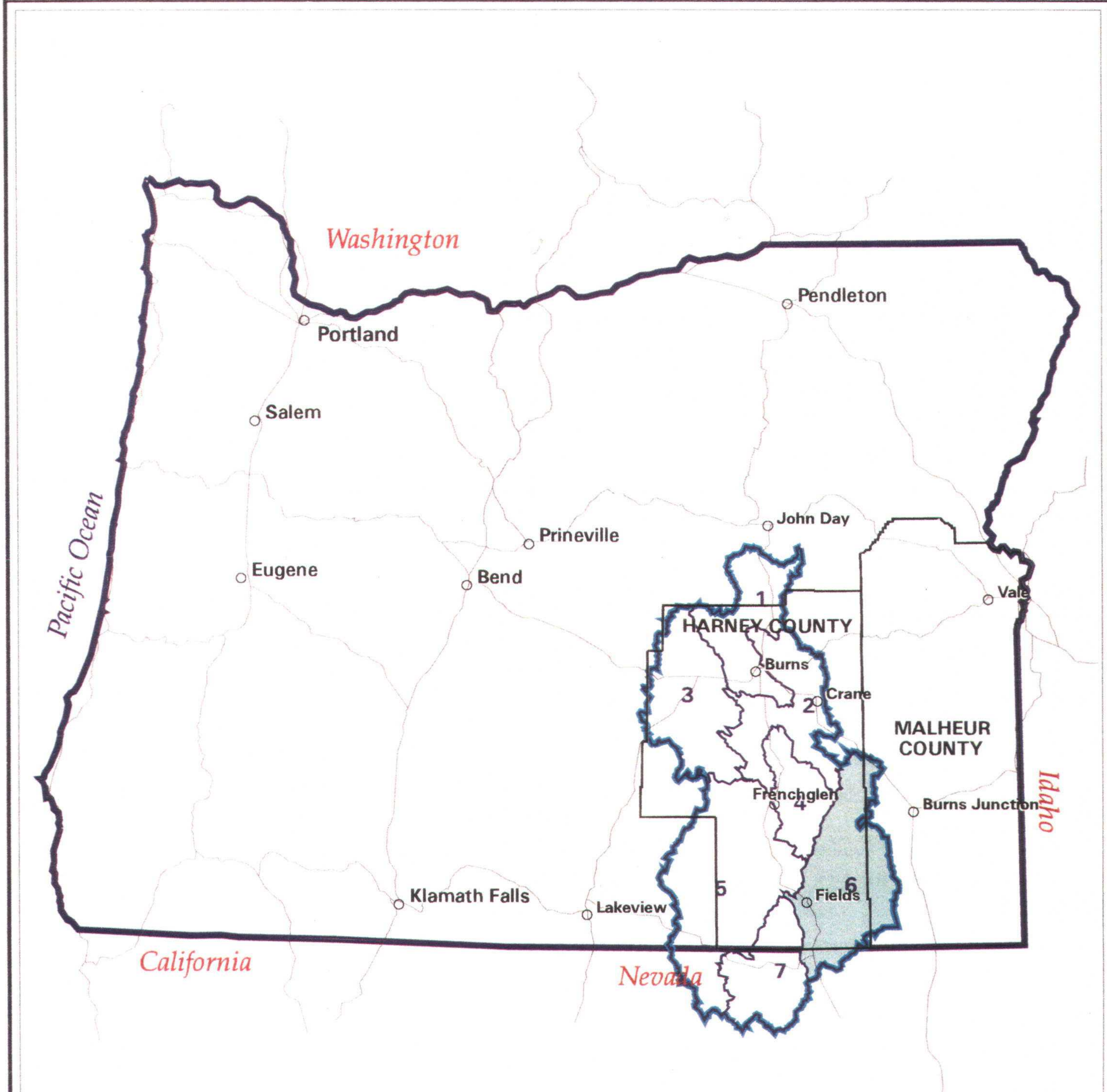
The Malheur Lakes Basin Watershed covers approximately 6.1 million acres. The basin is comprised of seven sub-basins: Silver, Silvies, Harney-Malheur Lakes, Donner und Blitzen, Guano, Thousand-Virgin and Alvord Lake. Some of these sub-basins overlap into Grant, Lake, Crook and Malheur Counties in Oregon, and Humboldt County in Nevada. (See Maps 1 and 2.) Given the large geographic land mass that these basins cover, assessing the health of even a single sub-basin is an expensive and complex task.

The HCWC was created in 1998 with primary goals of assessing each sub-basin and educating themselves and the community about watershed health issues. Toward this end, four sub-basin assessments have been previously completed and after this report two remain to be completed: Guano and Thousand-Virgin. These two remaining sub-basins are in the southwest portion of the basin. When all seven sub-basin assessments are complete, the watershed council will begin a process to review them in total and complete a Basin Action

Plan. The council will compile the old and new data into a meaningful picture of the basin, and then identify and prioritize specific projects to improve watershed health for the entire basin. In the meantime, HCWC and others use the completed assessments to guide projects throughout the Malheur Lakes Basin.

For this process to be most effective, the community needs to be fully engaged. The HCWC has good collaboration with the public land management agencies that manage over three-quarters of the land in Harney County, and involvement of private landowners has been increasing. The council continues to expand private landowner and citizen involvement through education and opportunities to participate in developing, implementing and overseeing actions and projects.

HCWC benefits from the active involvement of the following entities: private landowners, Oregon Water Resources Department, Oregon Department of Fish and Wildlife, Harney County, Malheur County, USDI Bureau of Land Management, Burns Paiute Tribe, OWEB, USDA Forest Service, Izaak Walton League, Malheur National Wildlife Refuge, Oregon Department of Environmental Quality, U.S. Fish and Wildlife, USDA Agriculture Research Service.




# MAP #1 - Harney County Watershed Council Sub-basins

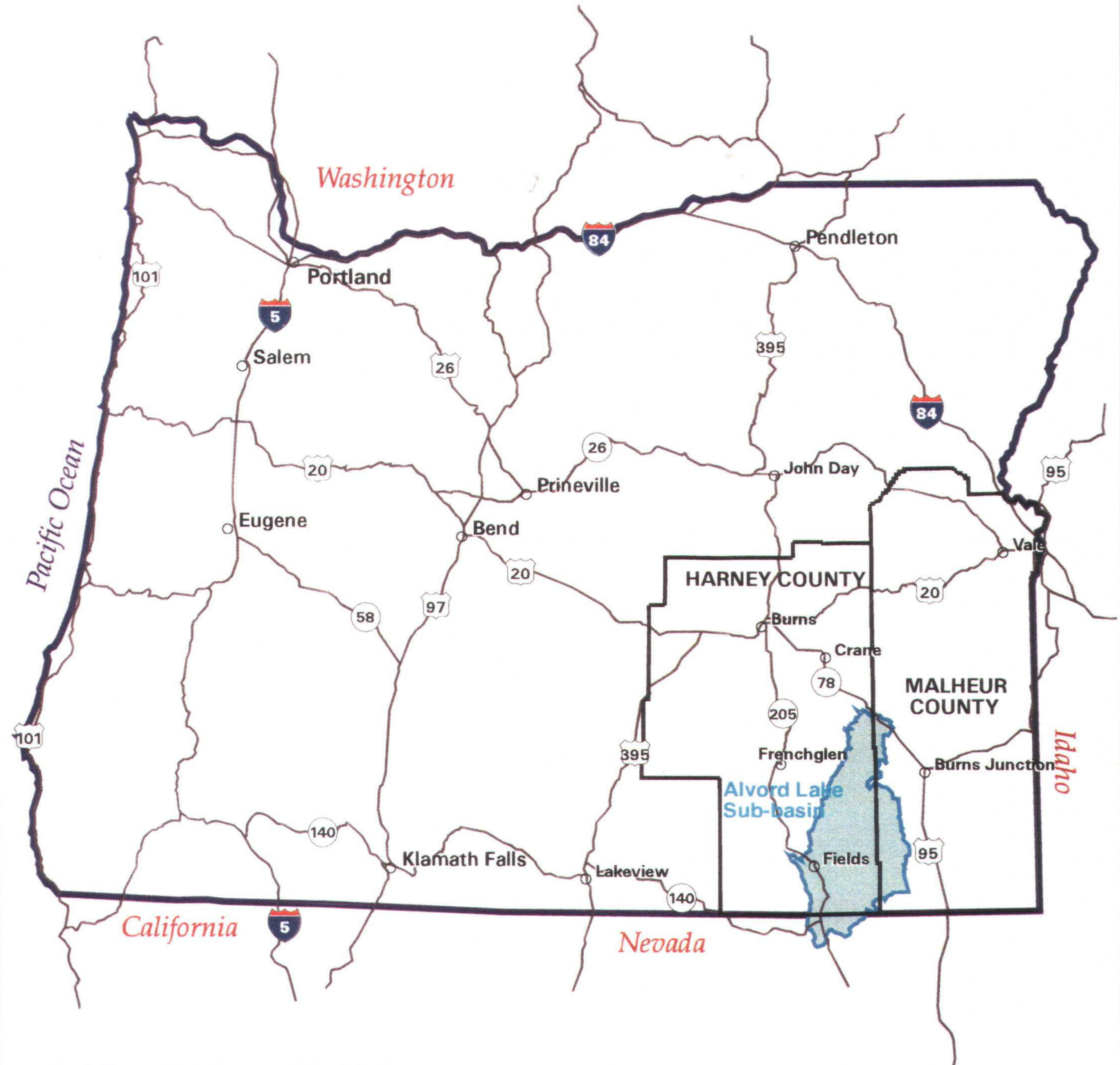
Watershed Council Boundary

Sub-basins:
1 Silvies, 17120002
2 Harney-Malheur Lakes, 17120001
3 Silver, 17120004
4 Donner und Blitzen, 17120003
5 Guano, 17120008
6 Alvord Lake, 17120009
7 Thousand-Virgin, 16040205

Scale: 1 inch = 56.8 miles

HARNEY COUNTY GIS
In cooperation with the
U.S. Bureau of Land Management
Burns District Office; Burns, Oregon

Date: 21-MAR-2006, Pam Keller, vicinity8x11.aml/alvvic1.ps




# MAP #2 - Alvord Lake Sub-basin Vicinity

The Nevada portion of the sub-basin was not evaluated in this watershed assessment, and is not shown on most other assessment maps.

HARNEY COUNTY GIS
In cooperation with the
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Burns District Office; Burns, Oregon

Date: 21-MAR-2006, Pam Keller, vicinity8x11.aml/alvvic2.ps

Scale: 1 inch = 56.8 miles

## SCOPE OF THE ASSESSMENT

The Alvord Lake Sub-basin is large, occupying nearly 1.4 million acres in Harney and Malheur Counties in Oregon and Humboldt County in Nevada. The portion of the sub-basin in Nevada (95,000 acres) ***is not assessed*** in this document (see discussion in Appendix 1, page 173.)

The funds available for this project were limited and the Harney County Watershed Council (HCWC) needed to carefully choose the types and amounts of work which could be completed for this document. However, our capabilities to produce an informative document have been greatly enhanced by in-kind support provided by the Burns and Vale Bureau of Land Management Districts and by other federal, state and county agencies. In general, HCWC decided the focus of this watershed assessment would be to summarize data from existing research and management plans, plus fill data gaps where possible by conducting field assessments with the cooperation of private land owners.

The United States Department of Interior, Bureau of Land Management (BLM) manages nearly 83% of the sub-basin area (Oregon) and has extensive on-going efforts to assess their lands. Similarly, other federal, state and county agencies have on-going management activities in the sub-basin.

***Snow stays year around on the high Steens. Alvord Desert, close by, but 5000 feet below is visible to the left.***

Photo courtesy of BLM

The Oregon Watershed Assessment Manual focuses on assessing watersheds as related to fish-bearing and/or perennial streams. Since the BLM and Oregon Department of Fish and Wildlife (ODFW) have past, on-going, and future plans for studies on fish and fish habitat in the area, HCWC decided to concentrate efforts on the inventory and assessment of perennial stream riparian zones, and potential sources of stream sediment. Similar efforts on non-perennial streams and on the uplands were beyond the constraints of the project.

Private lands constitute about 16%, or 210,000 acres of the sub-basin. To meet the mission of HCWC, active involvement of private landowners in varying ways is required. Furthermore, a goal of HCWC is to provide private landowners, when they desire, information on specific attributes of their land which relate to watershed health. We engaged several private landowners in the sub-basin, and performed inventories and assessments of perennial stream riparian zones on their lands. For more information about these procedures, see the sections titled HCWC Field Work—Stream Sediment Sources and HCWC Field Work—Riparian Inventory in Chapter 2.

Readers should understand that assessments of this type are at best a snap-shot-in-time. Some of the data and information in this report is very current; other materials may appear dated but still provide an indication of watershed condition. There is often significant lag time between the implementation of new management and the documentation of its effects.

It is a goal of HCWC to use the information in this report to guide future involvement in sub-basin watershed management opportunities. That involvement could range from facilitating specific watershed enhancement projects to reassessing the overall sub-basin watershed health again at some future time. HCWC hopes that this document helps readers understand important parts of watershed health in the Alvord Lake Sub-basin. We also invite the public to become involved with the HCWC efforts to understand and improve watershed health in the sub-basin.

## Chapter Contents

There are four chapters in the report. Below are their titles and brief descriptions.

1. **Introduction.** A short introduction to the HCWC and the Alvord Lake Sub-basin.

2. **Watershed Assessment.** Discussions of various topics with emphasis on their connection to watershed health in the sub-basin.

3. **Basin Characteristics.** General information about the sub-basin, its physical features and the plants and animals which reside there.

4. **Land and Resources: Use and Managemen**t. General information on various land management topics.

## Information Sources and Formatting

The text of this report borrows heavily from three primary documents: 1) the Andrews management Unit/Steens Mountain Cooperative Management and Protection Area Proposed Resource Management Plan and Final Environmental Impact Statement, Burns District BLM, 2004 (abbreviated throughout the document as Andrews FEIS); 2) Proposed Southeastern Oregon Resource Management Plan and Final Environmental Impact Statement, Vale District BLM, 2001(Vale FEIS); and 3) the Alvord Lake Sub-basin Total Maximum Daily Load & Water Quality Management Plan, Oregon DEQ, 2003 (Oregon TMDL). The three abbreviations are used throughout the text. In addition to the mentioned sources other information sources are also used and cited (see below).

To facilitate the user's understanding of this report, HCWC has consistently set off and formatted certain types of information within most report sections. At the beginning of those sections is a short, boxed note titled 'Information sources and authors' which indicates generally the origin and/or authors of the information in the section. Where appropriate, further similar information such as specific literature citations can be found in the main body of the section. That note is followed by the main body of the section which contains text and possibly figures, tables and maps. Following the main body, but oftentimes just before a section-ending map, are two more boxed notes. The first of these is titled "Importance of topic to long-term watershed health in the Alvord Lake Sub-basin." That note is a summary opinion by HCWC about the importance of the section's topic to watershed health in the sub-basin. In some cases, we use this location to justify our focus, or lack of focus, on the particular topic in the report. Remember, restraints of the project did not allow a full exploration of all individual topics. The last boxed note is titled "Issues, concerns and action items." This is a listing of factors which HCWC feels should be the focus of the public and land managers in future use and management of the area.

## Report Review Process and Final Production

Prior to producing this final report of the Alvord Lake Sub-basin watershed assessment, HCWC had produced a public draft version which came out in April, 2006. During the production of that draft, we sent letters to the 60 private landowners with the largest land holdings in the sub-basin. In those letters we outlined the review process and asked who would like a copy of the draft for review and who would like a copy of this final report. The draft reports were then sent to those requesting them. In addition, copies were distributed to county, state and federal agencies and entities in Harney and Malheur counties, and to Oregon Watershed Enhancement Board members.

The public review period was April 22, through May 25, 2006. During that time we held two public meetings to review the draft, one in Fields, Oregon and one in Burns, Oregon. The meetings were announced in the initial letters to Alvord Lake Sub-basin landowners and advertised by radio, newspaper and public fliers. Four people from the public attended the Fields meeting, none attended the Burns meeting. The discussions in Fields were mostly general in nature, with only a few specific topics covered. The HCWC policy, as stated in the announcements, was that public comments must be submitted in writing by May 25 to be addressed in this final report. HCWC received no written comments submitted from the public, and there is no public comment section of this document.

Despite the lack of public input, there has been extensive review of the document by scientists and technical staff of the BLM, EOARC and ODFW. Most of the individuals involved were already connected to HCWC in various capacities. HCWC feels that these review activities are part of the normal production of the final document and consequently these activities are also not documented per se in this report.

Anyone with questions about this report and its production should contact the Harney County Watershed Council, 450 N. Buena Vista, Burns, Oregon, 97720, 541-573-8199.

## ALVORD LAKE SUB-BASIN DESCRIPTION (HUC 17120009)

The Alvord Lake Sub-basin is one of seven sub-basins in the Malheur Lakes Basin Watershed of southeastern Oregon (Maps 1 and 2). There are eight 5th field watersheds within the sub-basin: Cottonwood Creek (HUC 1712000901), Alvord Lake (902), Big Alvord (903), Whitehorse Creek (904), Twelve Mile Creek (905), Willow Creek (906), Summit (907) and Quail Creek (908) (see Appendix 1 for a description of Oregon and federal HUC watershed systems.) These 5$^{th}$ field watersheds are shown together in Map 3 (page 11), and separately in Maps 9-16, beginning on page 124.

Photo HCWC

***The Alvord Desert is the largest of the many playa lakes in the sub-basin.***

The entire sub-basin contains approximately 1,373,000 acres or 2,150 square miles (Map 3). The sub-basin is bounded by the crests of the following mountains or ranges: the Steens Mountain and Pueblo Mountains on the west, the Trout Creek Mountains on the south and southeast, and the Sheepshead and Oregon Canyon Mountains on the east. The sub-basin extends south into Nevada between the Pueblo Mountains and Trout Creek Mountains, but the Nevada portion (95,000 acres) ***is not included*** in the area covered by this watershed assessment (Appendix 1). The BLM manages 82% of the Oregon area, the State of Oregon 2%, and 16% is privately owned (figures rounded to nearest percent).

The terrain in the sub-basin varies from rugged, steep mountains at over 9700 feet to playa lakes at approximately 4000 feet. Interestingly, the highest point in the sub-basin is the top of the Steens Mountain (9733 feet), which is only seven miles from the edge of the Alvord Desert—a playa lake and one of the sub-basin’s lowest elevations (4000 feet). Nearby, Mickey Basin at 3920 feet is lowest place in the sub-basin and in Harney County.

The sub-basin is closed—it does not have a surface water connection to the Pacific Ocean. In addition, many of the fifth-field watersheds are isolated from the others, with only internal drainage. Furthermore, most perennial streams (year around surface flow) are isolated from each other and do not flow into other perennial streams. All of the perennial streams develop high in the mountains which form the sub-basin boundaries—there are no perennial streams which originate in the lower ranges in the middle of the basin.

Most perennial streams on the east sides of the Steens and Pueblo Mountains form in high mountain basins, then flow through relatively short, steep, rocky canyons, and out onto well-developed alluvial fans. Those streams tend to lose water to the coarse alluvium of the fans, and the remaining surface water generally goes into ranch irrigation systems or out into the common playa lakes at the base of the mountains. Water reaching the playa lakes is usually absorbed or lost to evaporation in a relatively short time—usually within each year.

In contrast to the relatively short, perennial streams of the Steens and Pueblo Mountains, the perennial streams of the Trout Creek and Oregon Canyon Mountains tend to be longer and flow significant distances through lower gradient valleys. Those streams in their lower reaches are commonly used for irrigation of hay fields, and the unused waters flow into playa lakes.

The playa lakes of the sub-basin generally do not support fish populations due to the fact that they dry out in most years. During wet cycles, populations of fish may temporarily live in those playa lakes which are fed by fish-bearing streams. This is most likely true of Alvord chub in Alvord Lake, but could be also true for other species in other locations, especially in wet cycles that last for more than a year. Also, there are no large streams, rivers or stream networks in the sub-basin which serve as immigration conduits for fish, or which allow interconnection of salmonid (trout) populations. As a result, most perennial streams in the sub-basin support only isolated populations of salmonids, if they have any at all. In contrast, some believe that Willow Creek and Whitehorse Creek in the southeast end of the sub-basin periodically have interconnected waters in their lower ends, allowing fish passage between those two streams.

***Mickey Basin is the lowest elevation in the sub-basin.***

Photo HCWC

The geothermal waters of Borax Lake in the Alvord Desert are home to the endangered Borax Lake chub. The threatened Lahontan cutthroat trout is also present in some streams in the basin, representing the northern most, natural distribution of this fish species in the United States.

There are four natural lakes which have perennial water in the sub-basin. Mann Lake (227 acres) is located at the base of the Steens Mountain north of the Alvord Desert, Wildhorse Lake (17 acres) and Little Wildhorse Lake (2 acres) are found high in Wildhorse Canyon, beneath the top of the Steens Mountain and Borax Lake (9 acres) is in the desert northeast of Fields.

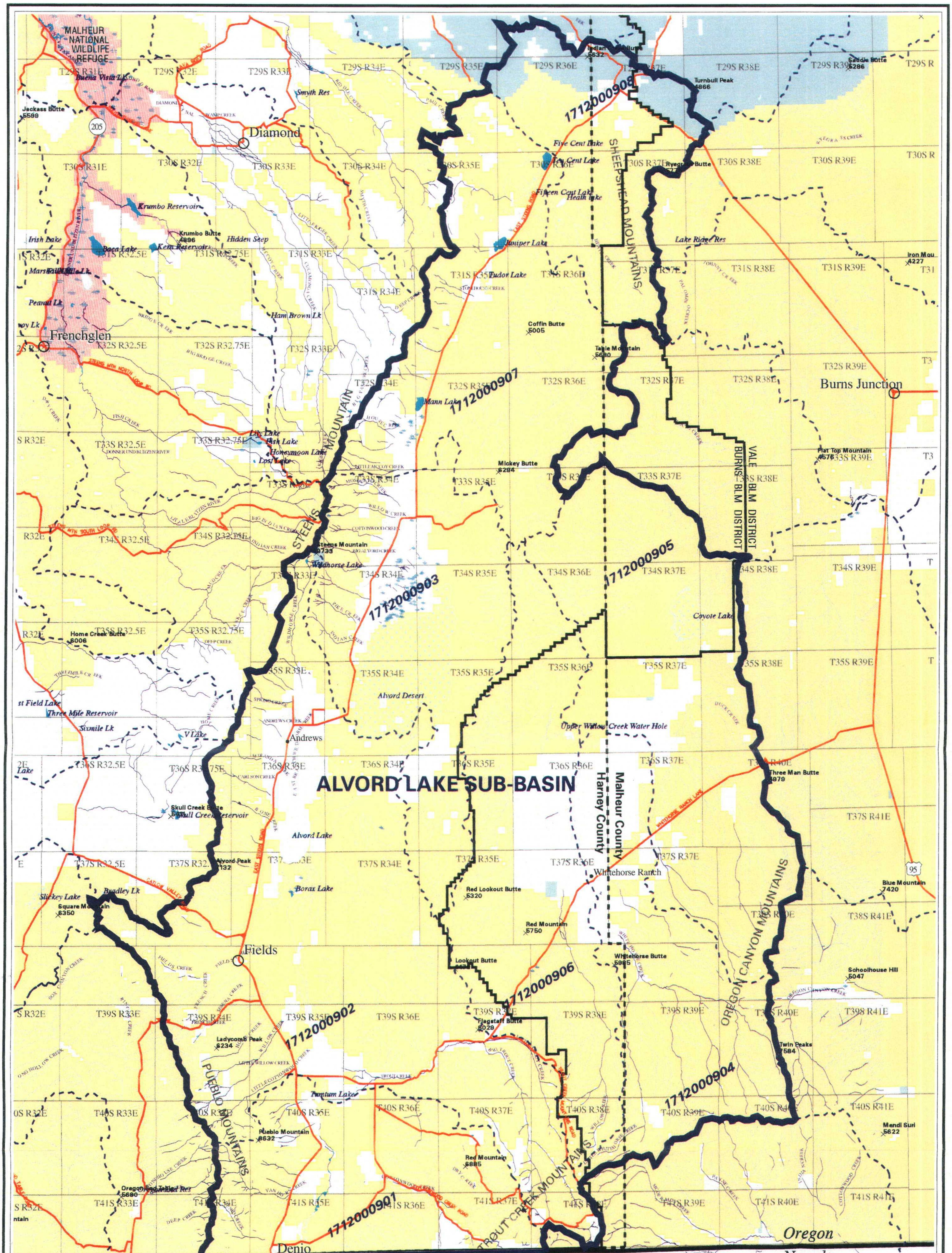
The sub-basin is predominantly shrub dominated uplands (about 78%), but also has juniper and aspen dominated uplands, plus cottonwood, aspen, and shrub dominated riparian zones, and some small upland and riparian areas dominated by herbaceous vegetation (Table 16, page 107.) The dominant land use is agriculture. Livestock graze on most of the rangelands, and hay production is common on a small portion of land in the valley bottoms.

The Alvord Lake Sub-basin is semiarid, with most locations receiving 8 to 14 inches annual precipitation. The tops of the mountains forming the sub-basin boundaries receive more moisture, with the top of the Steens Mountain receiving 49-55 inches of precipitation, much as snow. The lowest sub-basin elevations generally do not have a winter-long snow pack. There is abundant sunshine throughout the year and with the dry air, there are usual significant day and night temperature differences. Summer day temperatures in the lower elevations can get to over 100 degrees Fahrenheit and frost may occur during any month of the year. Thunderstorms are common between April and September, and the prevailing winds are west-southwest.

The Alvord Lake Sub-basin lies in the northwest portion of the Great Basin in the Basin and Range Physiographic Province. The Steens Mountain is a fault-block mountain and is the northern-most range in the Basin and Range Physiographic Province. The oldest rocks in the area are metamorphosed volcanic rocks approximately 150 to 200 million years old. Most surface rocks are basalt and welded tuffs extruded in the past 16 million years.

In the last 24,000 years pluvial lakes have periodically occupied Alvord and Pueblo Valleys, plus smaller isolated low areas in the sub-basin. The lakes first formed following a cold period in which glaciers were present on the Steens Mountain. Sediment from the surrounding mountains is more than 1000 feet deep in the Alvord Valley.

Surface soils in the sub-basin are generally young and poorly developed. Soil-building processes are slow in the dry climate and erosion is common. Most locations do not have distinct, deep soil horizons. Naturally bare soil between plants is common in much of the sub-basin.




## MAP #3 - Alvord Lake Sub-basin - LAND OWNERSHIP and 5th FIELD WATERSHEDS

| | |
|---|---|
| BLM Lands: | 1,052,600 acres |
| Private Lands: | 202,300 acres |
| State Lands: | 23,100 acres |
| Oregon : | 1,278,000 acres |
| Nevada : | 94,800 acres |
| (not shown) | |
| | 1,372,800 acres |

Perennial Lakes
Dry Lakes
Intermittent Lakes
Marsh

Alvord Lake Sub-basin (4th Field Watershed): HUC17120009
5th Field Watersheds: HUC1712000901,02,03,04,05,06,07,08
Major Roads
Perennial Streams
Intermittent Streams

Note: No warranty is made by Harney County or the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

See Appendix 1 for specific data disclaimers.

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Scale: 1 inch = 6.0 miles

US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon

Date: 21-MAR-2006, Pam Keller, subbasin11x17.aml/alvhuc5.ps

# Chapter 2 - Watershed Assessment

This chapter contains discussions of most of the topics which HCWC feels are important to watershed health in the sub-basin. Various aspects of water, water quality, streams and stream functioning are addressed, as are significant watershed health issues posed by invasive plants. The habitat requirements and well-being of sage-grouse and several fish species are covered, as those animal species can be considered as indicators of the area's watershed health. Finally, field work performed by HCWC is presented and discussed.

Photo HCWC

## GENERAL HYDROLOGY, WATER USE AND WATER RIGHTS

**Information sources and authors**

The majority of the text for this section was taken from the Andrews FEIS and a small amount was taken from the Oregon TMDL. Information in two paragraphs and the table was provided by the Oregon Water Resources Department.

Alvord Lake Sub-basin is an internally drained basin. It is part of the Malheur Lakes Basin, and part of the larger Oregon Closed Basins Sub-region and the Pacific Northwest Region. The topographic features of this area direct surface and some shallow subsurface water to streams, rivers, lakes, reservoirs, or playas.

### Surface Water

Watershed function in the form of capture, storage, and release of available precipitation regulates the timing, intensity, and duration of runoff through attributes of landform, soil, and vegetation. Capture and storage of precipitation occurs through upland and riparian landform features such as floodplain, meadows, swales, and ephemeral/intermittent lakes, as well as constructed facilities (soil and water detention structures and ephemeral/intermittent reservoirs). Upland and riparian vegetation further contribute to this process by trapping snow, disrupting overland and stream runoff, and maintaining soil structure, which facilitates infiltration. Water that infiltrates and percolates into and through the soil profile is available to sustain vegetation and contributes flow to seeps, springs, streams, and lakes. Stored water in riparian systems and adjacent uplands subsequently releases as a cool water source that augments baseflow, buffers stream temperature, and provides habitat for aquatic species.

Various other parts of this report focus on surface water—especially perennial streams. There is also a descriptive section on wetlands. The short paragraph above briefly explains the ties between precipitation, surface water and ground water.

## Ground Water

The regional ground water gradients and the extent of aquifer systems within the area have not been studied. Ground water data are limited. The Oregon Water Resources Department database indicates that there are 146 water wells in the sub-basin which irrigate 6,548 primary acres, and 6,380 supplemental acres (OWRD, email correspondence, April, 2005)

The geology of the area is composed primarily of volcanic rocks. The water-bearing properties of these geologic formations depend largely on faults, fractures, joints, etc. The rate and quantity of ground water movement depends on the hydraulic conductivity of the geologic formation and the hydraulic gradient.

Ground water occurs as both confined and unconfined aquifer systems. Most unconfined aquifers are located in stream valleys or are associated with Pleistocene lakebeds that contain recent alluvial material; some may exist as perched aquifers. Alluvial aquifers vary greatly in size and yield from one stream/lakebed to another. These aquifers are important as transient storage systems to move ground water to or from streams and the deeper confined aquifers, and they are typical of drainages in the area. Perched aquifers occur along ridges between stream valleys and can usually be identified by the occurrence of springs above the valley bottoms. They are often associated with alluvial aquifers where streambeds intersect permeable outcrop areas.
Little is known of the extent or depth of the deep, confined bedrock aquifer systems. The DEQ has not identified any sole-source aquifers. The presence of numerous volcanic flows and faults does not support the concept of a uniform regional ground water gradient. Recharge to ground water systems occurs mainly at higher elevations where precipitation highly exceeds seasonal evapotranspiration. Precipitation is the major recharge source in areas with an exposed permeable formation and average annual precipitation in excess of 12 inches.

Ground water is used for domestic and livestock purposes and for irrigation. Ground water quality depends on the chemical makeup of the water-bearing formation. Most of the region contains good quality water, but the water is usually hard and contains moderate amounts of dissolved minerals. Minor exceptions are geothermal and hydrothermal waters that have concentrated elements such as arsenic, mercury, molybdenum, uranium, and selenium (Ferns et al. 1993a; Ferns et al. 1993b). Springs and seeps occur in areas where water from aquifers reaches the surface. Many springs begin in stream channels; others flow into small ponds or marshy areas that drain into channels. Some springs and seep areas form their own channels that reach flowing streams, but other springs lose their surface expression and recharge alluvial fill material or permeable strata. Inflow from riparian/hyporheic zones affects baseflows and associated water temperature buffering and moderation. Water from springs differs from that of overland runoff in that it is generally more constant in temperature and lower in dissolved oxygen, especially close to the source. Mineral content in water varies from spring to spring along stream courses, depending upon the geochemistry of the substrata through which it flows.

## Water Use

Beneficial uses of water occurring in the Alvord Lake Sub-basin are the same as for the Malheur Lake Basin overall. Common beneficial uses are irrigated agriculture, fish and fish habitat, livestock, domestic and recreation. Salmonid fish (trout) spawning, salmonid rearing and resident fish and aquatic life are the three uses deemed the most temperature sensitive beneficial uses within the Alvord Lake Sub-basin.

The only state Water Resources Division water availability data existing for the Alvord Lake Sub-basin is for Wildhorse Creek in the Steens Mountain and Trout Creek flowing out of the Trout Creek Mountains. Both creeks eventually flow to Alvord Lake. Water availability data equates to the amount of surface water available for appropriation and the data is used to evaluate applications for new uses of water (OWRD, Water Availability Information).

## Water Rights

Under Oregon law, all water is publicly owned. With some exceptions, cities, farmers, factory owners and other users must obtain a permit or water right from the Water Resources Department to use water from any source—whether it is underground, or from lakes or streams. Landowners with water flowing past, through, or under their property do not automatically have the right to use that water without a permit from the Department. There are water rights by decree for Whitehorse Creek, Trout Creek, Willow Creek, and Wildhorse Creek, as shown in Table 1.

**Table 1. Water Rights by Decree in the Alvord Lake Sub-basin**

| Decree | Whitehorse Creek | Trout Creek | Willow Creek | Wildhorse Creek |
|---|---|---|---|---|
| Rate (not to exceed) | 1/40th cfs/acre of land | 1/40th cfs/acre of land | 1/40th cfs/acre of land | 1/60th cfs/acre of land |
| Duty | 3 acre feet | 3 acre feet | 3 acre feet | 2.5 acre feet |
| Season | 3-1 to 9-1, or any time use is beneficial | 3-1 to 10-1 | 3-1 to 9-1, or any time use is beneficial | None |
| Uses | Irrigation. Livestock. | Irrigation. Livestock and domestic. | Irrigation. Livestock. | Irrigation. Livestock and domestic. |

Source: Harney County Watermaster, Summary of District 10 Decrees

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Watershed assessments in Oregon traditionally focus on surface water. Other parts of this report do that. The ground water section here is short and only descriptive. It does not focus on the Alvord Lake Sub-basin and it has little relevance to watershed health as generally discussed in this document. Water use and water rights are controlled by state law. Beneficial uses of water as controlled by state law guide efforts to improve water quality when use standards are not met. Given the general and legal focus of the information in this section, there is little direct connection to long-term watershed health in the sub-basin.

**Issues, concerns and action items.**

- Educating the public on the connection of precipitation, surface water and ground water, and the role of ground water in surface water augmentation and temperature amelioration.

# WETLANDS

**Information sources and authors**

The text for this section comes from the Vale FEIS.

Wetlands are lakes, reservoirs, playas, sloughs, meadows, springs, and seeps that are permanently or seasonally covered with water. They are also commonly found as features independent of a defined stream channel and can occur throughout various elevations and landscape settings. This is particularly true for meadows, springs, and seeps that may be present within very arid areas and at low elevations. Common plant species of these areas include salt grass, Baltic rush, spikerush, and cattail. Intensity of wildlife use of wetlands varies seasonally. Many species of waterfowl and shorebirds use these areas during spring and fall migrations, but in summer, wildlife use is restricted to resident species. Seasonal playas may contain aquatic invertebrates that are adapted to survive periods of desiccation.

The Army Corps of Engineers, EPA, USFWS, and Natural Resources Conservation Service (NRCS) worked together to develop common language and criteria for the identification and delineation of wetlands in the United States. They defined wetlands as possessing three essential characteristics: 1) hydrophytic vegetation; 2) hydric soils; and 3) wetland hydrology, which is the driving force creating all wetlands. Hydrophytic vegetation is defined as plant life growing in water, soil, or substrate that is at least periodically deficient in oxygen as a result of high water content. Hydric soils are those that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic (without oxygen) conditions in the upper part of the soil profile. Generally, hydric soil is subject to water saturation at temperatures above freezing for at least a week during the growing season.

Wetland hydrology is defined as permanent or periodic inundation of water, or soil saturation to the surface, at least seasonally. The presence of water for a week or more during the growing season typically creates anaerobic conditions in the soil, which affect the types of plants that can grow and the types of soils that develop. Meadows occur in narrow strips around springs and along streams. Some of the most important meadow habitats are located at mid and upper elevations of complex mountainous terrain. Good examples can be found in the Trout Creek/Oregon Canyon Mountains.

Protection and restoration of meadows require management of activities that could affect the vegetation and the soils, which in turn affect the overland and subsurface flow and storage of water. In most settings, meadow habitats are vulnerable to grazing influences and other surface-disturbing impacts, such as OHV use and mining operations, which can affect soil stability, water-holding capacity, and plant composition. In some instances, where management has been changed, proactive stabilization of gullies may be required to slow or reverse the physical processes that are causing the degradation, until the system can begin to recover on its own.

Springs and seeps can support unusual invertebrates, such as snails or other species that may be endemic to local areas. These systems tend to provide constant water flows and consistent temperatures that are distinctly different from adjoining riparian habitats.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

The functioning and health of non-stream wetlands are important factors in watershed health. However, wetlands have not received the same attention as have streams in rangeland management. Procedures have been developed to assess wetland areas (for example, BLM TR-1737-11 and TR-1737-16), but at this time the BLM is not using those procedures extensively in the sub-basin. Similarly, HCWC due to project restraints chose not to focus on wetlands for this report, neither in the field nor in this report.

**Issues, concerns and action items.**

- Raise the level of awareness of the functioning and importance of wetlands in the general public and land managers.
- Over time increase the focus and allotment of HCWC resources towards wetlands.

# STREAMS AND RIPARIAN ZONES

Streams and their associated riparian zones are important components of watersheds. Likewise, the condition of streams and their riparian zones are very important components of watershed health. In the following sections we: 1) present the amount (length in miles) of perennial streams in the Alvord Lake Sub-basin, 2) provide information on the determination of the riparian condition throughout the sub-basin and present the results of those determinations, and 3) discuss three situations about sub-basin streams which are informative about stream functioning and which have implications for stream and riparian management.

## Perennial Streams

Perennial streams are generally defined as streams which have surface flow year around. See pages 34-38 for a more complete discussion of perennial vs. non-perennial streams. Due to their year around flow, perennial streams inherently are considered to have greater value than do non-perennial streams. There are about 485 perennial stream miles in the Oregon portion of the Alvord Lake Sub-basin. See Table 2 below for mileage by 5$^{th}$ field watershed.

**Table 2. Perennial Stream Lengths in the Alvord Lake Sub-basin. The lengths are rounded to the nearest mile. Maps 9-16, starting on page 124, show the individual 5$^{th}$ field watersheds and the perennial stream reaches.**

| 5$^{th}$ Field Watershed | Watershed Name | Miles |
|---|---|---|
| 1712000901 | Cottonwood Creek | 74 |
| 1712000902 | Alvord Lake | 161 |
| 1712000903 | Big Alvord | 59 |
| 1712000904 | Whitehorse Creek | 84 |
| 1712000905 | Twelve Mile Creek | 26 |
| 1712000906 | Willow Creek | 31 |
| 1712000907 | Summit | 50 |
| 1712000908 | Quail Creek | 1 |
| | **Total** | **485** |

Source: USGS topographical data as determined by BLM GIS, Burns and Vale Districts. Data includes all landownership categories.

## Riparian Zones: Condition and Trend

**Information sources and authors**

The text for this section comes largely from the Andrews FEIS (Burns BLM Functioning Condition Assessments) and the Vale FEIS (Vale Trend Assessments).There is a small amount of text written by HCWC (HCWC Functioning Condition Assessments). The two tables use BLM and HCWC data.

**Burns BLM Functioning Condition Assessments.** The majority of public land riparian areas associated with perennial streams assessed between 1997 and 2000 by the Burns BLM used the PFC assessment methodology. Functioning condition of riparian/wetland areas is a result of interactions among geology, soil, water, and vegetation. PFC is an assessment of the physical function of riparian and wetland areas through consideration of hydrology, vegetation, and soil/landform attributes. This assessment utilizes existing site specific inventory and monitoring information, as well as helping to identify management objectives and future monitoring. Definitions of the PFC ratings are identified below:

- **Proper Functioning Condition:** Riparian/wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; to filter sediment, capture bedload, and aid in floodplain development; to improve floodwater retention and ground water recharge; to develop root masses that stabilize stream banks against cutting action; to develop diverse ponding and channel characteristics; to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and to support greater biodiversity.

- **Functional—At Risk (FAR):** Riparian/wetland areas that are in functional condition, but an existing soil, water, or vegetation attribute makes them susceptible to degradation.

- **Non-functioning:** Riparian/wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, etc.

Photo HCWC

Riparian/wetland vegetation resources support and are supported by the ecological function of watersheds. Past management practices such as historic livestock grazing coupled with natural events of drought, flood, and wildland fire have and may continue to affect the distribution, abundance and diversity of riparian/wetland vegetation and the overall function of the watershed. PFC assessments, of which riparian/wetland vegetation is a primary attribute, indicate that the majority of riparian areas assessed in the area are at a level of PFC. PFC does not necessarily equate to ecological potential or a theoretical “desired future condition”; rather it demonstrates the level of resilience required for a system to function and allow for maintenance and recovery of riparian/wetland communities. The range between PFC and an area’s physical and biological potential becomes the “decision space” for social, economic, and other resource values. The values derived from riparian/wetland vegetation include water quality, fish and wildlife habitat, scenery, recreation and livestock forage.

Table 3 shows the results of the 1997-2000 Burns District PFC assessments.

**HCWC Functioning Condition Assessments.** In 2004 HCWC conducted riparian zone inventories on 17 miles of perennial streams on private lands in the sub-basin. Included in those inventories was an assessment patterned closely after the BLM Proper Functioning Condition (PFC) assessment (TR 1737-15, 1998). See pages 85-93 for more information in those inventories and assessments. The results of the assessments are included with the PFC data for the Burns BLM District in Table 3 below.

**Vale Trend Assessments.** Vale BLM resource area specialists evaluate riparian areas on the basis of trend information gathered from field studies collecting resource information at two or more time periods (years) and evaluating relative differences in the data. A variety of field study methodologies are used to determine riparian trend, including low-level infrared imagery, line intercept vegetation transects, photo points, and aquatic invertebrate samples

Trend evaluations factor in site potential capabilities that are often variable and dependent on the location of the riparian area within the watershed. A variety of information sources is used in assessing site potential. Specific site-guides for determining potential natural communities have not been developed for riparian/wetland areas in southeastern Oregon. BLM is currently using existing data collected at various riparian/wetland areas to assist in projecting site potential. Much of this information is derived from existing riparian enclosures that have been in place since the 1970s and 1980s and serve as reference areas for stream systems in the general area. Additional information for determining riparian site potentials has been gleaned from established streamside monitoring and study sites in allotments and pastures where livestock grazing practices were adjusted to meet objectives developed for riparian/wetland restoration.

Riparian areas with an unknown trend are of two types: 1) riparian information has not been obtained, or 2) riparian baseline data has been gathered but more time is needed for long-term trend to be apparent.

Table 4 shows the results of the Vale District trend assessments.

**Table 3. Functioning Condition Assessment Results.** Includes data from both Burns BLM and HCWC assessments performed on streams in five 5th Field HUCs. Reaches assessed as being Functional—At Risk are further judged to be in Upward, Unknown or Downward Trend. These trend judgments are not the same as used by the Vale BLM – see Table 4 and the discussion in the report text.

| HUC | Name | PFC[1] | FAR-UP[2] | FAR-NA[3] | FAR-DN[4] | NF[5] | Total |
|---|---|---|---|---|---|---|---|
| 1712000901 | Cottonwood Creek | 29.4 | 5.5 | 4.3 | 0.0 | 0.6 | 39.8 |
| 1712000902 | Alvord Lake | 77.9 | 11.2 | 14.4 | 0.9 | 9.4 | 113.8 |
| 1712000903 | Big Alvord | 44.6 | 0.0 | 3.0 | 0.0 | 0.0 | 47.6 |
| 1712000907 | Summit | 9.4 | 0.0 | 2.6 | 0.0 | 0.0 | 12.0 |
| 1712000908 | Quail Creek | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Totals** | | **161.3** | **16.7** | **24.2** | **0.9** | **10.0** | **213.2** |
| **Percents of Totals** | | **76%** | **8%** | **11%** | **<1%** | **5%** | **100%** |

[1] Proper Functioning Condition
[2] Functional—At Risk Upward Trend
[3] Functional—At Risk Unknown Trend (NA = Trend Not Apparent)
[4] Functional—At Risk Downward Trend
[5] Nonfunctioning

**Table 4. Riparian Trend Assessment Results.** Includes data on streams in the Vale BLM District within three 5th Field HUCs.

| HUC | Name | Up[1] | Static[2] | Down[3] | Unknown[4] | Total |
|---|---|---|---|---|---|---|
| 1712000904 | Whitehorse Creek | 84.3 | 0.7 | 0 | 0 | 85.0 |
| 1712000905 | Twelve Mile Creek | 0 | 0 | 0 | 36.3 | 36.3 |
| 1712000906 | Willow Creek | 26.2 | 0 | 2.8 | 0 | 29.0 |
| **Totals** | | **110.5** | **0.7** | **2.8** | **36.3** | **150.3** |
| **Percents of Totals** | | **74%** | **<1%** | **2%** | **24%** | |

[1] Riparian trend is upward
[2] Riparian trend is static
[3] Riparian trend is down
[4] Riparian trend is unknown

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Tables 3 and 4 indicate the assessed riparian zones in the sub-basin largely are either in proper functioning condition or have an upward trend. These results indicate favorable current conditions and also allow favorable assumptions for long-term watershed health.

**Issues, concerns and action items.**

- Stream miles classified as Functional—At Risk, Nonfunctioning, and/or having a downward trend should be improved.
- Streams which have not been assessed for functioning condition or riparian trend to this point in time should be. Re-assessment should occur periodically on all streams to document possible changes in condition.

# STREAM MANAGEMENT: HCWC OBSERVATIONS AND ISSUES

The following three sections document situations and issues which came to light during HCWC field work for this watershed assessment. Documenting these for this report was not part of the original HCWC field work plan. All three sections concern streams, stream functioning and management issues. HCWC hopes that by detailing these situations, readers of this document will better understand facets of surface water hydrology within the sub-basin.

In the first two sections concerning: 1) stream functioning on alluvial fans and 2) the effects of irrigation on riparian zones, we emphasize what appear to be positive benefits to riparian zones following alteration of natural functioning systems. Though these benefits appear very real in their own light, HCWC acknowledges that it is impossible to know that all of the resulting changes in the systems following the described alterations are beneficial. It could be that more subtle, but important, long-term changes are occurring that are not positive.

In the third section we describe and illustrate a stream mapping problem. This situation both illustrates the functioning of many sub-basin streams and also documents a relatively common problem in the sub-basin—the incorrect mapping of perennial stream reaches.

## Stream Functioning on Alluvial Fans

**Information sources and authors**

The text for this section was written by HCWC following field observations. The photos were also taken by HCWC. Two literature sources on stream functioning on alluvial fan are cited.

Alluvial fans are common in the Alvord Lake Sub-basin, especially along the steep mountain faces of the east sides of the Steens and Pueblo Mountains. Many of the major streams from these mountains flow across or onto these fans. Because of the unique conditions of fans, these streams generally function differently than streams in the other two typical settings in the sub-basin: 1) in steep mountain canyons in which the streams are partially cutting into bedrock, and 2) in lower gradient valleys where streams flow on valley fill which is much finer and more consolidated than typical alluvial fan materials.

In this report section we present: 1) a brief general description of alluvial fans and the streams which flow across them (French, 1987 and Harvey, 1997), 2) a section on Cottonwood Creek, an apparently unaltered alluvial fan channel in the sub-basin, and 3) a section on fans which have had their channels altered by channelization and dike building. A main emphasis of the section is the apparent positive changes to the streams and riparian zones which occur following channelizing and diking. While the easily noticed changes appear positive, it is possible there may also be other more subtle changes occurring which have unknown and possibly negative impacts.

Alluvial fans are fan-shaped deposits formed where a stream emerges from a canyon onto a plain or other relatively flat area. Fan materials are eroded from the drainage above, carried to the fan and deposited where and when the stream no longer has the power to carry them. Fans generally build over time, with the rate of buildup dependent on climatic, vegetative, geologic and geomorphic characteristics of the region. Significant deposition in an area or specific location of a fan will push later flows onto other parts of the fan where deposition fills lower areas. Through time, this process of shifting deposition makes the fan shape relatively symmetrical. Classic alluvial fans are often obvious on topographical maps as the contour lines are nearly uniform concentric half circles originating at the mouth of the canyon.

Water flow across alluvial fans can range from non-channelized sheet-like flow across significant portions of the fan surface, to channels which are incised the length of the fan. A very common situation is intermediate between these extremes and includes an incised single channel at the upper end of the fan, which becomes shallower down across the fan until it braids into multiple channels and then eventually just flows across the lower portions of the fan without being confined in any channel-like features. In these situations, the point at which the channel generally ceases to exist is called the intersection point (Harvey 1997).

Within the incised portion at the upper end of the fan, the channel is steepest toward the top and gradient usually decreases going downstream. At the top of the fan the water is generally confined in a relatively narrow channel which has a steep gradient. Therefore, the stream power is sufficient to carry large materials, at least in high flows. As the gradient decreases down stream and the channel widens, the water can only carry successively smaller materials, so deposition occurs. To a degree, larger materials are more common at the upper ends of many fans and smaller materials at the lower ends, but there is significant mixing of materials sizes throughout most fans. The amount of flow and the resulting distance various material sizes are carried varies dramatically throughout time. Additionally, mud flows and debris flows (two phenomena which carry large amounts of materials) occur periodically in many settings. These flows can cause in-channel deposition which may completely block the channel. Blocked channels can cause overland flow and possible new channel creation.

Because the surfaces of fans are relatively steep even at their lower ends, much of the finer materials brought by stream water onto the fan from above do not get deposited at all, at least during the higher flow events. Consequently, alluvial fans are often composed of mostly large materials throughout and have little fine material compared to lower gradient areas. This commonly results in the channel bank and bottom materials being porous to water, allowing significant water loss from the stream into the fan body. In some situations, it is common for all of the stream water to submerge into the fan in all but the highest of flows. In contrast, fans which have water crossing the length of the fan for significant parts or all of the year usually have one well defined channel whose bottoms and banks are less porous due to the long term deposition of materials.

Because of the varying water levels in fan channels and the relatively large bank materials, vegetative growth on banks directly adjacent to some channels is often restricted. In fact, those banks often have less vegetation than do the adjacent fan upland areas. Those adjacent uplands may have a full suite of the upland vegetation common to the region. When the riparian banks are well vegetated it is usually with willows and possibly cottonwood trees, both of which can establish and thrive on surfaces with few fine materials. Those species quickly send down a fast growing tap root the first couple years and once established they access underground water sources even in times where there is no water on the surface or in the upper several feet of fan materials. In contrast, a herbaceous layer is often lacking even where cottonwoods and willows exist. There is often not enough water held in the upper surface layers to allow these relatively shallow rooted species to survive in the drier parts of the year. In some situations where cottonwoods and willows have been established for significant time, fine sediments will accumulate allowing some herbaceous growth. In general, the longer the time of stability and plant establishment, the more likely that at least some of the vegetation will be grasses and/or forbs.

In some situations, established willows and cottonwoods will thrive for years along channels that no longer have surface flow, after the flow has shifted to other fan locations. In these settings, underground flows evidently still exist allowing those plants to stay alive. In other situations with shifting surface water, the underground water also often shifts, and dead or dying willows and cottonwoods can be found along old channels.

**Cottonwood Creek.** Cottonwood Creek is the next major drainage north of Big Alvord Creek on the east side of the Steens Mountain. Like all of the larger creeks in the region, Cottonwood Creek flows out of a steep-walled canyon onto an alluvial fan. This alluvial fan is partially confined on the south side by a low ridge extending out from the higher Steens. There is a large stand of black cottonwood (*Populus trichocarpa*) at the upper end of the Cottonwood Creek fan (or just above the upper extent of the alluvial fan, see Site 1 photo below). That cottonwood stand extends up along the creek into the canyon above.

The upper end of the Cottonwood Creek alluvial fan appears to be unaltered by human disturbances. The USGS topographical map shows Cottonwood Creek as being a perennial stream (surface flow through out the year) part of the distance down through Sites 1-6 (Figure 1, below) and then it is shown as changing to an intermittent stream. See pages. 34-38 for a discussion of perennial vs. intermittent streams and their mapping on the USGS maps. The location of that change appears to be roughly confirmed by evidence on the ground, even though surface water extended below the marked map location in October of 2005 when this set of photos was taken.

Within the reach containing the six sites documented in Figure 1, Cottonwood Creek is shown on the USGS map to braid into three different channels. The middle of the three channels is currently the one which is most obviously occupied by the stream. Sites 3-6 are along the middle channel below where the first side channel departs. The two side channels are visible on the ground, and are partially marked at their upper ends by cottonwood and willow plants which are dead or apparently dying.

The intersection point (where the creek level rises up to the same level as the rest of the adjacent fan) is approximately at Sites 5 and 6. Below that point to the county road (about 2500 feet) the natural channel is generally not well defined. Flows which go past the intersection point appear to spread to multiple, broad and shallow depressions which go toward the county road.

**Figure 1. Cottonwood Creek Alluvial Fan Photos and Descriptions.** All photos HCWC.

**Site 1.** This site is in the large black cottonwood (*Populus trichocarpa*) stand at or just above the upper end of the fan. Note that at least some of the bank and channel materials are very large rocks. Some of those rocks are held solidly in place by tree roots. The low floodplain to the right extends back and gradually elevates to the height of the terrace on the left. Not noticeable is the fact that there are some herbaceous plants which grow on these banks. Also, there is recruitment of young cottonwoods on the low right bank and on the low parts of the steep left bank. Black cottonwood is a species which can sprout new plants from old roots and the younger plants on the right and near left may have grown off older roots rather from seeds.

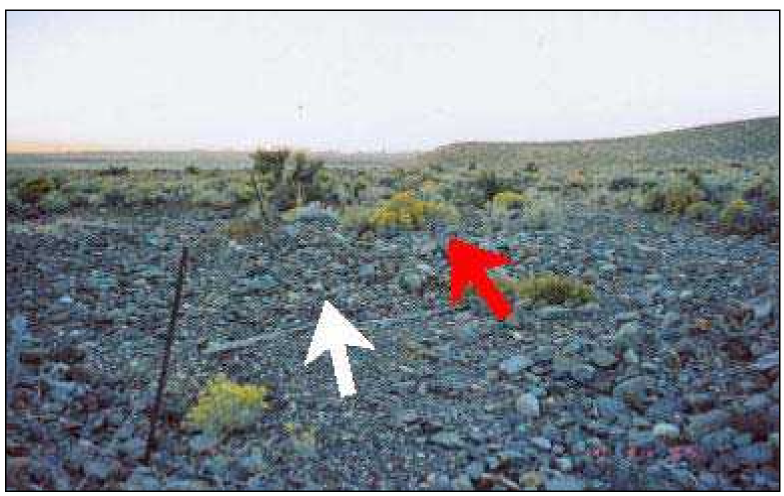
**Site 2.** This location is approximately 400 feet downstream of Site 1. Though not easily noticed in this photo, there is some stabilizing influence by relatively large trees at this site– most are back from the stream edge which here is stabilized by large rocks, shrubs (willows) and sapling-sized cottonwood trees. Note the on-going small shrub and tree recruitment in the right foreground opening. Overall the channel here is well defined and still very stable. The amount of flowing surface water here was judged to be the same as at Site 1.

**Site 3.** This location is approximately 2000 feet downstream of Site 2. There are still scattered, mature cottonwood trees, but there is also a significant amount of bare ground without a tree or shrub overstory. There are essentially no herbaceous understory plants (graminoids and forbs). There are significant amounts of large channel and bank materials at this site, but note their generally unstable appearance. The channel here is poorly defined and even moderate flows through this area may alter the channel location and shape. The surface water here was judged to be about 50% of the flow at Site 1.

**Site 4.** This location is about 600 feet down from Site 3. The cottonwood tree on the left is the last cottonwood of significant size going out onto the alluvial fan—it is about 20 feet tall and appears healthy. With the channel directly adjacent, this tree certainly has enough water on a yearly basis to thrive. If the channel moved away from this location, this tree would possibly decline and die. It is possible the tree could survive a shift of the channel, if underground water pathways continued to provide water. The amount of flowing surface water was judged to be only about 25% of that at Site 1. The relatively well defined channel here may be mostly a coincidence—this is the only such place in the lower portion of the studied reach. The trees and shrubs which are beginning to line the banks are not large enough yet to provide significant stability.

**Site 5.** This location is approximately 300 feet down from Site 4. None of the visible plants in this photo are cottonwood trees or willows. Instead the shrubs are upland species which grow more densely outside of the commonly disturbed channel-way. The furthest water visible to the left of photo center was the last surface water seen on the alluvial fan. Note directly beyond that water about another 50 feet is a vertical, dark line with some brown debris at its base. That is a fence post which is within the field of view of the Site 6 photo, but it is not actually visible in the that photo—see description.). Note that the channel here is poorly defined, plus it is wide and shallow. Though not obvious from this photo, it can be seen on the ground that in many higher flows, significant water flows outside of this channel—see below.

**Site 6.** This location is approximately 200 feet downstream of Site 5. This photo was taken across the channel rather than down the channel as in the Sites 1-5 photos. Though not apparent from this view, the channel-way shown in the Site 5 photo is just beyond the largest, yellow rabbit brush plant (*Chrysothamnus visidifloris*) near the photo center (red arrow). The bare foreground area (white arrow) is also a flow pathway for larger flows which get out of the channel shown in the Site 5 photo. This foreground area could easily turn into the main channel-way if flows deposit materials which block the current main channel in the area at Site 5 or above. Similar deposition events higher than Site 5 could easily cause the main channel to move completely away from this location on the alluvial fan.



**Altered Alluvial Fan Channels.** Just to the south of Cottonwood Creek there are at least three major drainages on which the stream channels have been significantly altered on their alluvial fans. These include Big and Little Alvord creeks, and Pike Creek. The alterations were performed primarily to establish definite channels to the appropriate bridges or culverts which allow the water to run under the main north/south county road. The channels were dug out and diked to keep the water in one channel as it moved down the respective fans. Efforts to direct the water on the fans have probably occurred since roads were first built in the area. The digging and diking which established the current channel locations occurred in the 1960s. On Big Alvord Creek, follow-up digging and diking are still periodically performed just above the county road, the last time being in the late 1990s. The goal of getting the water to the appropriate road crossings has generally been met. During recent history the majority of the water in these streams follows the established channels most of the time to the appropriate road crossings. At times some water comes out of the main channels during high water events and flows in different channels or depressions to the road. However, road flooding and wash outs are not as common as would be expected if the water were allowed to move down the fans naturally.

Of the three mentioned streams, Big Alvord Creek is the next drainage immediately south of Cottonwood Creek and it is the most similar to Cottonwood Creek in some noticeable fan attributes. In contrast, Little Alvord Creek and Pike Creek are further south beyond Big Alvord Creek and those streams appear quite different from Cottonwood Creek.

There are two main ways in which Little Alvord and Pike creeks and their fans differ from Cottonwood and Big Alvord creeks and their fans. First, the materials making up the Little Alvord and Pike creek fans and the materials carried onto those fans by the creeks are significantly smaller than the materials of Cottonwood and Big Alvord creeks and fans. There are significant amounts of fine materials (silts and clays) carried by Little Alvord and Pike creeks, and less gravel, cobble and boulders in comparison to Cottonwood and Big Alvord creeks. Second, Little Alvord Creek and Pike Creek have more consistent year-around flow even at the tops of the fans than do Cottonwood and Big Alvord creeks. Here “more consistent year-around flow amounts” refers to a smaller difference in amount between the snow melt driven, high spring flows in comparison to late summer and fall low flows.

As a result of differences in fan and flow characteristics, Cottonwood and Big Alvord creeks are more dynamic than Little Alvord and Pike creeks, with significant changes often occurring yearly with each high springtime flow. Though the channel materials are larger on Cottonwood and Big Alvord creeks, they are mostly unconsolidated, poorly stabilized by vegetation and can move relatively easily (see the Site 3-6 photos above.) In contrast, the mixed smaller and larger materials along Little Alvord and Pike creeks are more consolidated and consequently more stable. In addition, they are extensively stabilized by plant roots (both woody and herbaceous species (see Figure 2, second photo). Once stabilized these materials do not normally move much, even with high flows.

**Figure 2. Little Alvord and Big Alvord Creek Photos and Descriptions.** All photos HCWC.

**Little Alvord Creek.** View up across the alluvial fan, taken from the top of the constructed dike. Note the consistent willow and cottonwood cover along the channel in most of the visible reach.

**Little Alvord Creek.** View of understory composed of both herbaceous plants and the stems of willows. The dark shadow in the left upper edge of photo is from a sagebrush plant growing on the adjacent constructed dike which confines the stream to this location.

**Big Alvord Creek.** The dikes to the left and right are subtle in this reach and not discernible in this photo. The darker shrub is an upland species, lighter shrubs and trees in the distance are willows and cottonwoods. Light green to grayish small plants along the channel, including those in the bottom right corner, are young willows. Essentially all of the herbaceous plants shown are upland species. Note the size of the channel and bank materials.

While the goal of getting the water to the right road location was certainly the motivation for those who initially altered these alluvial fan channels, there now appears to be other resulting positive benefits to the stream, its riparian zone and to the amount of available fish habitat. With the water largely confined in the same channels year after year, vegetation can establish and thrive. Even if the water submerges part way down the fan in most years it does so in relatively consistent places, supplying both surface and underground water to the cottonwood and willows along the main channel. Additionally, that consistent flow location over time allows deposition of finer materials in greater amounts than would naturally occur in shifting channel situations. Not only does that fine material provide water holding capacity for shallowly rooted plants, it also can partially seal the channel bottom and banks, eventually slowing the submergence of water from the stream into the fan alluvium. With time this process can allow development of healthy riparian vegetation and extended surface flow.

The extension of surface flow and development of riparian zones has occurred relatively quickly on Little Alvord and Pike creeks. Both creeks now have well developed riparian vegetation, including woody overstories and herbaceous understories. They also have what appears to be perennial surface flow to the county road (see Figure 2, second photo). Despite already being advanced, the progression of vegetative development along these two altered streams continues, as there is an obvious pattern on both streams of older cottonwood trees toward the upper ends of the fans, and progressively younger and fewer cottonwoods further down stream. Less easy to notice on those streams is that the willows at the top also appear older than those below.

The extension of surface flow and development of riparian zones is also occurring on Big Alvord Creek, but apparently at a much slower rate. In addition, the process is naturally occurring along the current main channel of Cottonwood Creek, but at what appears to be a dramatically slower rate, and only in a short reach in the upper end of the fan. On Big Alvord Creek the apparent age and amount of the woody plants decrease significantly going down from the top of the fan toward the bottom, but it appears that with time the younger plants at the bottom of the fan will become nearly as numerous and abundant as those at the top. Similarly, there is some herbaceous vegetation on banks in the upper stream reaches of the Big Alvord Creek fan, but that disappears toward the lower end of the fan. The low end of the year-around surface flow also definitely appears to be moving down the fan, as observed by Ed Davis (personal communication, 2005) owner of the Alvord Ranch which includes the entire Big Alvord Creek fan.

On the Cottonwood Creek fan, the extension of willows and cottonwoods downstream is proceeding only along a relatively short reach of the current main channel on the upper portion of the fan. There are no willows or cottonwoods in the bottom 2500 feet of the fan. The willows and cottonwoods along the two most obvious old channels are dead or dying, apparently from the lack of water which now apparently flows primarily in the one main channel. Similarly, there is no herbaceous vegetation along the current main channel except in the very upper end of the fan.

The progressive development of the riparian vegetation down all three of the discussed altered channels (Big and Little Alvord and Pike creeks) is adding substantial vegetative diversity to the three fans. Though not wide, the woody plant dominated riparian zones along Little Alvord and Pike creeks now extend essentially from the mouths of the Steens Mountain canyons to the county road. Similarly, large woody plants extend down over half of the Big Alvord Creek fan distance between the canyon and county road. Small, woody plants are scattered to common over the remaining distance. Those small plants appear healthy and should grow to maturity as long as the stream is kept in the same location.

With surface water extending further down the altered alluvial fans, the amount of fish habitat and riparian vegetation is increasing. Big and Little Alvord, and Pike creeks all have local populations of Lahontan cutthroat trout above the alluvial fans. These fish can now expand into the habitat in the channels on the fans. Population size in Lahontan cutthroat trout is highly dependent on the amount of available habitat (see pages

49-53) consequently these expanding habitats are assumed to result in larger and more stable populations. While the conditions on the three altered fans are not entirely natural, the resulting above ground situations appear beneficial in the discussed manners. However, we do not know if there may be offsetting, negative impacts resulting from the alterations. Keeping the water on the surface for a greater distance may be reducing the amount of ground water in other areas on the fans. Those areas could be drying and undergoing changes to their vegetation. Other unknown changes of this nature could also be occurring, and could be having significant impacts. In addition, we also do not know if a similar set of stream and riparian circumstances would not have naturally occurred on these fans without the human alterations. It is possible that the three streams in the same time period could have each naturally stayed in one channel with similar results.

The need to continue directing the flows to specific road locations will not change, certainly allowing further development of desirable riparian and fish habitat. At the same time, we do not know all of the changes which may be taking place

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

The purpose of this section is twofold: 1) to educate readers about stream functioning on alluvial fans, and 2) to illustrate a situation in which human alterations at least appear to result in positive benefits, i.e. increased amounts of surface water and riparian zones and consequently improved fish habitat. While these changes appear significant where they occur, the total amount of change of this type in the sub-basin is relatively low as there are a limited number of places such changes could come about. There is limited impact in the sub-basin to overall watershed health from these changes.

**Issues, concerns and action items.**

- Educate the public and land managers as to the potential local positive effects of human-induced alterations to natural systems.

- Educate the public and land managers that we do not always understand all effects to natural systems once they have been altered.

# Irrigation Effects on Riparian Zones

**Information sources and authors**

The text for this section was written by HCWC following field observations. The photo was also taken by HCWC.

As part or the field work for this report, HCWC performed riparian inventories on several stream reaches which were within flood irrigated agricultural fields. In these reaches, the water is diverted from the stream channel and flows to ditches which run along the outside of the fields. Water flows out of the ditches and across the fields, and some returns to the channel as overland flow. Some water also returns to the main channel as underground flow and was commonly observed coming out of the sides of stream banks in the irrigated reaches.

The irrigated fields observed were not highly contoured and smoothed, and there are reaches of the riparian zones along the channel which are not irrigated due to natural undulations of the land. Also there are reaches which do not have irrigation systems, between reaches which do. The existence of adjacent reaches with and without irrigation permitted direct comparisons of the effects of the irrigation on the riparian zones along the main stream channel. The observations were consistent in that the observed effects of the irrigation on the riparian zones appeared to always be positive.

Photo HCWC

**Figure 3. Vegetation on Two Banks Influenced by Irrigation Water.** At this site, the vegetation on both banks appears to be influenced by irrigation, as evidenced by that vegetation's abundance and vigor. The vegetation on the right bank might be only slightly enhanced over what it would be without irrigation, due to its lower elevation relative to the stream. However, the suite of vegetation on the left, higher bank would surely not be this robust without the irrigation or some other source of non-stream water such as a natural spring.

The commonly observed apparent positive effects to the riparian zone were:

- **Widening of the riparian zone.** The returning irrigation water appeared to allow growth of the riparian woody and herbaceous vegetation further away from the channel than in the non-irrigated reaches. For example in one situation there were two adjacent inventoried polygons: one with irrigation which had an average riparian width estimated to be 60 feet and one without irrigation that had an estimated average width of 25 feet. While there were other reasons besides the irrigation or lack thereof which partially explain this width difference, a major part appeared to be due to the irrigation. In irrigated fields that are used to produce hay, the riparian zones in some places could even be wider than present, but the haying operations appears to keep willow patches from expanding even further into the fields. Young willows were commonly observed in moist parts of the hay fields which had obviously been cut during the haying.

- **The 'irrigated' riparian zones had very good vegetative growth.** Most had tall, thick willow growth and a significant understory of a variety of water-dependent herbaceous species. Non-irrigated reaches tended to have riparian zones which had less vigorous shrub growth and sometimes understories of plants which do not require significant amounts of water. Successful woody plant reproduction was more common in irrigated reaches. In addition, the vegetation in the irrigated riparian zones tended to be more diverse with varying types of resulting habitats.

- **The banks in the irrigated reaches appeared to be much more stable.** This effect is likely a direct result of the more vigorous plant growth.

- **The irrigated reaches generally had less bare ground.** Because they had less bare ground they appeared to be less of a source of stream sediment than the non-irrigated reaches. They also appeared to be better filters of sediment which came down from the adjacent uplands.

In addition to the mentioned effects to the riparian zones, this type of irrigation can have other positive effects on these systems. The irrigated areas theoretically provided more bank storage of water. This is surely true when the irrigation water is considered, but it may also be true of stream water that does not get into the irrigation system as healthier riparian zones are believed to capture and store more stream water than do less healthy riparian zones. The increased storage of water results in the delayed release of that water back into the stream, enhancing flows later in the year. This can benefit fish populations by providing increased water in times of normal low flows.

In contrast to the apparent positive effects, it is important to understand that there may be negative effects due to the water withdrawals. Among the potential problems are: 1) fish passage impediments – these would occur where the diversions prevent passage upstream, especially by young fish, or maybe by all fish, 2) habitat suitability changes due to the lower water levels in the channel, and 3) channel form alterations, due the removal of part of the water and part of the sediment that water naturally carries, from the main channel. These potential negative effects may be subtle or possibly unnoticeable—especially on one time visits to the sites. They may require sophisticated channel morphology studies, or fish tracking or fish population sampling to understand. Ultimately they could have consequences on the fish populations in the reaches, which are not easily determined.

The net results of the irrigation in the observed reaches are riparian zones which are wider, apparently healthier and more diverse than reaches without irrigation. In-stream flow is certainly delayed and late summer and early fall flows probably are greater than would occur without irrigation, and those flows may be cooler. However, while the observed effects of the irrigation on the riparian zones appear positive, the overall effects on fish populations and in-stream habitat are unknown.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Like the section on alluvial fan stream functioning, this section describes apparent positive effects of human-induced alteration of a naturally functioning system. Where these observed changes occur, they can be rather dramatic. The observed changes would appear to have long-term benefits to at least some components of watershed health. At the same time we do not understand all of the resulting effects to these systems.

**Issues, concerns and action items.**

- Educate the public as to the potential positive effects of human-induced alterations to natural systems.
- Educate the public that we do not always understand all effects to natural systems once they have been altered.

## Perennial and Non-Perennial Stream Reaches

**Information sources and authors**

The text for this section was written by HCWC following field observations. The photos were also taken by HCWC.

There are three stream designations which categorize the duration of flowing surface water in a stream channel. Perennial streams by definition have year-around surface flow which is assumed to be connected to ground water sources. Intermittent streams have less than year-around water, but have at least 30 days of surface water during a repeating and predictable time period. In the Alvord Sub-basin and most of the arid western United States, that time is in spring during and following winter snowmelt. Ephemeral streams have surface water only after specific storm events, and do not have greater than 30 days of surface water in a consistent time period during each year. In many non-technical applications, this three category system is simplified to a two category system of perennial and non-perennial streams. Also, the United States Geological Survey (USGS) uses two terms on there topographic maps, perennial and intermittent, with intermittent including both the intermittent and ephemeral streams of the three part system.

The Alvord Sub-basin is very dry and there are very few perennial streams which flow together and form connected stream networks. More commonly, a few small and usually unnamed headwater streams relatively high in the mountains on the outer edges of the sub-basin flow together, forming a named perennial stream. These streams usually have only a few small tributaries along their lengths before the water submerges, usually into alluvial fans or into valley bottom fill. During high flows which are most common in the spring, the surface water from these creeks often reaches the common playa lakes in the sub-basin.

The amount, extent and duration of surface water in many of the sub-basin streams varies on a yearly basis. Those factors also vary over longer time periods, based on wet and dry climatic shifts. Additionally, streams which flow out onto alluvial fans commonly shift their channel locations. Consequently the extent of the surface water in these alluvial fan streams can change as new and old channel-ways are often very different in characteristics—mostly particle size of the channel bottom and banks—which allow or prevent the water from submerging into the alluvium. Other factors such as the presence or absence of beavers, roads and other types of construction, and management practices can affect the amount of surface water.

Understanding the amount, extent and duration of surface water in the sub-basin is becoming increasingly important, as management of both public and private lands is becoming increasingly site specific. Furthermore, management is becoming more controversial as various groups of the public have differing views on what constitutes proper management. The perennial extent of streams obviously has significant implications on the expected range of local fish populations and the expectations for the riparian vegetation along the streams. It also has implications on the expected range of wildlife populations, livestock management decisions and various other management concerns.

Historically, information about surface water has been recorded in two manners—at USGS gauging stations and by aerial photo interpretation during the process of making USGS topographic maps (topo quads). There are only two long term USGS gauging stations in the Alvord Lake Sub-basin, and one is no longer operating. In contrast, the perennial versus non-perennial status of all stream reaches was photo-interpreted during the USGS map making process and are differentiated on the final maps.

The perennial versus non-perennial nature of stream reaches is determined by photo interpreting the streamside vegetation and the presence/absence of visible water coupled with knowledge of the time of year the photos were taken. That interpretation is often difficult for those areas which are marginally perennial and interpretation errors of either factors can and do occur. In addition, errors can occur if the exact location of the stream channel is not obvious and the interpreter makes an incorrect call on the location. Several locations within the sub-basin with apparently incorrect USGS ‘perennial’ interpretations were observed during the field investigations in 2004 for this report. At one of those locations, Buena Vista Creek, the situation was photo documented and is discussed below. This situation appears to be the type of interpreting error in which the interpreter did not know the exact location of the Buena Vista Creek channel.

Buena Vista Creek forms on the steep, east-facing slope of the Steens Mountain. It is a tributary of Mosquito Creek which has perennial (or at least near perennial) flows past the East Steens Road and toward the north end of the Alvord Desert. Buena Vista Creek is shown on the USGS topo quad as being perennial to its confluence with Mosquito Creek. That interpretation is obviously wrong as: 1) the channel becomes nearly indistinguishable in the lower half mile, 2) there are few signs of sustained flow in that lower reach, but there are indications of high disruptive flows which move the channel from side to side, and 3) there are reaches with essentially no riparian vegetation in, next to or even near the supposed channel. Additionally, the field observer for this project was at the site in fall months during both 2004 and 2005, and there was no surface water in the channel within a half mile of the confluence with Mosquito Creek (see the photos and discussions below.)

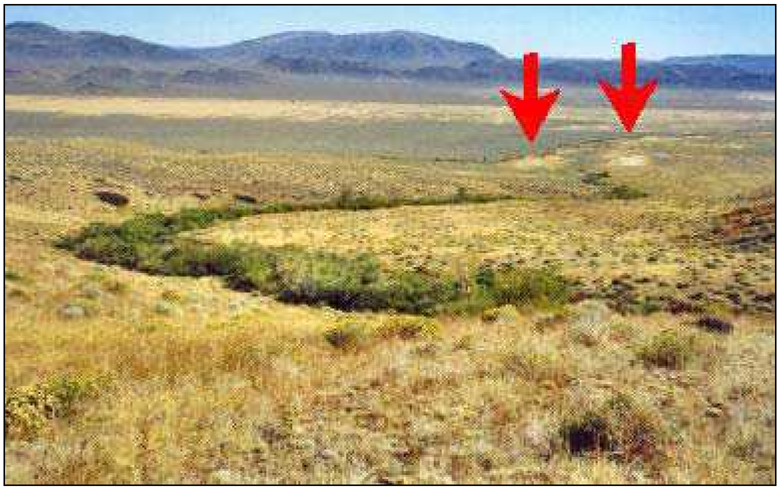
In addition to not being perennial in its lower half mile, Buena Vista Creek is also non-riparian in most of that reach. The term non-riparian in this use defines a stream which does not have riparian vegetation on its adjacent banks (see #3 in the paragraph above.) Riparian vegetation here is defined as that vegetation which occurs along a stream course which is dependent on the water in the channel, or on underground water near the channel-way, and which is different than the vegetation in the adjacent upland areas. So in this use, ‘riparian’ and ‘non-riparian’ are descriptors of the stream reach based on the presence or lack of vegetation which is known to grow only in areas with increased moisture availability. Available surface water year around or even for the entire growing season are not needed for reaches to be riparian, as sufficient plant growth can occur in a portion of the growing season allowing riparian plants to exist on a site. Stream reaches can easily be riparian, but not perennial. On the other hand, perennial streams are almost always riparian except in the rare instance where the substrate, such as solid rock or other sufficiently large materials, does not allow plant growth.

The incorrect determination of the Buena Vista Creek as being perennial in its lower half mile was probably due to the photo interpreter not knowing the location of the Buena Vista channel in its lower reach. There is a spring on the adjacent hillside to the north of the channel which yields sufficient surface flow to create a riparian zone which runs parallel to the Buena Vista channel. This spring starts in the same general area where the Buena Vista channel becomes non-perennial, and then non-riparian. There is no surface water connection between the two flow pathways in their upper, adjacent reaches. The first location which appears to have any significant surface flow between the two pathways is more than half the distance down toward the confluence with Mosquito from the spring. That location appears to only have periodic scattered surface flow moving from the Buena Vista channel-way toward the spring influenced riparian zone. The vegetation patterns there do not imply that overland flow from the Buena Vista channel-way has any significant affect on the extent of the spring-related riparian zone.

The six photos in Figure 4 show Buena Vista Creek changing from perennial and riparian to non-perennial and non-riparian. The perennial to non-perennial and non-riparian change occurs in about 0.5 miles between Site 2 and Site 6. In about half that distance (to Site 5) the channel has become mostly non-riparian and completely non-perennial.

**Figure 4. Buena Vista Creek Photos and Descriptions.** All photos HCWC.

**Site 1.** This photo is taken about 1.25 air miles above the Buena Vista and Mosquito Creek confluence. Buena Vista Creek is in the foreground—associated willows and cottonwood trees mark its path in the big sweep to the left. Scattered willows and then a grey area between two cream colored patches (red arrows) mark its course in the distance. That grey area between the cream colored patches is the non-perennial portion of Buena Vista Creek. Mosquito Creek is visible as a small, dark line of willows, coming from behind the ridge to the left. It is first visible just above the center of the photo. Though not easily seen on this photo, the Mosquito Creek willow line extends in the distance to the right edge of the photo.

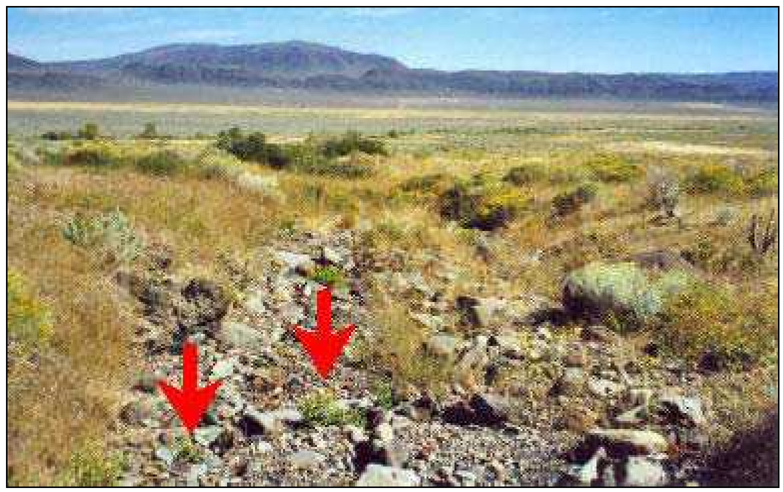


**Site 2.** Relative open reach of channel where the stream has migrated out of the middle of the riparian zone, to the former edge of the uplands (left bank).The channel movement was probably due to blockage within the dense willow cover in the middle of the riparian zone to the right. This location is approximately 0.5 stream miles below the closest riparian zone visible in the Site 1 photo. Buena Vista Creek was judged to have 1-1.5 cubic feet per second flow here. In addition to the amount of surface flow, the combination and amounts of willows, cottonwood trees (not obvious in this photo) and riparian herbaceous vegetation indicates that this reach is most certainly perennial, and it is obviously riparian.

**Site 3.** This site is about 800 feet below Site 2. The water has gone underground in that distance and was not observed to emerge anywhere down stream from here in the Buena Vista Creek channel. The vegetation here is similar to that in the area of Site 2.

**Site 4.** The channel here is dry and definitely non-perennial due to the lack of water and the nearly complete lack of riparian herbaceous vegetation, but it would still be considered riparian due to the patches of willows. This willow species (*Salix lasiolepis*) is often found in these settings which only have spring-time surface flows. Its common name is arroyo willow—indicating it often grows in and along dry washes.

**Site 5.** Though not obvious, the greenest short plants in this photo are small *Salix lasiolepis* (at points of red arrows). Larger, mature plants are visible along this Buena Vista Creek channel and along Mosquito Creek which comes in from the left in the distance. There are a few riparian herbaceous species in this photo, but most of the herbaceous plants along and in the channel are upland species.



**Site 6.** There is one 2-3 feet *Salix lasiolepis* clump in the middle of this photo (arrow). It was the last observed before the confluence with Mosquito Creek. The other plants visible associated with this wide, nearly indistinct Buena Vista channel are upland species. The one willow alone does not make this reach riparian, and the stream channel here is not perennial. The cream colored areas at the left and right photo edges are noted in the Site 1 photo.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

This topic has little direct importance to watershed health. It is important though in light of management expectations for this and other similar situations.

**Issues, concerns and action items.**

- Land managers and the public should be educated about situations where the perennial/non-perennial status of streams is incorrectly marked on USGS topographic maps.

- Various stakeholders should consider an organized effort to more clearly determine the perennial vs. non-perennial extent of the sub-basin's streams. This was partially done for fish-bearing perennial streams within the efforts of the Oregon DEQ TMDL process.

# WATER QUALITY

**Information sources and authors**

Most of the text and information for this section was taken from various sections of the Oregon TMDL. HCWC has written some of the text to introduce or briefly explain topics and to tie the Oregon TMDL information together.

The federal Clean Water Act (CWA) requires states to restore and maintain the physical, chemical, and biological integrity of the nation's waters. The federal Environmental Protection Agency (EPA) delegates this authority to the Oregon Department of Environmental Quality (DEQ). To implement the CWA, the State of Oregon develops and adopts water quality standards, which include beneficial uses, narrative and numeric criteria, and anti-degradation policies. Oregon's water quality standards are contained in OAR 340 Division 41.

Section 303(d) of the CWA requires the state to identify those waters not meeting the water quality standards, referred to as "water quality limited" or "impaired" and to establish a Total Maximum Daily Load (TMDL) for any water body designated as water quality limited. The TMDLs are written plans with analysis that describe the amount of each pollutant a water body can receive without violating water quality standards, and establishes that water bodies will attain and maintain water quality levels specified in water quality standards. The TMDL and Water Quality Management Plan (WQMP) for the Alvord Lake Sub-basin were completed by the DEQ and approved by the EPA in 2004.

The Alvord Lake Sub-basin is comprised of eight 5$^{th}$ field watersheds, seven of which have stream segments listed on the 2002 Oregon 303(d) List for temperature, and/or dissolved oxygen. Research and data on water quality in the Alvord Lake Sub-basin was published in a document titled Alvord Lake Sub-basin Total Maximum Daily Load (TMDL) & Water Quality Management Plan (WQMP) by DEQ in September, 2003.

The TMDL document addresses the water quality in the Alvord Lake Sub-basin in two different ways. There is a TMDL for temperature for the sub-basin as a whole. There is also a separate TMDL for Willow Creek for both temperature and dissolved oxygen. These TMDLs and the resulting Water Quality Management Plan apply to Alvord Lake Sub-basin streams which have salmonids and to non-salmonid bearing tributary streams that enter directly into salmonid bearing streams. The TMDLs and WQMP are summarized below, along with a discussion of the temperature and dissolved oxygen standards, and characteristics that contribute to the problem.

## Summary of the Alvord Lake Sub-basin Stream Temperature TMDL

The Alvord Lake Sub-basin is a closed basin which means that its streams are not connected to the Pacific Ocean and anadromous fish are blocked from accessing the basin. In addition, many streams are disconnected from each other. There are no large streams that serve as immigration conduits for fish, and connect stream networks and fish populations. As a result, the majority of streams in this sub-basin do not support salmonid fishes (salmon and trout) due to natural limitations. Because of the discontinuous nature of the stream network in the Alvord Lake Sub-basin, the TMDL was not established for all streams in the sub-basin. Instead, the TMDL was established for streams in the Alvord Lake Sub-basin that either contain salmonid fish or that are tributaries to streams that contain salmonid fish. Salmonid fish distribution was determined by ODFW. Federally threatened salmonids do reside in the sub-basin. The Alvord Lake Sub-basin temperature TMDL targets human caused sources of heat from one primary source: increased solar radiation loading.

## Summary of the Willow Creek TMDL

Willow Creek in the Trout Creek Mountains was added to the 303(d) list for not meeting the state's dissolved oxygen standard. The Willow Creek TMDL addressed both the temperature standard and the dissolved oxygen standard. The Willow Creek TMDL was addressed in a separate chapter of the Alvord Lake Sub-basin TMDL because the types of data and modeling analysis used on Willow Creek were different from the methods applied in other streams in the Alvord Lake Sub-basin.

The primary benefit of maintaining adequate dissolved oxygen (DO) concentrations is to support a healthy and balanced distribution of fish, invertebrates, and other aquatic life. In the Alvord Lake Sub-basin, the dissolved oxygen standard is designed to protect cool-water fish as the most sensitive beneficial use. While many chemical and physical processes can affect dissolved oxygen levels, stream temperature is a significant contributing factor, as increased temperature decreases the amount of oxygen in water. In addition, warm stream temperatures contribute to excessive algae growth, which in turn depletes dissolved oxygen levels.

The Willow Creek TMDL for both temperature and dissolved oxygen targets human caused sources of heat from increased solar radiation loading and uses percent effective shade targets as surrogate measures for non-point source pollutant loading.

**Table 5. Alvord Lake Sub-basin 303(d) Listed Stream Segments, 2002.**

| Stream Segment | Listed Parameter | Listing Status | Miles Affected |
|---|---|---|---|
| Big Trout Creek | Temperature (rearing)<br>Temperature (spawning) | 303(d) Listed<br>Potential Concern | RM 0-16.6<br>RM 0-16.6 |
| Denio Creek | Temperature (rearing) | 303(d) Listed | RM 0-6.1 |
| East Fork Big Trout Creek | Temperature (rearing)<br>Temperature (spawning) | Potential Concern<br>Potential Concern | RM 0-6.6<br>RM 0-6.6 |
| Little Trout Creek | Temperature (rearing) | Potential Concern | RM 0-9.3 |
| Little Wildhorse Creek | Temperature (rearing) | 303(d) Listed | RM 0-2.5 |
| Mosquito Creek | Temperature (rearing) | Potential Concern | RM 0-7.4 |
| Trout Creek | Temperature (rearing) | Potential Concern | RM 0-30 |
| Unnamed Waterbody (Jawbone Creek) | Temperature (spawning) | Potential Concern | RM 0-4 |
| Van Horn Creek | Temperature (rearing) | 303(d) Listed | RM 0-8.2 |
| Willow Creek (East Steens) | Temperature (rearing) | 303(d) Listed | RM 0-5.3 |
| Willow Creek | Temperature (rearing)<br>Dissolved Oxygen<br>Temperature (spawning) | 303(d) Listed<br>303(d) Listed<br>Potential Concern | RM 0-33.5<br>RM 0-33.5<br>RM 0-33.5 |
| Total Stream Miles included on 303(d) list for Temperature (rearing) | | | 72.2 |
| Total Stream Miles included on 303(d) list for Dissolved Oxygen | | | 33.5 |
| Total Stream Miles listed as "Potential Concern" for Temperature (rearing) | | | 53.3 |
| Total Stream Miles listed as "Potential Concern" for Temperature (spawning) | | | 60.7 |

Source: Oregon TMDL

## Summary of the Water Quality Management Plan

The pollutant identified in the TMDLs was heat from human caused increases in solar radiation loading to the stream network (removal of riparian vegetation by various means). The WQMP developed for these

TMDLs focuses on one activity that addresses both temperature and dissolved oxygen levels: establishing and protecting riparian area vegetation.

WQMPs are plans designed to reduce pollutant loads to meet TMDLs. The goal of the Alvord Lake Sub-basin WQMP is to reduce solar loading to the streams. The plan is described as preliminary in nature and designed to be adaptive as more information is gained regarding the pollutants, allocations, management measures, and other related areas. Proposed management categories and measures for controlling in-stream temperature include:

**Public Awareness/Education**
- General and Targeted Outreach

**New Development and Construction**
- Planning Procedures
- Permitting/Design
- Construction and Post-construction Control Activities

**Sub-basin-Wide Riparian Area Management**
- Revegetation
- Streambank Stabilization
- General and Targeted Outreach

**Federal Land Management**
- Riparian Area Management
- Targeted Outreach
- Streambank Stabilization
- Wildfire Prevention/Suppression
- Season of Use
- Borax Lake Geothermal Sources
- Uplands Management
- Exotic Plants Impacting Riparian Communities
- BMP Monitoring and Evaluation
- Instream Monitoring
- BMP Implementation and Monitoring

**Agricultural Practices**
- Streambank Stabilization
- Riparian Area Management
- General and Targeted Outreach
- Season of Use
- Uplands Management

- BMP Monitoring and Evaluation
- In-stream Monitoring
- BMP Implementation Monitoring

**Forest Practices**
- Riparian Area Management
- Season of Use
- BMP Monitoring and Evaluation

**Transportation**
- Road Construction/Maintenance/Repair

The WQMP expects the various management agencies to develop and implement Best Management Practices or other management measures to meet the load allocations. ODEQ also recognizes that it may take several decades after full implementation before changes can become fully effective in reducing and controlling in-stream temperatures.

**TMDL Standards: Temperature.** A seven-day moving average of daily maximums (seven-day statistic) was adopted by ODEQ as the statistical measure of the stream temperature standard. The observed maximum seven-day temperature statistics from data collected during 2001 indicate that stream temperatures follow a longitudinal (downstream) heating pattern and are above the salmonid rearing standard of 64$^{o}$F (17.8$^{o}$C) for most reaches, typically during portions of July and/or August. (*Note:* As of spring 2006, ODEQ adopted a new standard for the Malheur Lakes Basin Temperature Standard of a maximum of 68$^{o}$ F for both salmonid rearing and salmonid spawning, egg incubation, and fry emergence.)

**TMDL Standards: Oxygen.** While many chemical and physical processes can affect dissolved oxygen levels, stream temperature is a significant contributing factor to water quality standards violations for dissolved oxygen. Dissolved oxygen in water bodies may fall below healthy levels for a number of other reasons including carbonaceous biochemical oxygen demand (CBOD) within the water column, nitrogenous biochemical oxygen demand (NBOD, also known as nitrification), sediment oxygen demand (SOD), and algal growth, which in turn depletes in-stream dissolved oxygen levels. Increased water temperatures will also reduce the amount of oxygen in water by decreasing its solubility and increasing the rates of both nitrification and the decay of organic matter.

ODEQ sampled dissolved oxygen concentrations, dissolved oxygen saturation, pH, nutrients and BOD at eight locations within Willow Creek during the summer (August) and fall (November) of 1998. Samples collected during August correspond to a condition of high stress on Lahontan cutthroat trout resulting from elevated water temperatures. Sample locations were situated in order to allow for the evaluation of the longitudinal change of these water quality parameters as well as seasonal changes. During each sampling session, data was collected continuously at three of the sites in order to determine diurnal changes of these parameters. Grab samples were collected at all eight locations. Observed fall dissolved oxygen concentrations were much higher than under summer conditions. None of the sites violated the dissolved oxygen criteria during November.

## Factors Contributing to Stream Heating

**Stream Flow.** Low flows in the Alvord Lake Sub-basin generally occur during the mid-to-late summer months starting in July and extending into the early winter months due to minimal precipitation, post runoff season and in some cases agriculture water withdrawals for irrigation. Low stream flow is a significant contributor to increased water temperature for the simple reason that smaller amounts of water heat faster than larger amounts.

Historic stream flow data for the Alvord Lake Sub-basin is extremely limited. There are only two USGS/OWRD gages: Wildhorse Creek near Andrews, with a period of record ending 1953; and Trout Creek near Fields, which is still in use. The flows were measured as part of the sub-basin TMDL assessment. The flows during 2001 were recorded for all of the streams surveyed. The volume of low flow, or base flow, for most streams is generally less than 1.0 cubic foot per second (cfs). The exception was Trout Creek which was measured at 1.76 cfs during low flow.

Summer base flows in the lower reaches of Alvord Lake Sub-basin streams are reduced by water withdrawals for irrigation and lose-gain phenomenon in some streams. The out-of-stream beneficial uses of the water from these streams are primarily irrigation and domestic uses. The sub-basin has dedicated water rights for irrigation and other uses. There are in-stream water rights appropriated to ODFW for the protection of fish in the Alvord Lake Sub-basin in Trout Creek, Little Trout Creek, and East Fork of Big Trout Creek. Although water withdrawal affects stream temperature, the TMDL recognized irrigation as an out of stream beneficial use. Therefore, stream flow was not targeted directly in this TMDL.

Many streams in the Alvord Lake Sub-basin also have a lose-gain phenomenon as the result of site-specific geology and hydrology. High stream flows during bank-full or greater events down steep slopes results in deposits of large coarse-grained materials (boulder/cobble class) on large alluvial fans. These alluvial fans are very porous and readily absorb lower summer stream flows, resulting in very short perennial stream reaches.

Compounding this situation is the issue of water availability from snow pack. The average annual rainfall for low elevations in the sub-basin is about 8 inches. Desert streams depend on snow pack as a water source for base flow during the late summer period. Consensus among researchers and biologists is that streams within the Alvord Lake Sub-basin experience “shrink-swell” phenomenon based on the amount of water that is available from snow pack during any given year, resulting in patterns of fish distribution that expand or contract rapidly commensurate with available water. The extent of plant communities can also expand and contract, but the response is slow, requiring perhaps several years, or even decades.

**Riparian Vegetation.** Riparian vegetation plays an important role in controlling stream temperature change. Near stream vegetation height, width and density combine to produce shadows that when cast across the stream reduce solar radiant loading. Bank stability is partially a function of riparian vegetation and channel width is therefore influenced by riparian vegetation. Narrower channels have less surface area, absorbing less solar radiation. Riparian corridors often produce a microclimate that surrounds the stream where cooler air temperatures, higher relative humidity and lower wind speeds are characteristic.

Solar radiation is often the most significant heat transfer process and can be highly influenced by human related activity, especially reduction of riparian vegetation. Highly shaded streams often experience cooler stream temperatures due to reduced solar energy input. Decreased levels of stream shade increase solar radiation loading to a stream. The primary factors that determine stream surface shade are near stream vegetation physical characteristics and channel width. Near stream vegetation height controls the shadow length cast across the stream surface and the timing of the shadow. Channel width determines the shadow length necessary to shade the stream surface. Near stream vegetation and channel width are sometimes interrelated in that stream bank erosion rates can be a function of near stream vegetation condition. *Human activities that change the type or condition of near stream land cover and/or alter stream channels by widening beyond appropriate channel equilibrium dimensions to levels that result in decreased stream surface shading will like have a warming effect on stream temperature.* [sic] Such human activities include grazing of riparian vegetation by livestock, logging or clear-cutting of riparian vegetation, and straightening or armoring of stream channels.

ODEQ uses ***effective shade*** as a surrogate measure for stream temperatures in the Alvord Lake Sub-basin. It is defined as the percent reduction of potential solar radiation load delivered to the water surface. The surrogate measure of effective shade targets the establishment of a *system potential* riparian community to provide the instream temperatures that will result from a riparian system which is minimally impacted by human caused activities. The *system potential* riparian community provides thermal buffering in the form of shade as well as providing: 1) stream bank stabilization which results in a reduction in sediment inputs and subsequent decreases in channel width; and, 2) reconnection of the floodplain which restores function, channel stability, and water storage and release as hyporheic, or subsurface flows, during the warmer summer months.

System potential riparian community information and effective shade curves were developed for the four distinct ecological provinces in the sub-basin: East Steens, Pueblo Mountains, Trout Creek Mountains, and Willow-Whitehorse. Based on the field data collected, system potential conditions were developed for three to four different elevation zones within each ecological province—see pages 103-105.

**Channel Morphology.** Changes in channel morphology, namely channel widening, impact stream temperatures. Channel morphology is a broad term which encompasses hydraulic geometry (shape of the cross section of a stream channel), distance of vegetation from the stream, sinuosity, gradient, substrate, and other physical characteristics of a stream. The characteristics of a channel can significantly influence stream heating. For example, a stream with a large width to depth ratio will receive more solar radiation on a unit volume basis than one with a narrow, deep channel, resulting in greater diel fluctuations in temperature. The distance of vegetation from the stream is very important, since vegetation too far from the stream to provide shade will do little to prevent heating. An additional benefit inherent to narrower/deeper channel morphology is a higher frequency of pools that contribute to aquatic habitat or cold water refugia. In addition, the removal of streamside vegetation can reduce bank stability leading to increased sediment loads and a wider stream channel and can reduce connection with the floodplain leading to decreased water storage and hyporheic flow of cooler water during the summer months.

## Summary and Conclusions

Riparian vegetation, stream morphology, hydrology, climate, and geographic location influence stream temperature. While climate and geographic location are outside of human control, riparian condition, channel morphology and hydrology are affected by land use activities. Human activities that can contribute to degraded water quality conditions in the Alvord Lake Sub-basin include agriculture activities (including grazing), road location and rural residential development related to riparian disturbances.

Settlement of the Alvord Lake Sub-basin in the mid-1800s brought about changes in the near stream vegetation and hydrologic characteristics of the streams. Historically, human activities including agricultural practices have altered the stream morphology and hydrology and decreased the amount of riparian vegetation in the drainage. The sub-basin includes primarily agricultural lands. Channel straightening, while providing relief from local flooding, increases flooding downstream, and may result in the destruction of riparian vegetation and increased channel erosion. Irrigation diversions in the lower elevations of the Alvord Lake Sub-basin have reduced stream flow levels.

In general, the TMDL found that the elevated summertime stream temperatures attributed to human caused nonpoint sources resulted from the following:

- **Near stream vegetation disturbance or removal** reduces stream surface shading via decreased riparian vegetation height, width and/or density, thus increasing the amount of solar radiation reaching the stream surface (shade is commonly measured as percent effective shade or open sky percentage). Riparian vegetation also plays an important role in shaping the channel morphology, resisting erosive high flows, maintaining floodplain roughness, and maintaining connection with the floodplain for increased water storage and hyporheic flows.

- **Channel modifications and widening** (increased width to depth ratios) increases the stream surface area exposed to energy processes, namely solar radiation. Channel widening decreases potential shading effectiveness of shade-producing near-stream vegetation.

- **Reduction of summertime flows** decrease the thermal assimilative capacity of streams, causing larger temperature increases in stream segments where flows are reduced.

- **Upland vegetation disturbance or removal** decreases the ability of the uplands to safely capture and store precipitation and augment the volume of late season stream flows.

Land use activities in the Alvord Lake Sub-basin are managed either by the BLM (who manage 82% of the land in the sub-basin) or by private landowners. Although Oregon counties have authority to regulate land use activities through local comprehensive plans, it is unlikely that either Harney or Malheur County would have regulatory responsibilities over activities that would influence stream temperature. Given the extremely rural character of the Alvord Lake Sub-basin, riparian activities on private land would either be managed under an Agricultural Water Quality Management Area Plan (SB1010 Plan) or under the Forest Practices Act.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

In landscape systems, good water quality usually equates to good watershed health. Some water quality parameters are indicators of overall watershed health parameters. In this light, water quality is the effect, and watershed health parameters are the cause. So it is watershed health that is important to water quality. In this connection, the Oregon TMDL process used the concept of effective shade and defined desirable plant communities to be the management goal which in the long-term will insure water quality.

**Issues, concerns and action items.**

- HCWC and others should strive to educate the public on the connection of water quality and watershed health.
- In the rangelands of the sub-basin, watershed enhancement projects encompassing riparian zones should have as a goal the development and maintenance of healthy riparian plant communities.

***Mickey Hot Springs: a seemingly nice, pleasant, high desert oasis . . .***

Photo HCWC

***. . . wait, you better be careful!!***


Photo HCWC

# FISH AND FISH HABITAT

**Information sources and authors**

The text for this section comes from multiple sources, with the Oregon TMDL and Oregon Department of Fish and Wildlife personnel and in-house data being the most common. The generic information from those sources is not specifically cited in most cases. Other specific data sources are cited.

The Alvord Lake Sub-basin contains approximately 485 miles of perennial streams, an unmeasured length of intermittent streams, plus numerous springs, ponds, lakes, and reservoirs. Fish inhabit portions of each of these water body types in the sub-basin.

The sub-basin provides habitat for these native fish species: Lahontan cutthroat trout, Borax Lake chub and Alvord chub. Alvord cutthroat trout historically occurred in the sub-basin. However, it is now thought to be extinct. The sub-basin also contains introduced Lahontan cutthroat trout, brown trout, rainbow/cutthroat hybrid trout and goldfish (see Map 4). A high proportion of the native fish fauna is endemic to relatively small, localized regions, primarily due to the unique post-Pleistocene climatic and geologic history of the Great Basin. Of the three native fish populations, the Borax Lake chub and the Alvord chub are only found in the Alvord Lake Sub-basin, whereas the Lahontan cutthroat trout is also found outside the sub-basin.

The Lahontan cutthroat trout and Borax Lake chub are listed as threatened and endangered, respectively, by both the State of Oregon and the Federal Government. The Alvord Chub is a federal “Species of Concern” and state sensitive species because of its limited distribution in Oregon.

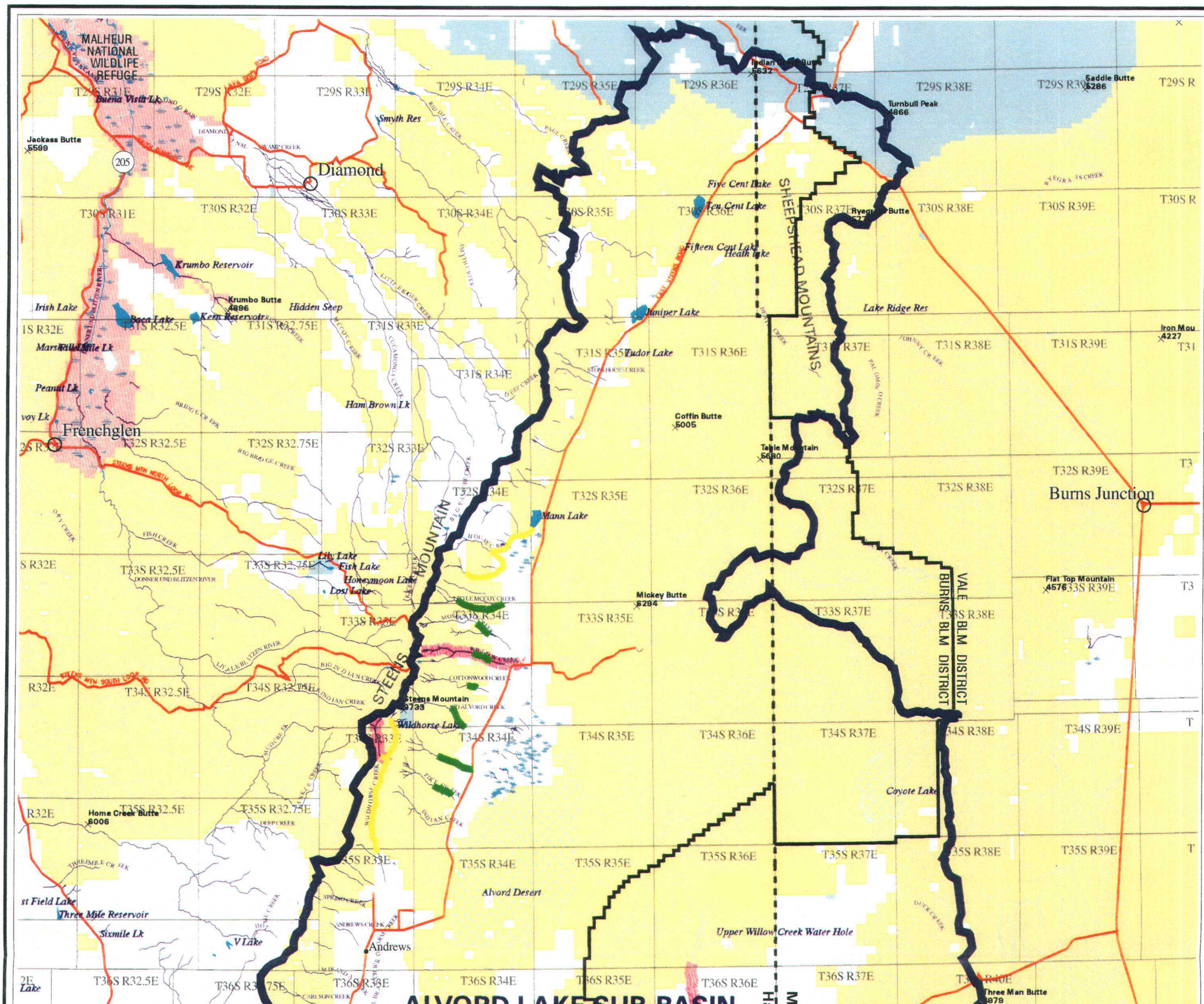
The zoogeography of the present day fish assemblage is poorly documented. The native chub species likely have origins from the Lahontan basin (Smith 1978) to the south in Nevada. The Alvord cutthroat trout, which is the native trout that occupied some streams in the region, is now extinct according to Behnke (1992). The Lahontan cutthroat trout originated from the Lahontan basin; however, the mechanism by which they arrived in the Alvord Lake Sub-basin is unclear. Lahontan cutthroat trout found in streams originating on the east side of the Steens Mountain and the Pueblo Mountains are the descendents of fish transplanted from Whitehorse and Willow Creeks in the Trout Creek Mountains by the Oregon Department of Fish & Wildlife (ODFW). Given the absence of natural mechanisms, like large rivers or lakes, to connect and distribute fish populations, the fish species within the Alvord Lake Sub-basin are now dispersed in isolated streams and habitats where water has been continuously available in suitable habitat conditions.

A variety of non-native fish species have been introduced to the area. The ODFW periodically stocks hatchery-raised Lahontan cutthroat trout in Mann Lake and Juniper Lake. In the past ODFW also stocked hatchery-raised Lahontan cutthroat trout in Wildhorse Lake. Descendents of those stocked fish now occupy Wildhorse Lake and Wildhorse Creek. Past rainbow trout stocking of the Trout Creek system has resulted there in a self-sustaining population of rainbow-cutthroat hybrids. The source of those rainbow stockings is uncertain as the ODFW does not have written records of their stocking rainbow trout in the Trout Creek system. However some local residents believe they remember ODFW being the source. In addition, there has been unauthorized stocking of brown trout in Van Horn Creek in the Pueblo Mountains, and goldfish in Mann Lake.

The size and viability of fish populations is highly dependent on the quantity and quality of available habitat. The condition of aquatic habitat, in turn, is a reflection of physical and biological processes operating throughout the watershed. For example, streams transport water and sediment through a watershed. Changes in rates of erosion in upland areas can therefore affect stream ecosystems. Increases in fine sediment supply to the stream may negatively affect salmonid spawning and the production of aquatic macroinvertebrates, an important food source for all fish. Therefore, the integrity of uplands in the watershed has consequences for the health of aquatic ecosystems and the health of the inhabitants of those ecosystems.

Fish habitat is also dependent on the integrity of the stream channel, floodplain, and adjacent riparian vegetation. Riparian vegetation moderates water temperature, influences channel morphology, adds structure to the banks to reduce erosion, and provides overhead cover for fish. Intact vegetated floodplains dissipate stream energy, store water for later release, and provide rearing areas for juvenile fish. Well-established riparian woodlands also supply woody debris to the stream channel, an important component in developing habitat complexity in stream channels.

Water quality is another indicator of the condition of fish habitat. Some streams in the Alvord Lake Sub-basin have been listed as water-quality limited for exceeding the temperature standard (see pages 39-45, plus Map 4, next page.). Most of these streams contain special status fish species. Fisheries management in the area is ongoing to restore, maintain, or improve habitat to provide for diverse and self-sustaining communities of fishes and other aquatic organisms.




## MAP # 4 - Alvord Lake Sub-basin - FISH SPECIES and 303D LISTED STREAMS

FISH Species, BLM data only:

- Lahontan Cutthroat Trout
- Alvord Chub
- Brown Trout
- Trout Hybrids
- Borax Lake Chub
- Hatchery Lahontan Trout
- Mann Lake: Hatchery Lahontan Trout and Goldfish

- 303D Listed Streams

- Sub-basin Boundary
- Major Roads
- Perennial Streams
- Intermittent Streams

0 1 2 3 4 5 6 MILES

Scale: 1 inch = 6.0 miles

Note: No warranty is made by Harney County or the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

See Appendix 1 for specific data disclaimers.

US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon

Date: 20-MAR-2006, Pam Keller, subbasin11x17.aml/alvfish.ps

## Special Status Fish Species

The following section is a description of special status fish species found in the area. It includes a discussion of distribution and current status, important habitat relationships, and key factors influencing status. Portions of the following discussion is excerpted from the Southeast Oregon Resource Management Plan (USDI 1998b) and the Interior Columbia Basin Ecosystem Management Project (ICBEMP) Scientific Assessment (USDA/USDI 1996).

**Lahontan Cutthroat Trout.** The Lahontan cutthroat trout is native to the Pleistocene Lake Lahontan Basin of northwestern Nevada, northeastern California, and a small adjacent portion of southeastern Oregon. It has been introduced elsewhere in southeastern Oregon and eastern Washington.

During the 1970s and early 1980s, Lahontan cutthroat trout from Willow and Whitehorse creeks were introduced into Denio, Van Horn, Pike, Mosquito, Little McCoy, Big Alvord, Little Alvord, Cottonwood, and Willow creeks in the Alvord Lake Sub-basin. Those introductions were successful. In 2004 all of these streams were sampled except Denio Creek. Those 2004 surveys found Lahontan cutthroat trout in all sampled streams except Van Horn Creek, where only brown trout were collected. A population of hatchery-produced Lahontan cutthroat trout also inhabits Mann Lake, Wildhorse Lake, and Wildhorse Creek. Since these fish originated from hatchery stock, they are not considered pure-strain Lahontan cutthroat trout and are not considered a protected species.

Pursuant to the Endangered Species Act (ESA), this subspecies is federally listed as threatened throughout its range. The BLM and the USFWS conduct interagency consultation pursuant to Section 7 of the ESA regarding authorization of grazing permits where Lahontan cutthroat trout are present and may be affected, except for hatchery produced populations. These consultations have concluded that current grazing practices are not likely to jeopardize the continued existence of the trout. The USFWS Biological Opinions (USFWS 2001, 1999, and 1995) further recognize that current livestock grazing practices associated with these permits allow for the continued improvement of instream and riparian conditions. In 1995, the USFWS office in Reno, Nevada formalized a cooperative management agreement among the ODFW, the Nevada Division of Wildlife, the USFS, and the BLM for the coordination and performance of activities identified in the Lahontan Cutthroat Trout Recovery Plan. The primary purpose of the agreement was to provide specific direction to conserve the trout and reduce or remove threats that could prevent its recovery.
Although somewhat hardier than other cutthroats, the Lahontan subspecies requires cool water temperatures, deep-water refuges, and silt-free gravels for spawning. Optimal riverine habitat for Lahontan cutthroat trout is characterized as clear, cold water with an average maximum summer temperature of less than 22º C (72º F); an approximate one-to-one pool-to-riffle ratio; well-vegetated, stable stream banks; at least 50% of the stream area providing cover; a relatively stable water flow regime; and a relatively silt-free rocky substrate in riffle-run areas (USFWS 1995b).

The size and range of Lahontan cutthroat trout populations are known to fluctuate through time. Table 6 shows the estimated populations of Lahontan cutthroat trout in the combined Willow and Whitehorse Creek drainages in the southern end of the sub-basin for five different years starting in 1985. These population estimates were obtained by the Oregon Department of Fish and Wildlife using electrofishing techniques.

**Table 6. Estimated Lahontan Cutthroat Trout Populations in the Willow and Whitehorse Creek Drainages.** Survey and analysis techniques varied through the years, but ODFW feels the table data are reasonably good population estimates. N.E. = not estimated, N.D. = not determined.

| Year | Estimated Total Fish | Estimated Fish >1 Year Old | 95% Confidence Interval |
|---|---|---|---|
| | | | |
| 1985 | 79,000 | ~60,000 (>3" long) | N.D. |
| | | | |
| 1989 | 9,000 | ~8,000 (>3" long) | N.D. |
| | | | |
| 1994 | 39,500 | 22,000 | 16,900 – 27,000 |
| | | | |
| 1999 | N.E. | 32,000 | 27,800 – 36,100 |
| | | | |
| 2005 | N.E. | 13,500 | 9,900 – 17,100 |

Various factors are capable of influencing Lahontan cutthroat trout populations. These include the possible presence of other competing fish species, habitat health and weather/climatic conditions. In the Willow and Whitehorse drainages, weather/climatic conditions and habitat health are the factors which influence the changing Lahontan population sizes shown in Table 6.

Non-native, competing salmonid fish species can cause lower Lahontan numbers, through a combination of predation, competition or genetic introgression. However, there are no known non-native salmonids in the Willow and Whitehorse drainages. The only known presence of non-native salmonids associated with existing Lahontan cutthroat trout in the sub-basin are brown trout in Van Horn Creek in the Pueblo Mountains.

Habitat health or degradation, especially loss of riparian vegetation, has been identified as a key factor impacting some Oregon Lahontan populations. Loss of vegetation can result in the loss of forage organisms and cover (Hanson et al. 1993). Excessive turbidity and sedimentation also contribute to habitat degradation problems because of their effects on food production, spawning areas, and feeding ability (Hanson et al. 1993). In addition, habitat degradation often compounds the effects of weather/climatic conditions. Loss of riparian vegetation can contribute to increases in summer stream temperatures that exceed those considered optimal for the sub-species. Also, the lack of cover can increase the likelihood a stream will freeze during low winter temperatures.

While degrading habitat conditions could theoretically explain the general trend in lower fish numbers in the 21 years spanned by the Table 6 surveys, it is widely acknowledged that riparian habitat in the two watersheds has been improving in that time period. In the late 1980s and early 1990s, a coalition of federal and state managers and scientists, local landowners and representatives of the environmental community agreed upon and implemented significant land management changes in the Trout Creek Mountains. These changes included extensive non-use of the range, fencing of riparian zones, and adjusted livestock use schedules. These management changes have resulted in improved riparian and fish habitat conditions throughout most of the Willow and Whitehorse drainages. Table 4 (page 20) indicates that 110.5 miles of 114.0 total miles of streams assessed for riparian trend in these two drainages are now considered to have an Upward trend (Vale BLM data). Fish habitat in these drainages, as indicated by the general health of the riparian zones and their vegetation, is now considered healthy and resilient to disturbances. Therefore fish habitat is not now considered to be a source of significant fluctuations in population sizes (ODFW Aquatic Inventories Project, unpublished data.)

The changes in the population sizes shown in Table 6 are best understood by considering weather/climatic conditions, with additional influence by habitat conditions. The dramatic drop in the population between 1985 and 1989 followed dry conditions between the two sampling years and an extreme cold period in early 1989 (approximately February 6-9, 1989, see temperature data for the Whitehorse Ranch at the wrcc@dri.edu link mentioned on page 96). That cold period is assumed to have frozen much of the creeks in the drainages and killed many fish. The recorded low temperatures for those four days were all between -18 and -21 degrees Fahrenheit, and are some of the coldest temperatures ever recorded for the Whitehorse Ranch weather station. Poor riparian cover is assumed to have contributed to the amount of stream freezing and the loss of fish. The population recovery from 1989 to 1999 coincides with habitat recovery and several high water years between those dates. There was an extended drought between 1999 and 2005 until the spring of 2005 when significant rain fell in the drainages. The population fell during that drought period from approximately 32,000 in 1999 to 13,500 in 2005. (Note: The >1 year old fish sampled in 2005 would have hatched in or before 2004, and the wet spring of 2005 would have little if any effect on the population in 2005.)

The effect of drought conditions on Lahontan cutthroat trout populations is understandable considering the very dry nature of these drainages. In addition to fish population size, ODFW noted the expansion and contraction of the range of the populations during their surveys. In dry periods the extent and amount of the surface water in many Alvord Lake Sub-basin creek channels decreases, along with a decrease of inhabitable stream length. Conversely, in wetter periods there are more miles of flowing water and/or the amount of water in any given place can be greater. Additionally, more flowing water usually indicates lower summer water temperatures, resulting in more favorable habitat. In reviewing the populations estimates (Table 6) for 1985, 1989 and 1994, Jones et al. (1998) concluded that the “population appears to expand during favorable conditions, as in 1985, and contracts during unfavorable conditions, as in 1989 and 1994.” Similarly, ODFW data for 1999 indicates that there was 37% greater stream length occupied by fish than in 1994 (77 km [47.7 miles] vs. 56 km [34.7 miles]). That 37% increase of occupied stream length is comparable to the 46% estimated increase in fish populations between 1994 and 1999 (22,100 to 32,300). It is likely that the 1999 and 2005 population estimates would have been lower without the known improvement of the habitat resulting from the cooperative management changes implemented around 1990. When examining population estimates after several years of drought (i.e. 1999 – 2005), it appears that improved habitat conditions allow more fish to survive during a drought cycle.

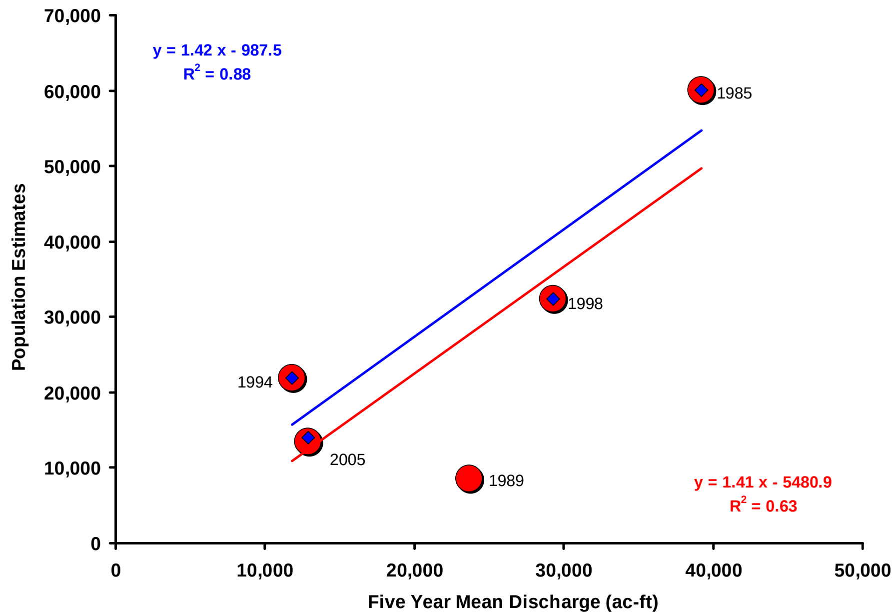
ODFW recently performed a statistical analysis to show the relationship between Lahontan cutthroat trout populations, and wet and dry climate cycles (previously unpublished ODFW data May 2006). This process showed mathematically that there is a correlation between climate and population. They used regression analysis to show that the adult Lahontan cutthroat populations shown in Table 6 (third column) increase and decrease with increasing and decreasing stream flow.

Neither Willow Creek nor Whitehorse Creek have stream flow gauges. Instead ODFW used gauge data for this analysis from McDermitt Creek which is just south of the Willow/Whitehorse drainages. The headwaters of Willow Creek, Whitehorse Creek and McDermitt Creek are directly adjacent to each other in the Trout Creek Mountains. Due to the drainages being subject to essentially the same weather patterns, it is assumed for this analysis that the Willow/Whitehorse drainages and the McDermitt Creek drainage have relatively similar stream flow amounts (discharges) on a year-to-year basis.

ODFW computed the McDermitt Creek mean (average) acre feet (ac-ft) discharge for five year periods for each of the Table 6 sampling years and used those as surrogates for the Willow/Whitehorse creek stream flows. Each five year period included the year of sampling, plus the previous four years. Since Lahontan cutthroat trout live for as much as four or five years, the five year discharge average is the significant period of influence on nearly all fish sampled in each of the sampling years. For the 2005 sampling, discharge data for parts of only four years was averaged as the gauging station was terminated in September of 2004. Figure

5 is the ODFW graph showing the population estimates and the estimated mean five year discharge amounts. ODFW performed two regression analyses, the first using all five sets of flow and population data. In the second analysis they left out the 1989 data which was assumed to be highly influenced by the deep freeze with high fish mortality which occurred in the winter prior to the 1989 sampling. In Figure 5 the data for all five sampling years are shown as red-filled circles, and the data for the four sampling years (1989 excluded) are additionally shown as having a blue diamond inside the circles.

**Figure 5. ODFW Regression Analyses: Lahontan Cutthroat Trout Populations vs. Stream Discharge.**




Regression analyses results in 'best fit' lines (graphed as in Figure 5) and two important statistics. The red line and red numerical results in the bottom right are the results of analyzing the data of all five sampling years. The blue line and blue numerical results in the upper left are the results of analyzing the data of the four sampling years, with 1989 left out. The first important statistic is represented by 1.41 in the red equation and the 1.42 in the blue equation. Simply explained, those numbers being positive indicate that as the average stream flow increases, the population estimate also increases. The other and often more important statistic determined by regression analysis is an $R^2$ value. $R^2$ values range from 0.0 to 1.0, with values closer to 1.0 indicating a stronger relationship between the two variables. The two computed values of 0.63 and 0.88 indicate that the population size of Lahontan cutthroat trout is greatly influenced by the amount of water in the drainages prior to sampling. If those $R^2$ values were significantly smaller, such as less than 0.5, then the conclusions would be that other factors are also having significant influence on the fish populations. The $R^2$ value of 0.63 being much lower than 0.88 indicates that the fish numbers were substantially different than one would expect for that flow period. In this case the fish numbers were much lower than would be predicted (see Figure 5 and the fact that the 1989 data point is much lower than the lines.) This appears to confirm the expected influence of the extreme cold prior to the sampling in 1989.

In conclusion, the regression analysis results appear to strongly confirm the earlier discussion and the mentioned results of Jones et al. (1998) and ODFW findings. Those analyses also concluded that recent water flow amounts affect the numbers of Lahontan cutthroat trout, but with different methods. While the relationship is intuitive, the $R^2$ value of 0.88 for the four sampling years which did not have a known disruptive event indicates a very strong influence by the amount of water on the number of fish.

**Borax Lake Chub.** The Borax Lake chub is a small minnow restricted to the Borax Lake ecosystem (size ~10 acres) south of Alvord Lake (see Map 3, page 11). The Borax Lake chub is a sister taxon of the Alvord chub that became isolated as the waters of pluvial Lake Alvord receded (Williams and Bond 1983). In addition to Borax Lake itself, the Borax Lake outflow channel and Lower Borax Lake Reservoir have provided Borax Lake chub habitat in the past; however, the species is not present in those locations at this time. Water flows from the elevated rim of Borax Lake in many directions, but most typically to the southwest, where it enters a marsh and then flows into Lower Borax Lake (a reservoir). Chub reproduction is limited to Borax Lake. The fish occur throughout the lake except in hot spring inflow areas, where temperatures exceed approximately 34º C (93º F).

From 1986 to 2005, population estimates for the Borax Lake chub ranged from 3,900 to 34,000 depending on the year and season (Williams 1995, plus unpublished data from ODFW and The Nature Conservancy).

Proposed geothermal energy exploration and manipulation of surface flows from Borax Lake were the primary factors that resulted in the 1980 listing of the species by emergency provision under the ESA. Changes in thermal flows that enter the lake may cause slight temperature increases or decreases that could be detrimental to the species. Alterations in surface flows from Borax Lake could isolate subpopulations adjacent to the lake causing their desiccation. In 2000 the public lands surrounding Borax Lake were included in a mineral withdrawal area designated by the Steens Mountain Cooperative Management and Protection Act (2000). This management change has in essence removed the greatest potential threat to the Borax Lake ecosystem.

Due to the restricted size of the lake other threats still exist, including potential introductions of chemicals or non-native species. Protection of the fragile salt crusts that maintain water level at Borax Lake is also critical (USFWS 1987). Livestock grazing and physical damage from OHVs, mechanized vehicles and humans are the primary risks to shoreline salt crusts. The Borax Lake chub is also at risk because of its highly restricted range and specialized habitats. Borax Lake, Lower Borax Lake, and the surrounding block of land totaling 640 acres is designated critical habitat for the Borax Lake chub. (USFWS 1987).

**Alvord Chub.** Alvord chub are endemic to the Alvord Lake Sub-basin of southeastern Oregon and northwestern Nevada. The Alvord chub is a moderately sized minnow that inhabits marshes, creeks, and springs with little or no current. The American Fisheries Society considers the Alvord chub to be a species of special concern (Williams et al. 1989), and it is a BLM special status species.

The Alvord chub is widely distributed within springs, creeks, and lakes in and just outside of the Alvord Lake Sub-basin. Williams and Bond (1983) reported Alvord chub from 16 localities, including Serrano Pond, Trout Creek, Alvord Lake, and Pueblo Slough in Oregon, as well as Bog Hot Creek, Bog Hot Reservoir, Thousand Creek Spring, Thousand Creek, Continental Lake, Warm Spring, Dufurrena Ponds, Gridley Springs, and West Spring in Nevada. The distribution of this species has apparently changed little during the past 100 years except for a recent report of Alvord chub in Juniper Lake, Oregon (Bond 1974), where they were introduced and subsequently disappeared, and the elimination of the Alvord chub population from Thousand Creek Spring.

The Alvord chub occurs in a wide variety of available habitats such as isolated springs, cool and warm water creeks, reservoirs, and lakes. Within the principal creek systems where they live, chubs occur commonly in the mid and lower elevation sections, but are rare or absent entirely in high elevations. Within spring systems, the Alvord chub occupies a variety of spring habitats except springs with water temperatures above

31º C (88º F). Alvord chub are absent from Bog Hot Springs, which is fishless, and from Borax Lake, which is occupied by the Borax Lake chub.

Alvord chub appear capable of occupying a wide range of habitat conditions as long as relatively clean water persists that is free of introduced species. The Alvord chub has been eliminated from Thousand Creek Spring because of the presence of introduced guppies. Alvord chub are absent from some ponds at Dufurrena, which are dominated by introduced sunfish (Williams and Bond 1983). Introductions of non-native fish and diversion of stream flows pose the greatest immediate risk to populations. Maintenance of the integrity of aquifers that feed surface waters in the Alvord Basin is critical to the long-term persistence of this species.

## Other Fish Species

**Rainbow/Cutthroat Hybrid Trout.** The fish that currently inhabit the Trout Creeks (Trout Creek, Big Trout Creek, and Little Trout Creek) are a hybridized mix of rainbow and the Alvord cutthroat trout. It is assumed the dominant characteristics of these fish are those of an exotic rainbow trout. The stocking of rainbow trout in the Trout Creeks apparently started in the late 1920s and persisted for many years which increased competition for food and habitat, and caused genetic introgression of the endemic Alvord cutthroat trout. The Alvord cutthroat trout which originally occupied this system is presumed extinct (Behnke, 1992). There have been no life history studies of the current hybrid form of rainbow/cutthroat trout although it is assumed this fish has similar life history attributes as the Lahontan cutthroat trout given phenotypic adaptation to the desert environment.

**Brown Trout.** Brown trout are native to Europe. They are piscivorous (eat other fish) and efficiently compete with other trout species in altered, warm water habitats. Although they are not currently stocked in any streams of the sub-basin, brown trout are found in the lower portion of Van Horn Creek. They were first observed there by fish biologists in 1983, the result of an illegal introduction. They were observed again in Van Horn Creek in 1991 and in 2004. The abundance of brown trout in Van Horn Creek has not been estimated nor has the life history been studied. Van Horn Creek is the only known location of brown trout in the sub-basin.

**Goldfish.** Goldfish were illegally introduced into Mann Lake sometime before 2001 (ODFW, unpublished data). The goldfish population is thriving in the lake, impacting both water quality and the Lahontan cutthroat trout population. Goldfish disturb the lake bottom while feeding, increasing water turbidity. The high turbidity reduces aquatic plant growth and limits Lahontan cutthroat trout feeding ability. In addition, goldfish compete with young Lahontan cutthroat trout for food.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Fish are generally indicators of watershed health. To a lesser degree they can influence that health. Desirable native species can positively influence their own habitat by nutrient cycling and the consequent effects on invertebrate populations. However, undesirable non-native species (for example goldfish in Mann Lake) can negatively impact the habitat of native fish, by influencing factors such as turbidity and aquatic vegetation. Maintaining healthy populations of native fish implies the maintenance of watershed integrity.

**Issues, concerns and action items.**

- Increase public awareness of the relationship between healthy watersheds and healthy fish populations.
- Increase public awareness of the relationships between climate cycles, the health of riparian zones and the extent and size of fish populations.
- Increase public awareness of the consequences of illegal fish introductions, and work to prevent such introductions.

# SPECIAL STATUS BIRD SPECIES

**Information sources and authors**

The text for this section comes from a variety of sources. The original text came from the Andrews FEIS, but it has been modified by HCWC with help from EOARC, ODFW and BLM scientists and technical staff.

## Greater Sage-Grouse

The western subspecies of the greater sage-grouse is a species of concern in the Alvord Lake Sub-basin. It is currently listed as a BLM sensitive species. Sage-grouse populations have exhibited long-term declines throughout North America, declining by 33% over the past 30 to 40 years. The species has disappeared in five states (Arizona, New Mexico, Oklahoma, Kansas, and Nebraska) and one province (British Columbia). It is "at risk" in six other states (Washington, California, Utah, Colorado, North Dakota, South Dakota) and two provinces (Alberta, Saskatchewan). Even in states where the species is considered to be "secure" (Oregon, Nevada, Idaho, Wyoming, Montana), long-term population declines have averaged 30% (Connelly and Braun 1997; Crawford and Lutz 1985). The ODFW has indicated that the population is now stable in Oregon (Willis 1993).

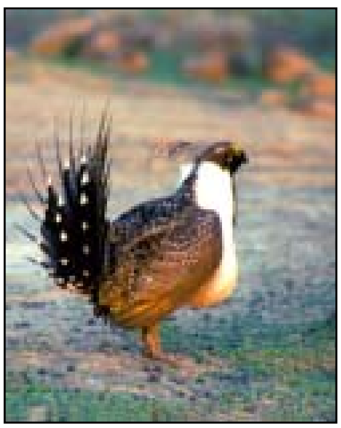


Photo courtesy of BLM

Sage-grouse depend largely on sagebrush-grassland communities. In Oregon, sage-grouse are most commonly found at elevations of 4000 to 8000 feet, with annual precipitation of 10 to 16 inches (25 to 38 cm) on rolling topography with slopes less than 30%. Migratory sage-grouse populations may travel great distances seasonally. Summer and winter ranges may be greater than 50 miles apart. Free water is a component of sage-grouse habitat, but it is not required for daily survival. Water is used when available from late spring through late fall, and sage-grouse attain their highest population densities in areas that contain abundant and well distributed surface water. They can rely on snow and ice during the winter months and moisture from succulent plants when available.

A variety of vegetation types are needed through the seasons of a year to meet sage-grouse habitat needs. Stands of sagebrush or other dominant shrub species constitute the most desirable habitat. In general, good habitat should contain some small canopy openings, some dense shrub stands, and approximately equal amounts of big and dwarf sagebrush or other shrub species.

Because of the status of sage-grouse and its declining numbers in many western states, its ecology (i.e. life history, habitat use, etc.) and management have become important considerations in larger land management decisions. Recent research has focused on describing commonly used habitats during specific life history stages (Connelly et al. 2000, Crawford et al. 2004, Rowland 2004).

Four important life history stages are lekking (mating), nesting, brood rearing and winter use. Lek sites are usually small (less than 1 acre to 10 acres), generally open areas commonly found in sagebrush-grassland habitats. Due to their small size and usual open nature, which can occur because of a variety of influences (both natural and human-induced) potential lek sites are not considered limiting. The other three life history stages are considered more limiting in ensuring the successful hatching and raising of young birds. All three of these life history stages most commonly occur in sagebrush-grassland habitats. Big sagebrush (*Artemisia tridentata*) is the most common species dominating these communities, but smaller sagebrush species and non-sage shrub species sometimes dominate areas periodically used by sage-grouse. Recent research has shown that three big sagebrush subspecies, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) provide different habitat characteristics due to their natural size differences, and therefore should not be considered equivalent in providing suitable habitat.

Vegetation requirements for the three limiting life history stages are variable. Optimal canopy cover amounts of the following plant groups have been shown to vary between life history stages: tall shrubs, low and moderate height shrubs, grasses (tall and short) and forbs (sometimes classified as ‘key’ and ‘non-key’). In general, the amount of the dominant shrub cover appears to decrease going from nesting to brood rearing to winter use sites. This can be explained by the decreasing need for protective cover as the young birds mature. Nest site requirements can be specific to the exact nesting area, but need not be consistent throughout a larger area which may have only islands or small regions suitable for nesting. Brood rearing sites tend to be closer to longer term open water than nesting sites. Winter use sites do not need open water as snow and ice can be used by sage-grouse as water sources.

Sage-grouse populations in the Alvord Lake Sub-basin and throughout eastern Oregon have been and will continue to be influenced by human activity, and by natural phenomena which are now partially controlled by human activity. Fire, livestock grazing, cheatgrass and other weed invasions, range improvements and juniper expansion are all management issues or factors which are tied to sage-grouse population levels. The interactions of these factors are not always straightforward and management goals for one may not be desirable in light of others. For example, fire is increasingly used to control juniper invasions, but fire will remove big sagebrush (*Artemisia tridentata*), therefore the availability of functional sage-grouse habitat should be taken into consideration when designing large restoration projects. In addition, in some environments fire can allow dominance by cheatgrass or possibly other weeds, thus greatly reducing an area’s suitability as sage-grouse habitat.

To successfully manage for sage-grouse, healthy sagebrush habitat is required. Healthy sagebrush-grassland communities will also insure healthy watersheds by providing adequate capture and storage of water, stable soils, diverse vegetation, and suitable habitat for other species.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Sage-grouse live in and depend largely on the common sagebrush-grassland communities in the sub-basin. Significant changes to those plant communities can potentially be harmful to sage-grouse populations. Those plant communities are threatened by a variety of factors (e.g. fire, noxious weeds, cheatgrass, juniper invasion, etc.) which need to be managed with multiple objectives in mind. Rather than being a factor of watershed health, sage-grouse populations are affected by watershed health in the sub-basin.

**Issues, concerns and action items.**

- Increase public awareness of the importance of sage-grouse as an indicator of watershed health.
- Increase public awareness of the effects of various threats (fire, noxious weeds, cheatgrass, juniper invasion, etc.) to the required sagebrush-grassland communities used by sage-grouse.
- Maintain the political will for a strong, continued effort to balance management objectives to allow overall ecosystem health.
- Increase the awareness of the impacts of rangeland management on sage-grouse habitat.

# VEGETATION PROBLEMS

Photo courtesy of BLM

This section describes three of the largest apparent threats to watershed health in the sub-basin. Each involves invasive plants which disrupt and replace native vegetation. Western juniper is a native tree species which can become problematic when it grows into areas it once did not occupy. The other two problems involve non-native species—cheatgrass and plants which are designated as noxious weeds.

## Western Juniper

**Information sources and authors**

The majority of the information for this section is from a publication from EOARC, "Biology, Ecology, and Management of Western Juniper (*Juniperus occidentalis*)" by Miller et al., 2005. Additionally, a small amount of material was provided by Burns BLM and HCWC.

**General Attributes.** Western juniper (*Juniperus occidentalis* var. *occidentalis* Hook.) is native to the Alvord Lake Sub-basin and southeastern Oregon. There is scientific evidence of its presence in southeastern Oregon for 4,800 years and in south-central Oregon for 6,600 years. In its natural settings, western juniper is an important and beneficial species to biological diversity and watershed health. However, due to its spread to new habitats and its increased cover on many sites, it has become one of largest threats to the biological diversity and watershed health of southeastern Oregon and to parts of the Alvord Lake Sub-basin.

Western juniper is important to diversity and watershed health because it is the only native tree species which can grow in much of semi-arid southeastern Oregon. When found in limited amounts it provides a valuable layer of tall plant growth over the sagebrush and other shrubs that generally dominate the area, providing benefits to a wide variety of animals that reside in the sub-basin for parts or all of their life cycles.

Western juniper historically appears to have occupied rocky ridges, low sagebrush (*Artemisia arbuscula*) flats, and pumice soils where understory vegetation was too sparse to carry fire. These "fire-safe" sites often had less than 10% tree canopy cover on the rocky shallow soils and up to 10 to 25% tree canopy cover in more productive soils. Tree establishment on these sites was certainly very low, but once established trees tended to live to old age due to the lack of fire. These sites can still be recognized by the relatively sparse canopy cover of juniper, generally round-topped trees (versus conical shaped younger trees), the presence of standing and on-the-ground dead trees and tree parts, decadent trees (significant numbers of dead limbs), abundance of lichen on dead branches, and hollows and cavities in the wood.

Western juniper is now greatly increasing throughout its range. It is moving out from the fire-safe sites and occupying many different habitats. When it increases in an area to the point of dominating the landscape and forming closed stands it has detrimental effects on associated vegetation, and consequently on animals which use the areas. It also affects some physical processes which are part of watershed health. In this use the term ‘closed stands’ indicates western juniper stands with a canopy cover of approximately 25 to 65% of an area, depending on the site and associated vegetation. The detrimental effects not only impact the natural biological and physical functions, but they also limit human use of the impacted areas.

The current increases in extent and density of western juniper in its native range is considered to be at least partially due to fire suppression and other human influences on the landscape. These increases and effects have been the subject of a wide variety of scientific studies for many decades. In recent years, much of that research has been carried out by scientists based at the Eastern Oregon Agricultural Research Center (EOARC) in Burns, Oregon. Scientists from EOARC have written a document titled Biology, Ecology, and Management of Western Juniper (*Juniperus occidentalis)* (Miller et al., 2005). That document is a review of the scientific literature of western juniper. It includes guidelines for choosing juniper treatments, and identifies the knowledge gaps in our understanding of the biology, ecology, history and management of western juniper.

Throughout its range western juniper is usually the only conifer species on a site except where western juniper woodlands adjoin ponderosa pine (*Pinus ponderosa*) forests. There are no ponderosa pine forests in the Alvord Lake Sub-basin. Consequently western juniper is usually the only tree species on sub-basin sites except when found with aspen (*Populus tremuloides*) or cottonwood (*Populus trichocarpa* and/or *P. angustifolia*).

Western juniper is a long-lived species—often living more than 1,000 years. It becomes reproductively mature in 40 years. It is submonoecious and develops male cones in early spring, which attain full size the first summer and mature during the second summer. Female cones persist on trees for nearly two years. Seeds are dormant and germination potential is greatly enhanced by prolonged cool-moist stratification, which is cumulative from year to year. Seed dispersal of western juniper occurs through gravity, overland flow, and animals. At least 12 species of birds feed on the fruits and as a group those birds are the most important disseminators of western juniper seed.

Western juniper grows on a wide variety of parent materials and soils including materials derived from aeolian (e.g., pumice sands), sedimentary, and igneous sources (e.g., rhyolite, andesite, basalt). Soil textures range from clay to sandy and soil temperature regimes from mesic to frigid.

Western juniper is most common in areas which receive 10 to 15 inches of precipitation, but less common in areas with as little as seven inches or as much as 20 or more inches. It is capable of growing in much wetter sites than commonly observed. This is evident from its presence in moist upland or riparian aspen stands, and in riparian cottonwood stands. Most western juniper is found growing between 2000 and 6000 feet in elevation, but it is known to grow between 600 feet and 8000 feet elevation.

Western juniper apparently first occurred in southeastern Oregon around 4,800 years ago and it probably reached its current geographical range approximately 3,000 years ago. The so-called Little Ice Age occurred in the area 700 to 150 years ago (ending about 1850). Increased grass cover during that period probably supported higher fire frequencies which limited western juniper distribution and abundance. During that time the species was apparently only common in areas which were either rocky or otherwise did not support sufficient vegetation to carry fires. There is some evidence that western juniper began to increase around 1850, but the rapid increase came later in the 1800s. That increase generally coincided with European settlement of the area.

Western juniper has increased its cover rapidly since 1870. Currently it occupies areas in its range estimated to be 10 times the 1870 cover. Various scientists believe that it has the potential to occupy far more area than it now does. The rapid post-settlement expansion (i.e. since 1870) appears to have initially been the result of: 1) on-going significant precipitation, allowing successful western juniper germination and establishment, combined with 2) the simultaneous but unintended fire suppression which resulted from early post-settlement, season-long grazing of the area by domestic livestock. Fire suppression by livestock results from their use of fine fuels (grasses and forbs) prohibiting the ability of fires to carry across the landscape. The purposeful and increasingly efficient fire suppression by humans in later parts of the post-settlement era has allowed continued increases of western juniper.

Three transitional phases of juniper woodland succession are defined as:

1. **Phase I:** Trees are present but shrubs and herbs are the dominant vegetation that influence ecological processes (hydrologic, nutrient, and energy cycles) on the site;

2. **Phase II:** Trees are co-dominant with shrubs and herbs and all three vegetation layers influence ecological processes on the site;

3. **Phase III:** Trees are the dominant vegetation and the primary plant layer influencing ecological processes on the site.

These phases represent important differences in the functioning and effects of western juniper in varied habitats in its range. It is the transition from Phase II to Phase III (see Figure 6 below) when juniper changes from being a generally beneficial plant in most environments to a less desirable and even detrimental plant. The loss or decline of associated shrubs and herbs not only signals decreasing vegetation diversity with concomitant decreases of most beneficial uses by native and domestic animals, but it also represents the time of altered physical functions within the stands.

The minimum time for the tree overstory to begin suppressing the understory is 45 to 50 years, and the minimum to approach stand closure is 70 to 90 years on cool wet sites and 120-170 on dry warm sites.

The rate of loss of shrubs and forbs with increasing juniper cover is dependent on a variety of site specific factors. The two most important factors, at least on the herbaceous component, are the relative wetness of the site (with dry sites being most affected) and the presence or absence of a restrictive sub-surface soil layer (with sites having a restrictive layer most affected). In addition to the changes to the understory vegetation with increasing juniper cover, there are also less obvious, but biologically important changes in nutrient and organic matter cycling, and nutrient availability in changing juniper stands. Those effects are varied and complex, and they have both long and short term implications.

Some hydrological functions change with increasing juniper cover. These changes include: the decrease in rain and snow reaching the ground due to increasing juniper cover; the resulting decrease in potential soil moisture and possible resulting effects on stream and spring flow; and changes to hill slope runoff and erosion. While all three of these potential changes can theoretically be important and detrimental, increased runoff and erosion (i.e. removal of topsoil and its nutrients) may have the greatest long-term effects on a site, as soil development and nutrient accumulation in semiarid environments are both slow processes.

**Figure 6. Photos—Phase II and III Juniper Sites, plus Recovery Following Treatment.** These photos were all taken just outside of the Alvord Lake Sub-basin on the west slope of the Steens Mountain.

**Phase II.** The junipers at this site have yet to noticeably affect the shrubs and herbaceous plants—at least in the foreground area. Further growth and crowding of the junipers will eventually alter that other vegetation.

**Phase III.** The understory at this site has been greatly altered by the presence of the junipers. The sagebrush and the herbaceous plants (grasses and forbs) are dead or dying. The junipers themselves are showing the effects of age and the declining productivity of the site.

**Recovery Following Treatment.** The junipers have been removed from the foreground area by cutting. The grasses, forbs and shrubs have revived with vigor. They now again occupy nearly 100% of the available, cut area.

These photos courtesy of Jon Bates, EOARC

Changes in hydrologic processes and water balance as tree abundance and dominance increase are not well understood or documented. Evidence suggests that juniper can impact infiltration rates, sediment loss, and soil water storage and depletion rates. Accelerated soil water depletion rates in western juniper-dominated stands can decrease the length of the growing season by as much as four to six weeks. However, the impacts of western juniper on the water balance at the watershed or basin level have not been determined, nor have the effects of woodlands on subsurface flow into streams and springs.

As a result of these concerns, control of western juniper has been a major concern of land management since the early 1960s. Many different western juniper control practices have been utilized, including fire, mechanical, chemical, seeding, and post-treatment grazing. In the 1960s through the early 1970s chaining and dozing were the most common forms of western juniper control. In the 1970s, chainsaws became a widespread tool used for juniper control. In the 1990s and since, the use of prescribed fire for juniper control increased.

Our ability to control juniper using these various techniques is quite high, but that alone does not translate into a refined ability to manage the ecosystems where this species now grows. The response of juniper and other vegetation to control measures is highly site specific, complicating the choice of available control alternatives. In addition, our understanding of the results of control measures on other ecosystem attributes is still incomplete. Control measures which result in weed infestations, the loss of desirable native plant species, or in a lack of protective ground cover may be more harmful than beneficial. Most management alternatives are expensive and mistakes can have long term negative effects.

While a great deal has been learned about the ecology, biology, history, and management of western juniper over the past several decades, not all of the questions have been answered. These knowledge gaps limit our ability to manage western juniper on an ecosystem basis.

**Western Juniper in the Alvord Lake Sub-basin.** Currently, there is a relatively small amount of western juniper in the Alvord Lake Sub-basin. The only area with significant juniper cover is the east face of the Steens Mountain, with the northern half of the east face having much more than the southern half. In 1984-1986 when the Burns BLM vegetation cover data was collected there were 25,400 acres of juniper dominated lands in the sub-basin. In comparison there were 91,200 acres in the Donner und Blitzen Sub-basin which abuts the Alvord Lake Sub-basin to the west and north, and which is only 40% of the size of the Alvord Lake Sub-basin. There were another 18,500 acres in the Guano Sub-basin on the southwest flank of the Steens Mountain, just west of the Alvord Lake Sub-basin.

Besides the juniper on the east face of Steens Mountain there are only a few scattered stands or scattered trees in other locations in the Alvord Lake Sub-basin. The general lack of juniper distribution in the sub-basin at this time is not understood by scientists. While many of the older stands on the east face of the Steens occupy rocky and apparently fire-safe sites, there are sites throughout the sub-basin which are similar and also appear to be fire safe, but which are completely bare of juniper.

Unfortunately, Alvord Lake Sub-basin lands now occupied by juniper are expanding. The juniper in the enlarging area exhibits the signs of typical post-settlement expansion, with younger trees occupying a variety of habitats and showing the potential to fill in and eventually form Phase III stands.

To date there have been no public land juniper control efforts in the Alvord Lake Sub-basin as time and resources are being focused on the more heavily stocked and larger juniper stands on the west and northerly parts of the Steens Mountain. There has been some juniper control on private land on the east side of the Steens Mountain in the Alvord Lake Sub-basin, but the acreage is quite small.

With the relatively small current amount of juniper in the Alvord Lake Sub-basin and the developing knowledge of juniper control, the species should not be a major problem in the sub-basin in the future if the political will is maintained to keep its cover amounts low. In comparison to cheatgrass and noxious weeds (discussed below), juniper invasion is slow and definitely manageable. Juniper management is expensive, and future decisions regarding the species in the sub-basin will probably be based on cost/benefit analyses as to when to implement control measures to manage the species.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Juniper currently does not occupy much of the Alvord Lake Sub-basin, but it is increasing. Left unchecked it could become a serious long-term treat to watershed health. However, the problems posed by juniper are well understood and control methods are known. It is in the interest of almost all of the stakeholders in the sub-basin to not allow juniper to become a significant threat to watershed health.

**Issues, concerns and action items.**

- Increase public awareness of the problem with spreading juniper and its effects on watershed health.
- Maintain the political will for a strong, continued effort to control juniper.

## Cheatgrass

**Information sources and authors**

The information for the General Attributes section below was taken mostly from a document titled Cheatgrass: The Invader That Won the West (Pellant, 1996). The specific Alvord Lake Sub-basin information was provided by BLM and EOARC scientists and technical staff. This cheatgrass write-up is separate from the following noxious weed section, as cheatgrass is not officially listed as a noxious weed by Harney or Malheur counties. It effects though are significant and it is a major management concern in the Alvord Lake Sub-basin. See the discussion in the following section on what constitutes a noxious weed.

**General Attributes.** Cheatgrass (*Bromus tectorum* L.) is an introduced annual grass that has been widely distributed on rangelands in the western U.S. for over 75 years. Its distribution may still be expanding into new habitats due to its ability to adapt in new environments. It is tolerant of grazing and other land uses and it often increases with fire. Cheatgrass is adapted to many biotic regimes from low elevation salt desert shrub communities to the higher elevation ponderosa pine zone. These communities range from 1500 to 9000 feet in elevation and from six to over 20 inches of average annual precipitation.

Fall germination, late winter and early spring growth and the rapid lateral elongation of roots provide cheatgrass with a competitive advantage over native perennial species. It out-competes those species for water and nutrients. As a result, its presence can reduce establishment and growth of seedlings of other range grasses. Early growth by cheatgrass is particularly problematic following fires when it can quickly garner the majority of released nitrogen and other nutrients.

Cheatgrass completes its reproductive process early in the year and turns senescent quickly, becoming flammable earlier and remaining so later than most native perennial grasses. It is a prolific seed producer and the seeds can survive in the soil for many years, plus it can produce multiple seed crops in a single year. Plant densities can be very high—in the thousands of plants per square meter. It is used by wildlife and livestock when young and green, and will also be used after maturity when it is wet. It is generally not used when setting seed or at maturity when it is dry. The total time when it is palatable and desirable to most animals is short. The seeds though are used by a variety of small mammals and birds throughout the year.

Cheatgrass modifies the ecosystem attributes of soil temperature and soil water distribution. Its soil temperature altering abilities appear related to the fact it does not shade the soil as well as some of the shrub-dominated vegetation types it can replace. It is an efficient user of soil water in the upper soil profile, whereas many native bunchgrasses and shrubs extract water from deeper in the soil profile. Its water use pattern and annual life cycle result in vastly differing cheatgrass biomass production in wet and dry years. While its production may be quite high in wet years it can be very low in dry years. Several dry years in a row can result in cheatgrass rangelands having little or no residual plant growth or litter to protect the soil and promote water infiltration. This situation can also occur after wildfires, and in both cases the land can become highly susceptible to erosion. Besides altering sites so that they are more susceptible to erosion, cheatgrass can also make sites more susceptible to invasion by noxious weeds and other undesirable plant species.

Cheatgrass also appears to reduce the diversity and cover of microbiotic soil crusts. These reductions may affect nutrient and hydrologic cycles, plus energy flow and site stability.

The mentioned attributes result in cheatgrass being particularly successful in many environments which experience wildfires. Not only does cheatgrass thrive in some of those areas, it can alter some environments in ways that the fires and the fire cycle are changed and become more harmful to the native ecosystems.

Because cheatgrass matures earlier in the year than native bunchgrasses, it can carry fires across the landscape earlier in the year when the native grasses are still actively growing, have not set seed and are still green and thus prone to serious burn damage. Fires later in the year do not do the same damage once the native grasses have matured.

In substantial stands cheatgrass provides what fire managers call “fuels continuity,” i.e. a nearly continuous stand of fuel which results in nearly solid burn lines with very few unburned sites. In contrast, bunchgrass stands tend to burn in mosaics, with remnant islands of unburned native vegetation which can provide seeds for natural reseeding of the burned areas and which also act as refuges for the native fauna.

Because cheatgrass is a quick growing annual and a prolific seed producer, and because it quickly recaptures available nutrients following fire, it can make a site prone to fire again quickly after a previous burn. Consequently it can reduce the so-called fire return interval of a site, or the average time between fires. Some rangelands heavily infested with cheatgrass now have fire return intervals of less than five years, whereas the native rangeland types may have had historic fire return intervals of many decades on the same sites. Short fire return intervals can remove essentially all of the desirable native species as most are not adapted to the shortened regime. Once the native plants have been replaced their return is at best a slow process even with successful fire suppression.

After a core area has been dominated by cheatgrass, successive fires will burn rapidly through that area encroaching into even healthy stands of adjacent native vegetation. Even if the fire burns out relatively quickly in the native vegetation, the cheatgrass core will probably expand in size to some degree. Successive fires will repeat the process with the potential for expansion with each burn.

Revegetating cheatgrass dominated rangelands is difficult and expensive. In many situations it is better to take steps to prevent or reduce its invasion in the first place. That usually entails reducing the various types of disturbance which allow initial cheatgrass establishment. In relation to fire, that may mean reducing fire hazards, and preventing large fires which result in major vegetation changes. Strategic grazing can be used in some circumstances to reduce potential fuel loads. Various other management practices will also potentially play an increasing role, as managers increasingly incorporate their understanding of ecosystem functioning in choosing management practices.

**Cheatgrass in the Alvord Lake Sub-basin.** In the Alvord Lake Sub-basin cheatgrass is most common below 5000 feet, but it is also found at higher elevations based on local conditions. Disturbance of the soil surface often allows cheatgrass to at least temporarily invade very high sites in the sub-basin, but in those sites the cheatgrass will not persist without continual disturbance. At lower sites, but still above 5000 feet, cheatgrass may be able to persist after initial establishment without further disturbance if the site is relatively warm and dry. Below 5000 feet cheatgrass will usually persist in most environments once it has established. Readers should understand that the 5000 feet elevation is a rounded, somewhat arbitrary figure which is generally agreed on by local scientists. It is a point-in-time figure, controlled by the recent climate history and recent general management of the sub-basin. It should not be assumed absolutely true for any one site.

Cheatgrass is common in the Alvord Lake Sub-basin. In Table 16, page 107, the two references to annual grasslands are occupied by cheatgrass. The big sagebrush/annual grassland type was the most common vegetation type in the sub-basin (26% of the total land area) in 1984 to 1986, when the sub-basin was surveyed for vegetation types. That type has an overstory of big sagebrush and an understory dominated by cheatgrass, rather than the native bunchgrasses which originally occupied these sites. Since sagebrush does not re-sprout following fires many if not most of these sites could change to cheatgrass dominated grasslands with another fire cycle or two. In Table 14, the annual grasslands type is cheatgrass dominated rangelands. It occupied 0.4% of the sub-basin between 1984 and 1986. These two amounts (26.0% and 0.4%) with high cheatgrass cover amounts are assumed to have risen since 1986.

In the lower vegetated sites in the sub-basin, cheatgrass is invading the salt desert shrub/grassland communities. As in the various sagebrush types at higher elevations, the invasion into these lower shrub communities is often initiated by fire. Again, once it is present in significant amounts, cheatgrass is able to reduce the reestablishment of native grasses and shrubs, converting these sites after one or two fires to cheatgrass monocultures.

The BLM understands the potential danger posed by cheatgrass in the Alvord Lake Sub-basin. They have adopted fire management strategies for site-specific situations in relation to the known interactions between fire and cheatgrass. For example, the east face of the Steens Mountain is classified in their highest fire suppression category. This is the result of fires being relatively common in the area (several have occurred there in the past 15 years) and being hard to control due to changing day and night wind patterns. In addition, cheatgrass is already common in the area and it could dominate large areas with further major disturbance.

The emphasis in these discussions on the interaction of cheatgrass and fire is purposeful. First, fire is possibly the most significant disturbance in the sub-basin which allows the invasion of cheatgrass into new areas. In addition, prescribed fire is becoming a commonly used tool in rangeland reclamation (see the preceding section on western juniper). These contrasting roles and effects of fire pose problems to land managers in relation to cheatgrass. At the same time, other disturbances besides fire also allow cheatgrass invasion and once on a site cheatgrass has other negative ecological effects besides making the area susceptible to fire. Among these are its ability to prevent or slow the re-establishment of native species following disturbance, and the fact its presence may allow invasion by other undesirable plants, such as noxious weeds.

The future of cheatgrass and its management in the Alvord Lake Sub-basin are uncertain. While cheatgrass has been present and common throughout the west for decades, our understanding of its role as a serious threat to ecosystem functioning is only now becoming widely understood. The plant is ubiquitous and eradication is impossible; control and limiting the problems it cause should be primary management objectives. Fire suppression will certainly play a large role in managing cheatgrass and its influences. Managing the rangelands for overall ecosystem health will be very important.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

To this point in time, cheatgrass has arguably had the most profound negative influence on long-term watershed health of all influences in the sub-basin. Cheatgrass is common in the described settings throughout the sub-basin. Local range scientists feel it is probably expanding its cover. As described, fire enhances cheatgrass spread and fire is difficult to control. Fire though can be beneficial to other ecosystem components. Land owners and managers are faced with many dilemmas regarding cheatgrass, its control and their allocation of limited resources. It will take a significant effort to stop the spread and increasing impact of this species.

**Issues, concerns and action items.**

- Strive to maintain cheatgrass at current or less cover amounts.
- Increase public awareness of cheatgrass and its effects on watershed health.
- Maintain the political will for a strong, continued, governmental effort to control cheatgrass.

## Noxious Weeds

**Information sources and authors**

The text for this section was written by HCWC, from generic information found in a variety of federal, state and county documents. The information in Table 7 was provided by the sources cited in the table footnote.

Noxious weeds are possibly the most significant threat to rangeland ecosystem health in the western United States. Expanding infestations of a variety of weeds also have increasingly negative effects on regional economies. Weed impacts occur by: physical displacement of native plant species and communities, use of soil moisture and nutrients, production of toxic compounds dangerous or lethal to animals, promotion of soil erosion through the disruptions of native communities, and ever increasing costs in manpower and financial resources in attempts at weed control.

The most dangerous and aggressive noxious weeds are exotic plants—plants which are native to other parts of the globe. Increasing regional and international trade and travel results in exotic plant introductions, and these new plants arrive without the usual pests and predators which keep them under control in their native regions.

The term “weed” can be broadly defined as a plant growing where it is not wanted. In contrast, the term “noxious weed” is usually used in relation to specific plants which have been so designated by a governing body charged with defining and directing policy against the most harmful of weeds in a given area or on land of specific ownership. For this document we use the term “noxious weeds” as those plants that have been designated as such by Harney and Malheur Counties.

There are a large number of federal laws, regulations and programs which direct and prescribe noxious weed management on federal lands. Similar authority has been delegated to the states for weed management on state and private lands. In Oregon part of that authority and responsibility has been further delegated to the counties, with the state retaining significant ultimate control if the counties are not implementing sufficient programs. In their roles of controlling noxious weeds, Harney and Malheur Counties have chosen to emphasize weed education and awareness. In Harney County the recently formed Harney County Cooperative Weed Management Area (HCCWMA) represents all interested parties from private to state to federal entities. The Harney County Weed Board is part of the HCCWMA and it specifically represents the private landowners of the county. The County Weed Board has the responsibility to make decisions on technical issues, such as the inclusion of new species on the noxious weed list, for the private lands in the county. Malheur County has a similar CWMA and Weed Board.

The Burns BLM District uses their Geographic Information System (GIS) to map and store weed location and infestation information on federal land in the Alvord Lake Sub-basin. They also have a limited amount of private land sites in the data base. Map 5 (below) shows the recorded weed locations in the Burns BLM District portion of the sub-basin. The Vale District at this time has not similarly used GIS for their weed data. For this report there was no attempt to show their location information in Map 5. Note in Map 5 that most of the known weed occurrences are along roads. That is indicative of the facts that weeds are commonly spread by vehicles and that road corridors are easily and commonly observed. The BLM does attempt to do some systematic surveys of non-roaded areas, but those efforts are limited due to funding and personnel restraints.

Map 5 shows the locations of all originally recorded weed infestations in the Burns District. What is not indicated is the fact that the marked infestations have been treated and the vast majority of weeds originally recorded no longer occur at these sites. Most of the weed sites marked on Map 5 do not have active weed infestations. In fact at this point in time the public lands in the sub-basin are relatively free of noxious weeds.

This general success in keeping weeds out of the sub-basin can be attributed to active programs by the BLM, the state, counties and private individuals. That success though is also a source of concern, as alone it may lead to complacency toward the potential problems the sub-basin faces. The history of weed management is full of stories about the lack of attention and action during the initial stages of weed invasions. Increasing weed problems in other parts of southeast Oregon and northern Nevada will require increasing diligence to keep the lands in the sub-basin as weed free as they currently exist.

Compared to the public lands, noxious weed infestations on private lands within the sub-basin are not well documented, nor so effectively controlled. Whereas the BLM and state have reasonably well-funded, active programs to find, document and manage weeds on public lands, there is not a similar, long history of programs on the private lands.

Private lands in the sub-basin on average are more intensely used for agriculture than are the public lands. That use results in significant soil surface disruption, predisposing those areas to invasions by weeds. Those invasions are sometimes not recognized by land owners, or in some cases they may be ignored when the invasions are not yet directly impacting agricultural practices. Current information indicates that weeds are present on larger areas of the private land in the sub-basin (16% of total sub-basin area) than are found on the public lands (82% of the total area.)

There are now county-run programs in place to help private land owners manage the weed problems on their lands. Landowner involvement in these programs remains voluntary, but an increasing number of landowners are choosing to participate. In Harney County, major weed control programs in the sub-basin are relatively new. The Harney Soil and Water Conservation District (HSWCD) has taken the lead in the sub-basin within Harney County to administer programs which provide funding for private land weed control. Recently the HCCWMA has also begun offering weed treatment programs in the sub-basin. Landowner applications for these funding sources reveal part of the magnitude of the private land infestations. For example, applications for a 2005 HSWCD program indicate there are minimally 700 acres of Scotch thistle (*Onopordum acanthium*) and 870 acres of perennial pepperweed (*Lepidium latifolium*) on private lands in the sub-basin. In comparison, the sites shown on Map 5 represent only slightly over 1,000 acres, but most of those public land sites are now weed free due to past control measures. Applications for another 2005 HSWCD program indicates that there are also large infestations (acres not available at this time) of Russian and diffuse knapweed (*Centaurea/Acroptilon repens* and *Centaurea diffusa*) on private land. The mentioned HSWCD programs involve cost-sharing grants which allow the private land owners to economically manage the weeds on their lands.

In contrast to Harney County, Malheur County has had a major weed control grant program in the sub-basin for seven years. They have had good participation and success with that program. Information on the sizes of infestations on those private lands is not available.

One other management mechanism now often used is federal treatment of weeds on private lands. Federal law now allows spending federal dollars on private land weed infestations if doing so benefits federal land. The most positive result of this is that federal weed control specialists can quickly act to manage private land infestations. This is especially effective against small, new infestations before they expand and need to be dealt with on a larger scale. To keep the Alvord Lake Sub-basin relatively weed free, two strategies are needed: 1) large scale programs to control known large infestations, and 2) efficient, on-going, tactical programs.

Weed control programs are changing from older methods of simply applying the most effective chemical control agent, to more ecologically based management. The newer, more holistic processes use an understanding of the biology of the weeds and the ecology of the local ecosystem. They focus on developing and maintaining desired plant communities. Effective, least-toxic management methods are preferred, as the side-effects of harsh chemical or mechanical treatments can be counter productive. Weed control is becoming increasingly prioritized within the framework of overall management for an area and overall management goals often dictate the methods of weed control.

Newer weed management programs and processes go by a variety of names and acronyms, many of which reflect the broadening focus. For example, Integrated Vegetation Management (IVM), Invasive Vegetation Management (IVM), Integrated Plant Management (IPM), Invasive Plant Management (IPM) and others are all used by various groups with similar goals. Anyone seeking information about these processes can contact county weed groups and land management agencies, as mentioned above for the Alvord Lake Sub-basin. In addition, most of these entities have internet sites with information about their programs.

Table 7 lists the plant species which are currently on the Harney County Weed Board list of noxious weeds. For each named species there is a generalized description (none, low, moderate, abundant) of current known abundance in the Alvord lake Sub-basin. Also there are subjective predictions of the potentials for introduction and spread in the sub-basin. These predictions were made by Lesley Richman and Lynn Silva, weed specialists for the Burns and Vale BLM Districts, respectively. There are also short comments on most species. In general most of the comments concern the weed situation on public lands in the sub-basin. However there are also some comments related to private lands as well.

Readers should understand that the last two columns of Table 7 are predictions on the potential of the species to establish and spread in the sub-basin. These are point-in-time predictions. They are based on the recent behavior of each species in or near the sub-basin. However, the history of weed management is that the spread of weeds is often not predictable. Short and long term climatic changes can alter weed spread, as can: 1) the changing biology of the plants themselves, 2) legal and social changes on control methods (e.g. chemical controls are periodically outlawed or allowed), and 3) various other factors. All of the listed species should be considered as threats to the sub-basin. Neither the public nor land managers should assume that the current situation will be stable into the future.

**Table 7. Noxious Weeds on Public Lands within the Alvord Lake Sub-basin.**

| Species – Comments | Current Abundance | Potential for Introduction or Further Introduction | Potential for Spread or Further Spread |
|---|---|---|---|
| **diffuse knapweed (*Centaurea diffusa*)** | Low | High | High |
| Diffuse knapweed is spreading in the northern parts of Harney County. There are significant private land infestations within the Alvord Lake Sub-basin. | | | |
| **spotted knapweed (*Centaurea maculosa*)** | Low | High | High |
| There have been known occurrences of spotted knapweed in the sub-basin. Some populations previously identified as spotted knapweed have since been confirmed to be diffuse knapweed. See above. | | | |
| **yellow starthistle (*Centaurea solstitialis*)** | Low | High | Moderate |
| This distinctive plant is often introduced along roads and other high profile locations due to seeds being carried on vehicles. There is a high potential for further introduction, but due to the plant being quite distinct, there is a good chance that it would be noted and controlled, thus lessoning the chance for spread. | | | |
| **squarrose knapweed (*Centaurea virgata*)** | None | Low | Low |
| **tansy ragwort (*Senecio jacobaea*)** | None | High | Low |
| **rush skeletonweed (*Chondrilla juncea*)** | None | Moderate | Moderate |
| This species is spreading rapidly in the north end of Malheur County east of the sub-basin. | | | |
| **purple loosestrife (*Lythrum salicaria*)** | None | Low | Low |
| There are populations of this plant close to the sub-basin to the east. It grows in moist areas—usually in or adjacent to standing water. | | | |
| **leafy spurge (*Euphorbia esula*)** | None | Moderate | Moderate |
| This species is spreading into areas east of the sub-basin (Jordan Valley and Owyhee Mountains). Once in an area, its potential for spread is high. | | | |
| **Scotch broom (*Cytisus scoparius*)** | None | Low | Low |
| **tamarisk, salt cedar (*Tamarix ramosissima*)** | Not Known | High | High |
| There are five known tamarisk sites in the sub-basin. All sites have been treated and the plant appears eradicated from the sub-basin at this time. | | | |
| **musk thistle (*Cardus nutans*)** | None | Low | Low |
| **yellow toadflax (*Linaria vulgaris*)** | None | Low | Low |
| **black henbane (*Hyoscyamus niger*)** | Low | Moderate | Low |
| The known sites of this species' occurrence have been treated, and the plant is now not known to be on public land in the sub-basin. There are known sites on private lands. This is a poisonous plant and can be quite problematic. | | | |
| **Scotch thistle (*Onopordum acanthium*)** | Abundant | High | High |
| Scotch thistle occupies more sites and more acres in the Burns BLM District in the sub-basin than does any other weed species. It is not as common on Vale District lands. This large thistle can grow dense enough to form stands impenetrable to livestock. | | | |

| Species – Comments | Current Abundance | Potential for Introduction or Further Introduction | Potential for Spread or Further Spread |
|---|---|---|---|
| **dalmation toadflax (*Linaria dalmatica*)**<br>Dalmation toadflax is very common in the northern part of Harney County, but currently is not common in the sub-basin. Its possibility of further introduction and spread in the sub-basin is high. | Low | High | High |
| **perennial pepperweed (*Lepidium latifolium*)**<br>This species is usually found in lower elevation riparian zones, and is common on public and private land in the sub-basin. There is significant land owner cooperation in attempts to control perennial pepperweed. | Abundant | High | High |
| **medusahead rye (*Taeniatherum caput-medusa*)**<br>Medusahead rye is most commonly found on heavy, clay soils which are abundant in the sub-basin. Given enough time on a site, this annual will crowd out almost all other herbaceous vegetation. | Moderate | High | High |
| **Mediterranean sage (*Salvia aethiopis*)**<br>Mediterranean sage is rare in the sub-basin, but common just outside of it. It has long-lived seeds that are spread by the tumbleweed-like movement of the seed heads in the fall. | Low | Moderate | High |
| **puncture vine (*Tribulus terrestris*)**<br>This low-growing annual is very common to the east of the sub-basin, but there is not a lot of it in the sub-basin at this time. | Low | Moderate | Moderate |
| **Russian knapweed (*Centaurea/Acroptilon repens*)**<br>Russian knapweed occupies many acres on both public and private lands in the sub-basin. It forms dense stands and spreads locally by pervasive underground roots. | Moderate | Moderate | High |
| **St. John’s wort/Klamath weed (*Hypericum perforatum*)**<br>St. John’s wort is known to occur in the sub-basin, but it is not common. | Low | Low | Low |
| **Canada thistle (*Cirsium arvense*)**<br>Canada thistle usually inhabits riparian zones and other moist areas. It is relatively common in the sub-basin, but does not appear to be highly aggressive or spreading rapidly, especially in healthy riparian zones. Bio-control agents are used with this species and are quite widespread in the sub-basin. Herbicides are also used to control the species. | Moderate | Low | Low |
| **whitetop/hoary cress (*Cardaria draba*)**<br>Whitetop is very common to the east of the sub-basin in various areas of southeast Oregon and southwest Idaho. It is also spreading around Burns to the north. It is most common in riparian zones, fields or roadsides which have increased soil moisture, but it can move into upland sites and become problematic there too. | Low | Moderate | High |
| **Halogeton (*Halogeton* spp.)**<br>This annual plant is a poisonous weed that occurs in the sub-basin. It is particularly problematic if the associated vegetation is depleted. The center of the infestation in the sub-basin is in the low elevation, southwestern region between Fields and Denio. It is also common along the eastern end of Whitehorse Ranch Lane. | Abundant | High | High |
| **morning glory (*Convolvulus arvensis*)**<br>Morning glory is not common in the public land in the sub-basin. Its potential for spread is moderately high due largely to it commonly being found on roadsides and associated with agricultural fields where traffic can facilitate its movement. It may spread and become more problematic in the future due to a general lack of current control efforts. | Low | Low | Moderate |

Information sources: Burns BLM District GIS data base; Lesley Richman, Burns BLM District; Lynn Silva, Vale BLM District.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

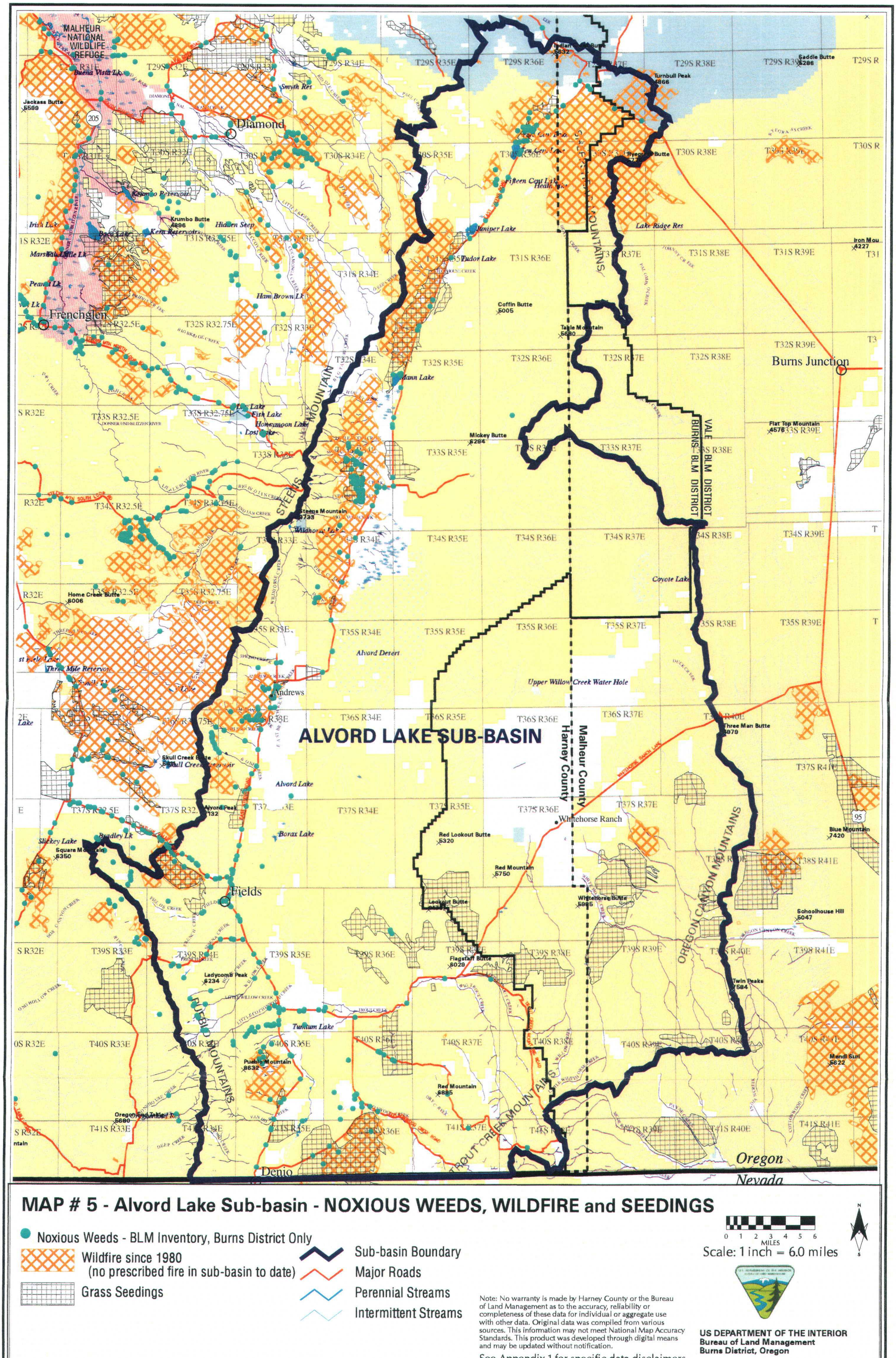
Noxious weeds and their potential effects are one of the most serious threats to watershed health in the Alvord Lake Sub-basin. Though noxious weed infestations are still relatively low within the sub-basin, the threat is increasing as weeds which are common in close-by areas spread and proliferate. Of all weeds which pose a threat to the area, medusahead rye (*Taeniatherum caput-medusa*) is potentially the most serious, as this fast-spreading, annual grass has the ability to invade undisturbed native rangeland sites and displace most of the native herbaceous vegetation. Areas with heavy infestations of this plant have greatly reduced value: in desirable forage production, as habitat for native plant and animal species and in a variety of other resource characteristics.

The other major sub-basin vegetation problems, i.e. juniper expansion and cheatgrass domination, both increase the threat of serious consequences of noxious weed invasions into the sub-basin. Fire too increases the threat of weed invasions. Interestingly, fire can enhance the spread of noxious weeds and cheatgrass, but it is used as a tool in controlling juniper expansion. Land managers will need to be educated and wise in their use and control of fire towards different and possibly competing end results.

Successfully preventing further noxious weed invasions is based in two main areas: 1) having an educated public, with individuals willing to help prevent weed establishment and spread, and 2) on-going formal efforts by various government and private entities with programs designed to fight the establishment and spread of noxious weeds. The political will to provide adequate funding for all of the facets of the battle against noxious weeds will have to be fostered and maintained.

**Issues, concerns and action items.**

- Strive to maintain noxious weeds at current or smaller amounts in the Alvord Lake Sub-basin.
- Increase public awareness of weed problems and their effects on watershed health.
- Maintain the political will for a strong, continued, governmental effort to control weeds.




## MAP # 5 - Alvord Lake Sub-basin - NOXIOUS WEEDS, WILDFIRE and SEEDINGS

- Noxious Weeds - BLM Inventory, Burns District Only
- Wildfire since 1980 (no prescribed fire in sub-basin to date)
- Grass Seedings
- Sub-basin Boundary
- Major Roads
- Perennial Streams
- Intermittent Streams

0 1 2 3 4 5 6 MILES

Scale: 1 inch = 6.0 miles

Note: No warranty is made by Harney County or the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

See Appendix 1 for specific data disclaimers.

US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon

Date: 21-MAR-2006, Pam Keller, subbasin11x17.aml/alvmgt.ps

# HCWC FIELD WORK—STREAM SEDIMENT SOURCES

**Information sources and authors**

The text for the following three sections on stream sediment sources was written by HCWC, from data we collected for this watershed assessment.

There is little or no discussion about sedimentation in the Alvord Lake Sub-basin in the various BLM management documents that cover the area. Consequently, for this assessment we attempted to address this data gap in the limited amount of field work that was budgeted. While conducting riparian inventories on 17 miles of perennial streams on private lands in the sub-basin, we collected sediment source data related to the stream reach being surveyed. In addition, we collected sedimentation data at 22 road crossings (bridges, culverts and fords) and along roads adjacent to perennial streams. This data collection is discussed below in three sections.

Within these efforts, all evaluations made by the field observer were subjective. There is no easy and repeatable way to quantitatively evaluate past or potential sediment supply by a source during a one time visit. For all sources we rated the apparent sediment supply as Low, Moderate, Significant or Extreme. As mentioned, the determinations were subjective; additionally they were relative in several ways. For example, at road crossing sites, the field observer mentally rated the sediment potential of that site verses other road crossing sites he had previously evaluated. Additionally, he also rated that crossing in relation to sediment supplying potential of other nearby sources he could observe from the crossing. For example, many crossings seemed more stable and less likely to provide sediment to the stream than did nearby bare banks, bare floodplains and uplands in the area. As another example, when rating the sediment supplied by irrigation return flow (an agricultural practice) in an inventory polygon, he subjectively rated it against that generated in the channel itself (bare banks, etc.) and by the adjacent uplands.

## Stream Sediment from Riparian Areas

While performing the riparian inventories on private ground we collected three primary types of sediment source data. The purpose of this examination was to determine the sources and relative amounts of sediment which entered, or became transferable by the stream within the polygon. This contrasts to sediment which was carried by the stream into the polygon area from above. The three categories of sediment sources were: channel/riparian, agricultural and adjacent uplands. We assigned a subjective rating of Low, Moderate, Significant or Extreme for each of these three categories in each polygon. These determinations were made based on all pertinent circumstances observed for each assessment. Using failing banks as an example, the number and size of bare, failing banks were considered, as well as the inherent stability (material sizes) of those banks, the bank angles, the presence or absence of filtering and stabilizing vegetation on the banks near the water, indications of extent of the banks reached by common high flows in the reach, the accessibility of the banks to large animal and human use, etc.

The three categories of sediment sources are:

1. **Channel/riparian.** This category includes sediment which comes from failing banks, sidecutting and down cutting of the channel, bare areas within the riparian zone which supply sediment, etc.

2. **Agricultural.** This category includes sediment carried to the channel by irrigation return flow and sediment generated by agricultural practices such as plowing and haying near the stream. Normal, dispersed livestock grazing ***was not considered*** a cause in this category. In contrast, concentrated grazing with large numbers of livestock for extensive periods ***was considered*** a cause. This differentiation was made to avoid doubly recording the effects of normal, dispersed grazing. Those

effects were recorded in the channel/riparian and adjacent upland categories. In contrast, the effects of concentrated grazing were recorded in the agricultural category.

For these two categories we collected two types of data: the number of sites observed that were considered as problem sites, and the overall determination of sediment supply as mentioned above (Low, Moderate, Significant or Extreme).

3. **Adjacent uplands.** This process rated the uplands adjacent to the riparian zone on their apparent potential to generate sediment and to supply that sediment to the riparian zone. To do this we used parts of a system described in Pellant et al. (2000). That system was developed to determine rangeland condition. We borrowed parts of that system which indicate a site's tendency to produce overland flow and sediment movement. In our use, the field observer established two 50 meter reaches just outside the riparian zone. At these sites he recorded Low, Moderate, Significant or Extreme potential for sediment production indicated by eight different features (see descriptions in Pellant et al. 2000). After completing the data collection at the two sites, the observer used the 16 bits of data to assign an overall determination of sediment production in the uplands, using the same descriptive categories: Low, Moderate, Significant or Extreme.

Sediment production in the nearby uplands may strongly indicate sediment delivery to the riparian zone, but it does not necessarily indicate sediment delivery to the stream since a primary function of riparian zones is to filter sediment. In general we did not assess polygon-wide filtering ability of the riparian zones as we assumed upland sediment production was generally reflective of the amount of sediment delivered to the stream. In a few polygons which were flanked by wide agricultural fields we did assume significant sediment filtering by the fields and our recorded overall upland sediment assessment was slightly better that the uplands themselves indicated.

In addition to indicating sediment production potential, the upland determinations partially indicate general upland condition, which is the primary focus of the Pellant et al. (2000) methodology.

**Results and Discussion.** Table 8 presents an overview of the determinations for the sources of sediment production in the polygons grouped by functioning condition categories. Of the three sources, channel/riparian is the most problematic as nine of the 16 polygons were rated as providing or having the potential to provide Significant amounts of sediment to the stream. This is not unexpected, nor does this statistic alone indicate that there are sediment problems in those polygons. Channels in dry climates, in deposited materials, especially on alluvial fans are often inherently unstable, and the banks and nearby riparian areas often do not have heavy vegetation cover (see pages 22-38). It is common for sediment to move into these streams and then be re-deposited on the banks or floodplains, or partially stabilized as channel bottom materials. At the same time there can be excessive sediment movement or availability which indicates less than desirable conditions. Table 8 also shows the results of the functioning condition assessment for the polygons. Note that of the nine polygons assigned the Significant category for sediment, seven were considered to be in Functional—At Risk condition (the second of three functioning condition categories) while only two were assessed as Proper Functioning Condition (the highest condition category).

The field observer noted several times in polygons with significant channel/riparian sediment sources that the channel in the polygon was commonly incised. Incised channels often have poorly vegetated banks which receive significant erosive energy from the stream in high flows. Those streams are less able to access the floodplain where energy is dissipated in relatively benign manners, than are non-incised streams. In a recently published book *Great Basin Riparian Ecosystems* (Chambers and Miller, 2004) varying contributing authors argue that incised or down cut streams and riparian zones in central Nevada, in environments similar to some found in the Alvord Lake Sub-basin, are a natural phenomena related more to historic climate change rather than to recent influences of various types following European settlement and use of the landscape. So while stream down cutting and incision, plus the resulting sediment production are not desirable conditions, they should not always be considered as un-natural or human-caused events.

A rating for Agricultural causes of sediment were only determined for six of the 16 polygons (Table 8). In the other 10 polygons dispersed livestock grazing was the only agricultural activity and it was not considered a cause for this category. The assumption is that if there is grazing-caused sediment production it would be shown in the channel/riparian and/or the upland determinations. Concentrated livestock grazing was considered as a cause for this category. Of the six polygons rated for this category, five were rated as having Low sediment production potential and one was rated as having Significant potential. Four of those polygons had active irrigation systems (diversions, ditches and flood irrigation). In all of those cases the irrigation return flow was observed and/or assumed to be quite free of sediment (due to timing of the inventories, irrigation was not occurring in all of the places it commonly is practiced, so assumptions were made in some instances.) Where observed, return flow was quite clear of sediment, evidently due to the vegetation which has grown into the flow pathways the water follows through the fields. The vegetation, even after being cut as hay, effectively filters sediment, keeping it in the fields and mostly out of the channel. A few places were observed where the returning water had down cut and made small gullies, but even those were often well-vegetated and were apparently not large sediment sources.

Concentrated livestock use was recognized as a problem in one polygon. Some areas which had significant livestock use were also quite dry and it was difficult to determine the relative effects of livestock use and the effects of the banks and adjacent floodplains being naturally well-drained and consequently not able to support stabilizing vegetation. In many of those questionable situations which had obviously weak banks or other sediment supplying situations, the field observer allocated the potential source problem to the channel/riparian category rather than to the effects of concentrated livestock in the Agricultural category.

The sediment source ratings for the Uplands were generally favorable. Three of the 16 polygons were assigned the Low source determination, while the other 13 were assigned the Moderate determination. In the 16 polygons, the ratio of Moderate to Low was similar in the proper functioning condition polygons (5 to 1) and in the Functional—At Risk polygons (4 to 2). Table 8 also shows any of the eight assessed features at the 32 sites (16 polygons, 2 sites each) which were individually assigned a rating of Significant or Extreme as indicators of potential or past sediment production. Polygons ranged from having no features to five of the eight features considered to indicate Significant or Extreme sediment availability (data not shown). The average is slightly over two features recorded per polygon. In most cases (82% —data not shown) the features were assigned the Significant or Extreme assessment at only one of the two sites. In fact there was an average of slightly less than three features marked of the possible 16 for each polygon (eight features times two sites). The most commonly recorded features were bare ground, erosion-prone soil, and vegetation effects (mostly due to undesirable amounts of annual plants.) It is important to understand that just because one or two of the individual features may alone indicate a possible source of sediment production, they do not necessarily indicate a definite source. For example, even though a higher than usual amount of bare ground at a site may be a warning sign of potential problems, if the other seven factors all appear in good condition, the overall site evaluation would likely be favorable.

In general the uplands appeared in good condition at the 32 sites assessed adjacent to the 16 inventory polygons. Most of the problems observed related to bare ground which is a common feature in these generally low elevation, semiarid rangelands.

Overall the channel/riparian sediment source category appears to supply the most sediment of the three general sediment sources assessed. Agricultural and upland sources for the inventoried reaches appear not to be major concerns.

**Table 8. Riparian Polygon Sediment Source Assessments**

| Functioning condition categories, number of polygons, and total miles of streams in each category. | Channel/ Riparian[1] | Agriculture[1] | Uplands[1] | Specific Upland Features[2] |
|---|---|---|---|---|
| Proper Functioning Condition<br>6 polygons, 4.8 miles total | Significant—2<br>Moderate—3<br>Low—1 | Low—1<br>N/A—5 | Moderate—5<br>Low—1 | Rills—1<br>Water flow patterns—1<br>Pedestals—1<br>Bare ground—4<br>Gullies—1<br>Erosion prone soil—4<br>Vegetation effects—3 |
| Functional—At Risk Trend Not Apparent<br>10 polygons, 12.2 miles total | Significant—7<br>Moderate—2<br>Low—1 | Significant—1<br>Low—4<br>N/A—5 | Moderate—8<br>Low—2 | Water flow patterns—1<br>Terracettes—2<br>Bare ground—7<br>Gullies—2<br>Erosion prone soil—5<br>Vegetation effects – 5 |

[1]See the text for descriptions of the channel/riparian, agriculture and upland sediment sources. The values indicate the number of polygons each categorization was assigned in the polygons with that functioning condition rating.

[2]The specific upland features listed were assigned a rating of Significant or Extreme at least once in the 16 polygons. The values indicate the number of times each was assigned Significant or Extreme in the 32 determinations (i.e. 16 polygons, two ratings in each.)

## Stream Sediment from Adjacent Roads

Roads can supply sediment to streams at various types of crossings such as bridges, culverts and fords, and they also can be a sediment source where directly adjacent to the stream. In the next section of this report we described our efforts to assess the amounts of sediment supplied to sub-basin perennial streams at crossings. Here we do the same for roads running alongside perennial streams.

We used 7.5 minute USGS maps to delineate potential locations where roads appeared to run adjacent to perennial streams in the Alvord Lake Sub-basin. We ultimately assessed eight of those sites. At the 7.5 minute scale it is not possible to always tell how close the road actually is to the stream and some on-site inspections revealed that the road had no potential effect on stream sediment either by virtue of its distance from the channel or due to the road no longer being used by vehicle traffic. There were 5 additional sites we had hoped to assess but did not. Four were inaccessible due to considerable snow fall at high elevations in the sub-basin early in the fall of 2004 and one was behind a private land which was closed to our passage.

There are a variety of ways roads can impact a stream’s sediment load. The most obvious way is when road sediment moves directly to the stream. Less obvious are when the road’s placement is such that it reduces the sediment filtering capacity of the riparian zone along the stream or when the road affects the riparian zone or channel itself to a degree that the channel is less stable and more prone to sediment producing geomorphologies (i.e. channel straightening, channel incisement, etc.).

As our main tool to assess the reaches, we developed a list of six ways (called “factors” below) in which a road may affect stream sediment amounts. The observer’s task was to note all of the listed factors that applied to each site and to subjectively rate and discuss each. The factors in the list, which are discussed below, are not exclusive of each other (e.g. when is loose sediment on a road shoulder best described as a sediment problem, a drainage problem, a stability problem, etc.) To deal with these over-lapping point-of-view situations, the observer marked all possibly applicable factors, but rated and described the circumstances in manners that did not overly dramatize the situation by listing several factors all with very poor assessments.

The following are the types of data collected at each site. Note that the six factors listed in the fourth item are the focus of the following Results and Discussion section. The completed field forms with all of the data are being returned to the appropriate county road departments and/or Bureau of Land Management offices.

- Administrative information: (stream name, reach number, date, location information)
- Reach description: continuous or discontinuous, length
- Road surface materials: native, gravel, paved, other
- Construction geometry: cut and fill slopes, two fill slopes, road at natural valley level
- Stream sediment producing factors. Each of the applicable factors was assigned a subjective determination of the potential sediment supplied to the stream using the following descriptors: Low, Moderate, Significant, or Extreme. The observer also described each applicable situation in text and made an overall subjective determination of the total effect of all factors.
    - Road surface sediment
    - Road stability problems
    - Road drainage problems
    - Road proximity to channel: data collected for horizontal and vertical distance, slope angle
    - Road restricting channel meandering
    - Road restricting riparian width
- Fill slope materials: size classes and amounts, stability and reason (material sizes and cohesiveness, and vegetation)
- Road and ditch drainage features and comments: water bars, drain dips, grade, culverts (adequate, inadequate, placement, condition, functioning or not, and reasons)
- At least one photo was taken and its scene was described
- General comments on topics partially discussed with the data mentioned above and on any topic that added perspective to the overall sediment supply determination.

**Results and Discussion.** Table 9 shows the assigned ratings of the six individual road factors and the overall rating for the eight assessed road segments. Factors with no assigned rating (blanks) were considered to not have any potential effects on stream sediment supply for that location.

Five of the eight reaches were assigned an overall rating of Low, and there is little effect in those situations by the road on the stream sediment supply. Four of those five did not have even a single factor that was rated as severe as Moderate.

The other three reaches were assigned overall ratings of Moderate and all three of those had one individual factor rated as Significant, and all other factors were rated as either Low or Moderate.

Despite their overall ratings of Moderate, the Little Cottonwood Creek and Colony Creek road segments are not situations of major concern. Both of these surveyed reaches are relatively short (<0.5 miles) and both are just above the streams flowing into irrigation systems. The much longer, un-impacted stream reaches in which stream sediment would be of greater concern are above the assessed segments on these two streams.

There are a variety of problems associated with the Trout Creek segment making it the most problematic road/stream sediment situation in the sub-basin. Whitehorse Ranch Lane, a major county road runs next to Trout Creek for approximately 2.2 miles in a relatively confined canyon. There are reaches within that length where the road is immediately against steep canyon walls and the creek is immediately adjacent to the road on the other side. In the worst of these locations the road is actually narrower than average, allowing little room for the construction of berms on the road shoulder to restrict runoff. Additionally, bed rock under the road in places restricts grading of the road toward hillside ditches which could be another potential solution to some of the problems observed.

There are many places in the segment where unvegetated gravel banks run from the road edge to the stream edge. Even where there is a well developed berm to restrict water from running off the road, materials can often move down the outside of the dry and mostly unvegetated berm onto the banks and then to the channel. While most of the banks are vegetated, some are bare and others do not have sufficient vegetation to restrict sediment movement. The berm is well constructed and maintained in much of the segment, but the mere acts of constructing and maintaining that berm certainly cause sediment to be pushed down off the banks and into the stream.

The channel and riparian zone is incised in much of the Trout Creek segment. This exacerbates some of the road-related problems as the stream is not currently able to develop meanders and consequently move away from the road in at least parts of the reaches. The riparian zone is also narrow and its surfaces adjacent to the stream are steep. It has only a limited capacity to trap and hold sediment coming off the road edge and berm above. Fortunately, the riparian zone is generally in good condition in much of the reach, lessening the effects of the impacts described above. Another mitigating factor in the reach is that beavers are currently present and have dammed part of the stream length. Not only do those dams trap sediment improving water quality, in the long term they also are raising the stream level, thus reducing the depth of stream and riparian zone incision. The field observer noted that one dam in the reach was five to six feet high.

Overall the Trout Creek reach was rated as Moderate in its potential sediment supply effect. To make that determination the length of the reach was considered, and the severity of the observed problems was tempered by the length of the stream and road which were assessed. If the same set of problems were seen in a significantly shorter length the situation would have warranted a more severe assessment.

Roads running along perennial streams do not appear to be major sources of sediment in the sub-basin. The situation on Trout Creek with the Whitehorse Ranch Lane is certainly the most problematic. The problems there are numerous, but are spread out over two miles of road length. Beaver activity in that reach appears to be at least partially mitigating both short and long term negative effects of the sediment supplied by the road to the creek.

**Table 9. Road/Stream Sediment Assessments**

| | FACTORS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Stream/Reach** | **Proximity of Road to Channel** | **Sediment from Road Surface** | **Road Stability** | **Road Drainage** | **Road Restricting Meandering** | **Road Restricting Riparian Width** | **Overall Effect** |
| Little Cottonwood Creek | Moderate | Significant | Moderate | Moderate | Moderate | Moderate | Moderate |
| | | | | | | | |
| Willow Creek – Pueblo Mountains | Low | Low | Low | Moderate | | | Low |
| | | | | | | | |
| Pass Creek | | Low | | Low | | | Low |
| | | | | | | | |
| Van Horn Creek | Low | Low | | | | Low | Low |
| | | | | | | | |
| Colony Creek | Moderate | Moderate | Significant | Moderate | Low | Low | Moderate |
| | | | | | | | |
| Trout Creek | Moderate | Significant | Moderate | Low | Moderate | Moderate | Moderate |
| | | | | | | | |
| Little Whitehorse Creek | Low | Low | | | Low | Low | Low |
| | | | | | | | |
| Willow Creek – Trout Creek Mountains | Low | Low | Low | Low | Low | | Low |

See the text for descriptions of the factors and the overall effect, plus the way they were rated.

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## Stream Sediment from Road Crossings

Road crossings are a potentially major source of perennial stream sediment. The sub-basin is a large area ~2000 square miles), but due to it being dry (only ~486 miles of perennial streams) and not heavily roaded, the total number of potential road crossings of USGS mapped perennial streams is relatively low. We assessed 22 of these crossings which were either on public lands or private lands on which we were allowed to work. There were approximately 15 potential crossings not assessed which were inaccessible due to considerable snow fall at high elevations in the sub-basin early in the fall of 2004. The number of those crossings is not exactly known as the available maps had scales which did not allow precise determination of crossings where roads ran in the canyon bottoms. Also, two public land crossings at relatively low elevations were not accessed as they were behind private land we did not have permission to cross.

Three types of crossings were assessed: bridges, culverts and fords. Two sites had both a bridge and a culvert or a ford. Fords are crossings with no structures—they are crossed by driving through the stream. Fords are relatively common in semi-arid rangelands which have only dispersed use and relatively long histories of settlement. They are found mostly on stream reaches with low flows and which have relatively small bank and stream bottom materials which are relatively stable.

The data collected individually for each type were the following:

**Bridges**

- Construction materials and condition of decks, stringers and abutments
- Opening size—height X width—and whether the opening appeared adequate for apparent flows, plus evidence if it appeared inadequate.

**Culverts**

- Shape: round or arched
- Size: diameter or height X width, and whether it appeared adequate for apparent flows, plus evidence if it appeared inadequate, length
- Corrugated or smooth construction
- Condition: good, plugged, crushed, corroded, etc.
- Correct alignment to channel
- Correctly installed on or below streambed grade
- Channel differences (substrate and channel geometry) above and below culvert, and significance
- Adequate inlet and outlet armoring
- Adequate energy dissipation at outlet

**Fords**

- Amount of materials in channel and on immediately adjacent banks by size classes (clay/silt, sand, gravel, cobble, bed rock)
- Stability
- Materials moving from road surface to channel

Additionally we collected the following information or performed the following at all sites:

- Administrative information (stream name, crossing number, date, location information)
- We rated and discussed sediment potential from outside the channel for:
    - cutbank ditches and whether they were adequately drained and filtered
    - road surfaces and whether they were adequately drained and filtered
    - fill slopes and whether they were adequately stabilized

- We made a subjective determination of the overall sediment supply to the stream using the following descriptors: Low, Moderate, Significant or Extreme.
- We took at least one photo and described its scene.
- We recorded general comments on topics partially discussed with the data mentioned above and on any topic that added perspective to the overall sediment supply determination.

**Results and Discussion.** Table 10 shows the determinations of the overall sediment supply for the 22 crossings in five categories—fords, bridges, culverts, a bridge and culvert together, plus a bridge and ford together. Of the 22 crossings, 12 were assessed as supplying Low amounts of sediment to the channel, eight were assessed as supplying Moderate amounts and two were assessed as supplying Significant amounts. In general these crossings do not appear to be major sources of sediment to the perennial streams in the sub-basin.

At first thought, fords would seem to have the greatest potential for sediment production among the three main types. But that does not appear to be true at this point in time. There were 11 assessed crossings which were exclusively fords (see the discussions below of a crossing with both a ford and a bridge). Six of these 11 were assessed to supply Low amounts of sediment and five were assessed to provide Moderate amounts. In many cases the angles and heights of the banks at the crossing were quite similar to the adjacent non-used banks. This is after decades of apparent use. In other cases banks have retreated and flattened over the years––some to the extent that they appear to no longer provide as much sediment as they once probably did. Most fords do not have a well vegetated road surface on either side of the stream. The few that are reasonably well vegetated benefit from both the added stability and the filtering of sediment that the vegetation provides.

Two assessed crossings exclusively had bridges and two others had a bridge and either a culvert or a ford. In all four situations only Low amounts of sediment appeared to access the stream at the crossings.

Seven assessed crossings exclusively had culverts. Two were rated as providing Low amounts of sediment to the streams, three were rated as providing Moderate amounts, and two were rated as providing significant amounts. The two culvert crossings providing significant sediment had the following common features:

- They are both on a well-used county road which receives regular maintenance.

- Both culverts appear too short, as one or both ends of each are essentially at the bank faces. Sediment can drop directly into the culvert openings from above, or from the sides. The culvert at one site is mis-centered with the road, as there is about three feet of culvert outside of the bladed road on one end and essentially no culvert outside of the bladed road on the other end.

- The gravel berms along the edge of the road which can potentially restrict water flow and sediment movement into the channel were in poor condition right at the crossings when the assessment was performed. One berm ended at the crossing and due to road grade, about 100 foot length of road surface drained directly into the channel, rather than into the ditch which could have potentially trapped some sediment.

- The banks are in general, poorly vegetated at the culvert openings.

- One culvert is relatively new, but the other is quite old and in poor condition. That culvert has a hole in the top (probably caused by the road grader) toward the edge of the road. Loose sediment certainly falls through that hole every time the road is graded, and also with some use by regular vehicles.

- Both culverts seemed to possibly be undersized for the potential high flows of their drainage basins.

A mitigating factor about the potential problems caused by the sediment provided to the streams at these two crossings is that the water just below each enters into private land irrigation systems. In contrast, above the road in each case the creeks run through largely unimpacted wildlands. Both streams are salmonid bearing (Lahontan cutthroat trout) and for both the bottom of the salmonid bearing reach (as determined and reported in the Oregon TMDL) is considered to be the county road at the crossing. Sediment accessing the streams at these crossings should then not affect the state-defined, beneficial downstream uses.

Another mitigating factor concerning the long term effects of these two culverts is that they are both on a road which will be paved in the next several years. The paved road surface will reduce the amount of maintenance and the amount of sediment potentially pushed into the stream from those maintenance activities. In addition, that construction will be a chance for the county to upgrade the culverts to new ones which are in better condition, and which are longer and possibly of greater diameter.

As mentioned, these crossings do not appear to be a major source of sediment to the perennial stream reaches in the sub-basin. Besides the mentioned two crossings with Significant sediment production, there are also several other situations where the streams flow into irrigation systems not too far below the assessed crossings. Except for a few situations, there appears to be little for land managers to be concerned with related to stream crossings in the sub-basin. We will return to the respective land managers (BLM, county road departments, and private land owners) the data sheets and photos for each site.

**Table 10. Road Crossing Sediment Assessments.** The numbers indicate the number of polygons assigned that rating for each crossing type.

| Crossing Types | Overall Sediment Assessment Rating |
|---|---|
| Ford | Moderate – 5<br>Low – 6 |
| Bridge | Low – 2 |
| Culvert | Significant – 2<br>Moderate – 3<br>Low – 2 |
| Bridge & Culvert | Low – 1 |
| Bridge & Ford | Low – 1 |

See the text for descriptions of the crossing types and the way they were rated.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Stream sediment is an important watershed attribute which appears to not have been addressed in prior Alvord Lake Sub-basin research. Excessive sediment can impact fish populations in a variety of ways. Understanding the probable sources of sediment is important to land managers, biologists and others interested in maintaining viable fish populations. A majority of road crossings and locations where roads are directly adjacent to perennial streams in the sub-basin were assessed for this project. HCWC feels that road/stream interfaces are not a major source of stream sediment in the sub-basin.

In contrast to the road/stream interfaces, HCWC inventoried only a small portion of the perennial streams in the sub-basin, but from the limited data it appears likely that stream channels and adjacent riparian zones are the major source of stream sediment. The relative contributions of natural vs. human-induced sediment production sources were not rated, as those determinations are difficult. General riparian health (or functioning condition) is often used as a first indicator of the probable sediment production. HCWC feels land managers and private land owners would be best served to focus on general riparian health as a way to assess and manage sediment levels and production sources.

**Issues, concerns and action items.**

- Encourage land owners and land managers to maintain riparian areas in proper functioning condition to assure low levels of human-induced sediment to enter perennial streams.
- Encourage various government entities, land owners and land managers to maintain road crossings and roads adjacent to streams in a condition that minimizes sediment entering the channel.
- Educate the public of natural watershed attributes and human-induced situations which result in sediment moving in the system.

# HCWC FIELD WORK—RIPARIAN INVENTORY DATA

**Information sources and authors**

The text for the following section on riparian inventories was written by HCWC, from data we collected on private land for this watershed assessment.

HCWC performed riparian inventories and assessments as part of the field work for this project. The main work we completed for this watershed assessment was riparian inventories. The inventories were performed only on perennial stream reaches on private ground. To collect the inventory information, the field observer divided the streams into reaches called polygons. One complete set of inventory data was collected for each polygon. In most situations, the polygons extended between obvious starting and stopping locations, such as ownership boundaries, stream confluences and/or the entrance of the stream into irrigation systems (ditches). In other cases polygon boundaries were placed at management boundary locations (fences) within private ground and in one case a boundary was subjectively placed in the middle of a long private piece of a stream solely to divide it into two polygons. Besides having a measurable length (determined from mapping software), the polygons had widths which were the distance between the riparian/upland boundaries on each side of the stream. The width varied throughout any one polygon and an average width for the polygon was estimated.

Each polygon was inventoried by walking its length twice. Most field-collected data was subjectively determined, i.e. estimates or interpretations were made, rather than taking any type of measurements.

A functioning condition assessment similar to that developed and used by the BLM (TR 1737-15, 1998) was performed as part of each inventory. We followed the methodology guidelines for assessing proper functioning condition (TR 1737-15, 1998), except for the fact that a team was not assembled for the field work. The budget for the overall watershed assessment did not allow having a multi-member team working in the field. Instead, one observer performed the assessments with the inventories. That observer has 15 years experience in performing riparian inventories and 13 years experience performing different types of riparian assessments. Much of that past experience was in areas relatively close to the Alvord Lake Sub-basin—in southwest Idaho and other southeast Oregon locations. Also, those earlier inventoried riparian zones have similar vegetation, stream types and functioning attributes as do the riparian zones inventoried for this project.

For each polygon, the following information was collected in the following four information types:

1. **Administrative Information**
   - Stream name, polygon number, date.
   - Location information: GPS and legal (township, range) data.
   - Riparian width information: polygon average, width range (minimum and maximum widths).
   - River miles were determined in the office with mapping software.
   - Polygon size was determined from the average width and the length.

2. **Riparian Vegetation Information**
   - Riparian vegetation types, percent of the polygon area for each type, disturbance-induced determinations, comments.
   - Plant group canopy covers by layers for two main vegetation types and by other groups, comments.
   - Bare ground for the two main vegetation types, locations, apparent causes.

- Tree and shrub regeneration, age-class presence and absence, potential vegetation for the reach, comments.
- Noxious weeds observed, locations and areas inhabited.
- Woody canopy cover providing stream channel shade, apparent on-going changes to shading, general characteristics.

3. **Stream/Hydrologic Sediment Source and Photo Information**
   - Rosgen geomorphology stream types and percents of channel length, energy dissipation mechanisms, discussions related to potential and management concerns.
   - Polygon-wide sediment source data (discussed on pages 74-77).
   - Adjacent upland sediment source and hydrologic function information (also discussed on pages 74-77).
   - Four to eight photos were taken and described, their GPS locations were recorded. One photo each was taken at the upstream and downstream ends of the polygons and the others were taken at varying locations.
   - General comments on the polygon were recorded.

4. **Functioning Condition Assessment Information**
   - Seventeen characteristics were assessed in three categories (Vegetation, Hydrology and Erosion/Deposition).
   - A Summary determination was made and various notes were recorded.
   - Comments tying the assessment information and the other inventory information were recorded.

The primary goal of the riparian inventories was to provide the participating landowners specific information about their riparian zones. The data, assessments, photos and resulting maps were returned to the landowners with various explanatory documents detailing the data, its collection and its meaning.

A secondary goal of the riparian inventories was to provide general data for this watershed assessment. The riparian inventory data presented here and in other parts of this watershed assessment is much more general in nature than was returned to the landowners for their specific reaches. Also, there is much less discussion here of data collection methodologies, the meaning of the data, etc. Instead we present here only summaries of that data, with general comments on its possible overall implications.

Readers should understand that these inventories were performed on only a small portion of the perennial stream riparian zones in the sub-basin (17.0 of the recorded 485 miles). As such they should not be considered as being representative of the sub-basin in general. The Bureau of Land Management (BLM) which manages the vast majority of land in the sub-basin (82%) which encompasses the vast majority of perennial stream miles (70%) ***has not*** routinely performed riparian inventories similar to these on the lands they manage. However, the Burns District BLM has performed similar functioning condition assessments (TR 1737-15, 1998) and the Vale District has performed other types of riparian trend assessments on most of the public land perennial stream miles in the sub-basin (see pages 18-21.)

The readers should also remember that to gain the private landowner participation in these efforts HCWC agreed that private land data collected for this watershed assessment would not be reported in a manner which indicated its location.

There were a total of 16 polygons inventoried, with a combined length of 17.0 miles for an average length of slightly less than 1.1 mile per polygon. The shortest polygon was 0.5 miles long, the longest was 2.1 miles. The 17.0 miles of stream length comprised 75.1 acres of associated riparian zones.

## Riparian Vegetation Types

Thirty six different riparian vegetation types were recorded in the 16 polygons. Five of the 36 types were tree dominated, 11 of the 36 were shrub types, 15 were graminoid (grasses and grass-like herbaceous plants) types and five were forb types. Table 11 names and gives the overall percent cover and the occurrence of the 13 most common of these types, each of which covered at least 1% of the total inventoried acres. Also listed in Table 11 are the species for which the other recorded types are named. Those other types each had less than 1% total cover in the 16 polygons.

> ***Note:*** There was no published classification of riparian vegetation types specifically for this region in Oregon at the time of the inventories. So, the vegetative communities observed here were named after types described in two classifications--one for riparian zones of Nevada (Manning and Padgett, 1995) and one for the riparian zones of Montana (Hansen et al., 1995). The field observer has seven years experience performing riparian inventories in the nearby Owyhee country of southwest Idaho and in other portions of the Vale BLM District. He used this combination of systems in those two areas for that time period. Both of these two classifications are reasonably comprehensive for the riparian vegetation of southeast Oregon and southwest Idaho. In combination they are essentially complete for these areas.

Shrubs and trees were the dominant riparian vegetation in the polygons, with vegetation types of these two groups covering approximately 88% of the area (Table 11). Types named for four willow species (*Salix lasiandra* [Pacific willow], *Salix lutea* [yellow willow], *Salix exigua* [sandbar willow] and *Salix lasiolepis* [arroyo willow]) covered 64% of the area. The other major type was the *Populus trichocarpa/Salix* (black cottonwood/willow) Community Type which covered an additional 16% of the area. The remaining 20% of the area was covered by 31 types of all four plant groups, each of which covered 3% or less of the acres.

As in their total covers, shrub types were the most common vegetation types recorded in the sixteen polygons. All five of the shrub types with >1% total cover were recorded in at least eight of the 16 polygons, and four of those were recorded in at least 12 of the 16. Various graminoid types were also recorded quite frequently (Table 11).

Despite the earlier admonition to readers to not assume our inventory data is reflective of the sub-basin in general, our types list developed in these 16 polygons is probably quite complete for the riparian zones in the sub-basin. This list contains all except two of the species named to represent vegetation communities in the Alvord Lake Sub-basin in the Oregon TMDL. In the Oregon TMDL (see pages 39-45) the Oregon DEQ divided the sub-basin into four ecological provinces and those provinces into three to five elevation zones each. For each zone in each province they list the one to seven plants, or plant groups (i.e. willow) that dominate the riparian zones. Their list has only two species not recorded in these 16 polygons. Both of those species are generally found in higher elevations than inventoried for this watershed assessment on private lands.

This list also contains most of the species for which major riparian vegetation types were recorded by the same field observer on several hundred miles of stream in past inventories in the nearby Idaho Owyhee country, the Bully Creek drainage in the Vale, Oregon BLM District, and on three streams on the southwest flank of the Steens Mountain west of the sub-basin.

**Table 11. Riparian Vegetation Types, Source, Percent Cover and Occurrence in the 16 Polygons.**

| Vegetation Types[1] | Source[2] | Percent Cover[3] | Occurrence[4] |
|---|---|---|---|
| Trees | | | |
| *Populus trichocarpa/Salix* (black cottonwood/willow) Community Type | NV | 16 | 6 |
| *Populus tremuloides/Salix* (quaking aspen/willow) Community Type | NV | 2 | 1 |
| *Populus trichocarpa/*Recent alluvial bar (black cottonwood/recent alluvial bar) Community Type | Both | 1 | 3 |
| Group Cover | | 19 | |
| Shrubs | | | |
| *Salix lasiandra* (Pacific willow) Community Type | MT | 28 | 12 |
| *Salix lutea* (yellow willow) Community Type | MT | 17 | 12 |
| *Salix exigua* (sandbar willow) Community Type | MT | 16 | 14 |
| *Salix lasiolepis/*Bench (arroyo willow/bench) Community Type | NV | 3 | 8 |
| *Rosa woodsii* (woods rose) Community Type | Both | 3 | 12 |
| Group Cover | | 67 | |
| Graminoids | | | |
| *Carex nebrascensis* (Nebraska sedge) Community Type | Both | 3 | 4 |
| *Juncus balticus* (Baltic rush) Community Type | Both | 3 | 10 |
| *Agrostis stolonifera* (redtop) Community Type | Both | 2 | 10 |
| *Phalaris arundinacea* (reed canarygrass) Community Type | MT | 1 | 3 |
| *Poa pratensis* (Kentucky bluegrass) Community Type | Both | 1 | 10 |
| Group Cover | | 10 | |

Other types named for the following species were recorded; each had less than 1% total cover of the 16 polygons[1]

Trees (Total Cover = <1%): *Populus tremuloides* (quaking aspen) and *Juniperus occidentalis* (western juniper).

Shrubs (Total Cover = ~1%): *Alnus incana* (mountain alder), *Cornus stolonifera* (red-osier dogwood), *Prunus virginiana* (common chokecherry), *Salix lemmonii* (Lemmons willow), *Artemisia tridentata* (big sagebrush) and *Prunus emarginata* (bitter cherry).

Graminoids (Total Cover = ~2%): *Agropyron smithii* (western wheatgrass), *Carex utriculata* (beaked sedge), *Distichlis spicata* (alkali saltgrass), *Eleocharis palustris* (common spikesedge), *Scirpus pungens* (sharp bulrush), *Agropyron* spp. (wheatgrass), *Alopecurus pratensis* (meadow foxtail), *Carex* spp. (sedge), *(Juncus ensifolius* (dagger leaf rush) and *Phleum pratense* (common timothy).

Forbs (Total Cover = <1%): *Typha angustifolia* (lesser cattail), *Berula erecta* (cut-leaved water-parsnip), *Equisetum arvense* (field horsetail), *Rorippa nasturtium-aquaticum* (water-cress), *Trifolium* spp. (clover) and unidentified species.

[1]Vegetation types which covered 1% or more of the total area (75.1 acres in 16 polygons) are listed in the upper section of the table. Species for which types were recorded for less than 1% are listed by plant groups in the lower section.
[2]The source is the riparian classification system (Montana, Nevada or Both) where the listed vegetation type is described—see the text.
[3] Percent cover is the percent canopy cover within the entire 75.1 acres of riparian zones assessed.
[4]Occurrence is the number of polygons (of 16) in which the type was recorded.

## Rosgen Stream Geomorphology Types

Table 12 shows the Rosgen (1994) channel geomorphology types recorded in the 16 inventoried polygons. In the Rosgen system, a letter/number code is used to signify stream geomorphology. Capital letters (A through G) indicate the general channel shape (width and depth), plus their confinement, and in the case of D channels if they have multiple channels. The numbers 1 through 6 represent the average particle size of the channel bottom and immediate banks with 1 indicating bedrock and 6 indicating silt and clay. The numbers 2 through 5 indicate boulders, cobbles, gravel and sand, respectively. The final small letters (and the plus symbol (+) with the small ‘a’ for A streams) are indications of gradients different (steeper or less steep) than the common gradient for a given stream.

In short A, B, C and E channels are usually considered desirable when found in certain settings. D channels, which have multiple stems, are usually considered unstable, consequently undesirable in most settings. F and G channels both indicate streams that are downcut or incised more than expected for a site and are consequently often assumed to be indications of degradation. Remember, the statements just made are generalizations, but for the most part those generalizations appeared true to the field observer while on these sites.

The A, B, C and E channels accounted for 71% of the inventoried stream lengths in the project, while the D, F and G streams accounted for the another 24% (Table 12). Beaver ponds are not a Rosgen designation, but were recorded for 6% of the length of the inventoried channels.

Rosgen F and G streams are generally considered to be undesirable and they are often thought to be the result of human influences. In contrast, contributing authors and editors of a recent book, Great Basin Riparian Ecosystems (Chambers and Miller, 2004) argue that downcut streams in central Nevada in settings similar to the many parts of the Alvord Lake Sub-basin, are often the result of historic climate change, and not necessarily the result of human influences.

**Table 12. Rosgen Channel Types and Lengths in the 16 Polygons.** The Rosgen (1994) system codes are briefly explained in the text. Each stream type, plus beaver ponds, recorded in the 16 polygons are listed in the first column. The percent of the total 17.0 miles of inventoried stream is listed for each type in the second column.

| Rosgen Types | Miles (in 16 Polygons) | Percent of Total Length |
|---|---|---|
| | | |
| A2 | 0.2 | 1 |
| A2a+ | 0.1 | <0.5 |
| A3 | 0.5 | 3 |
| A3a+ | 0.2 | 1 |
| A4 | 2.3 | 13 |
| A4a+ | 0.4 | 2 |
| Total | | 21 |
| | | |
| B1 | <0.1 | <0.5 |
| B3 | 0.1 | 1 |
| B3a | 0.1 | 1 |
| B4 | 1.9 | 11 |
| B4a | 1.5 | 9 |
| B4c | 1.5 | 9 |
| B6c | 0.1 | 1 |
| B6c | 0.4 | 2 |
| Total | | 33 |
| | | |
| C4 | 1.1 | 7 |
| C4b | 0.2 | 1 |
| C6 | 0.5 | 3 |
| Total | | 11 |
| | | |
| D3b | <0.1 | <0.5 |
| D4 | 0.1 | 1 |
| D4b | 0.3 | 2 |
| Total | | 3 |
| | | |
| E3b | 0.0 | <0.5 |
| E4 | 0.7 | 4 |
| E4b | 0.2 | 1 |
| E6 | 0.1 | 1 |
| Total | | 6 |
| | | |
| F3 | <0.1 | <0.5 |
| F4 | 1.4 | 8 |
| F4b | 0.2 | 1 |
| F6 | 1.1 | 7 |
| Total | | 16 |
| | | |
| G2 | 0.1 | <0.5 |
| G3 | 0.1 | <0.5 |
| G4 | 0.2 | 1 |
| G4c | 0.3 | 2 |
| G6c | 0.2 | 1 |
| Total | | 5 |
| | | |
| Beaver ponds | 1.0 | 6 |
| | | |
| **Totals** | **17.0** | **~100** |

## Other Inventory Data

Table 13 shows the bare ground and various types of vegetation information lumped by functioning condition categories in the 16 polygons. Brief explanations of the recording of the data for the various listed factors are given in the Table 13 footnotes. Overall, the combined information in Table 13 is positive. Short summary statements of each data type follow (not all data is shown or discussed):

- There were six of the 16 assessed polygons considered to be in proper functioning condition. The other ten polygons were thought to be in functional—at risk condition and the trends for those were not apparent. For several of those ten, the observer recorded comments indicating that there was likely an upward trend, but the evidence was not strong enough to make that determination in the one time visit. In contrast, there were no polygons in which the observer felt there may be a downward trend.

- The bare ground situation in nine polygons appeared favorable (generally low amounts, natural causes, away from the immediate stream edges), in two polygons it was unfavorable and in six polygons it was judged as being neutral.

- There was adequate tree and shrub regeneration to replace existing mature vegetation in 14 of the 16 polygons. In many of those it was noted that there was adequate regeneration to expect increases in the tree and shrub cover. In one polygon there was inadequate regeneration and in one there were areas with significant regeneration, but there were also areas with essentially no regeneration where cover by large shrubs was definitely declining.

- Nine polygons had adequate representatives of all age classes of the major woody plants. Six did not and one polygon had large areas where this factor was both positive and negative. In many cases the observer noted that in the six polygons with missing age classes, it was mature plants which were absent, but younger plants appeared healthy enough to assume they would soon reach maturity.

- In eight polygons the vegetation appeared to be the natural potential vegetation for the reach, in the other eight the situations were not as easily assessed. In four of those other eight, the observed felt the vegetation was not the natural potential vegetation in most of the polygon (‘no’ replies) and in the other four the vegetation appeared to not be in significant parts of the polygon. In many of the specific locations which had vegetation other than expected, the vegetation present was not necessarily undesirable, but it lacked at least some of the positive functioning attributes that the field observer thought could exist with the natural potential vegetation.

- The average stream shading provided by woody vegetation was approximately 25% with a range from 3 to 70% in the 16 polygons. An average amount of shading across various Rosgen stream types and across various vegetation types is not necessarily an important number, as it cannot be effectively judged without further analysis. What is important for this group of polygons and the shading data is that shading was recorded to be increasing in ten of the polygons and static in the other six.

As mentioned the information in Table 13 is generally positive. Six of the 16 polygons were considered to be in proper functioning condition. Of the other ten, six had increasing stream shade—a factor usually indicating recent and ongoing successful regeneration and growth of woody vegetation. The bare ground situations in most polygons were favorable. The vegetation observed generally did not appear to be different than expected for the sites.

### Table 13. Functioning Condition, Bare Ground, Vegetation Information and Stream Shading.

| Functioning condition categories, number of polygons, and total miles of streams in each category. | Bare Ground[1] | Adequate Tree & Shrub Regeneration[2] | Age Classes[3] | Potential Vegetation[4] | Stream Shade Amount[5] | Shade: Static, Increasing or Decreasing[6] |
|---|---|---|---|---|---|---|
| Proper Functioning Condition<br>6 polygons, 4.8 miles total | Favorable—6 | Adequate—6 | Yes—4<br>No—2 | Yes—5<br>Both—1 | 20, 20. 20,<br>30, 50, 70<br>Average = 35 | Increasing—4<br>Static—2 |
| Functional—At Risk Trend Not Apparent<br>10 polygons, 12.2 miles total | Favorable—3<br>Neutral—4<br>Unfavorable—3 | Adequate—8<br>Both—1<br>Inadequate—1 | Yes—5<br>Both—1<br>No—4 | Yes—3<br>Both—3<br>No—4 | 3, 10, 10, 20,<br>20, 20, 20, 20,<br>20, 50<br>Average = 19.3 | Increasing—6<br>Static—4 |

[1]Bare ground responses of Favorable, Unfavorable, and Neutral are subjective determinations of the overall bare ground situation in each polygon, considering bare ground amounts, locations and apparent causes. The amounts, locations and causes were judged in respect to apparent overall functioning of the riparian systems in each polygon.

[2]Tree and shrub regeneration amounts were rated as Adequate, Inadequate or Both on being enough to replace the existing older tree and shrub amounts. Both was recorded in a polygon where there were distinct separate regions with Adequate and Inadequate amounts.

[3]Age class responses were Yes, No, or Both indicating the general presence or absence of all age classes of the major woody species in the polygon. Responses of Both indicate polygons generally with all age classes of the major woody species, but lacking important age classes of at least one common species in a relatively large polygon area.

[4]Potential vegetation responses of Yes indicate the presence of a suite of vegetation which appeared to generally be the natural potential vegetation of the site. No or Both responses indicate situations where the field observer believed the vegetation present for nearly the entire polygon (No) or a lesser, but significant part of it (Both) was the result of past human-induced disturbances.

[5]Stream shade amounts are percents (rounded to the nearest 10%, or in one case to 3%) of the bankfull channel which had vertical overhanging canopy cover by woody vegetation. The readings of the individual polygons are shown as is the average for all polygons in the functioning condition category.

[6]Stream shade was subjectively judged as being static, increasing or decreasing over time.

General comment for notes 1, 2, 3, 4, and 6: The values indicate the number of polygons each categorization was assigned in the polygons with that functioning condition rating.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

HCWC inventoried these private land perennial streams to provide an overview of stream and riparian zone features in the sub-basin. That information will be valuable to the landowners if they wish to perform long-term monitoring of their land as the data was collected for specific stream reaches. The information has value to others as it adds detail to riparian information that is already publicly available (for example in the Andrews FEIS, Vale FEIS, and Oregon TMDL) about the riparian zones of the sub-basin.

The condition of the inventoried riparian zones as shown by the collected data was considered to be generally positive by the field observer who has extensive experience in similar riparian areas in southeast Oregon and southwest Idaho. All of the inventoried reaches are parts of working cattle ranches and the overall good condition of these reaches should be encouraging to anyone who cares about the condition of the rangelands within the sub-basin.

**Issues, concerns and action items.**

- HCWC encourages the involved landowners and others in the sub-basin to use the demonstrated procedures or other procedures to establish monitoring of their riparian zones and uplands. Photo point documentation is the simplest, easiest and sometimes most informative monitoring possible.

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# Chapter 3 - Basin Characteristics

This chapter contains general information about the sub-basin, its climatic and physical features, plus the plants and animals which are considered native to the area. There is little focus on management concerns and watershed health issues. At the end of the chapter are separate descriptive lists of features and maps of the eight 5th field watersheds in the sub-basin.

***Cold, clear winter days are common, as is snow in the mountains, but snow at low sub-basin elevations usually does not stay throughout the winter.***

Photo courtesy of BLM

## CLIMATE

**Authors and information sources**

The text for this section was partially taken from the Andrews FEIS. Some was written by HCWC from general sources. The data in Table 14 is from the cited source.

Southeastern Oregon and the Alvord Lake Sub-basin are semiarid with most locations having annual precipitation between eight and 14 inches. The prevailing winds from the west bring maritime air from the Pacific Ocean, but that air dries as it rises over Coast and Cascade Mountain ranges. The north/south running Steens and Pueblo Mountains on the west edge of the sub-basin create a local rain shadow effect, intercepting even more moisture from the once maritime air. Local areas at the top of the Steens Mountain (9700 feet) receive 49 to 55 inches of precipitation, much as snow which falls from November through February. Lower elevations in the sub-basin to the east receive a great deal less precipitation (see the Whitehorse Ranch and Andrews weather records below). The accumulated deep snows at the top of the Steens Mountain often remain until mid-June, with some patches persisting year-around. The lowest sub-basin elevations generally do not have a winter-long snow pack. Localized flooding often accompanies spring snowmelt adjacent to the higher mountains.

There is abundant sunshine throughout the year, and that with the dry air, results in significant day and night temperature differences. Summer temperatures in the lower elevations can range from highs over 100 degrees Fahrenheit to night time lows below freezing. Frost may occur during any month of the year. Thunderstorms, occasionally accompanied by hail, typically occur each year over virtually every part of the area. High-intensity thunderstorms occur between April and September; storms during June or July are typically drier than those in August or September.

The prevailing winds are west-southwest, with the most intense winds during March and April. December and January are the calmest months.

The table below contains data from the two long-term weather stations which have been operated in the sub-basin. The Whitehorse Ranch weather station is still in operation, but the Andrews station last provided weather data in 1993. See the note below the Andrews data about the actual location of that station.

**Table 14. Whitehorse Ranch and Andrews Climate Data.** These two weather stations have produced the only official, long term weather data in the sub-basin.

**Whitehorse Ranch, Oregon (359290)**
**Monthly Climate Summary—Period of Record: 4/ 1/1965 to 12/31/2004**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (F) | 41.1 | 47.3 | 53.6 | 59.9 | 69.1 | 77.5 | 86.7 | 85.1 | 77.1 | 65.2 | 50.4 | 41.8 | 62.9 |
| Average Min. Temperature (F) | 19.6 | 22.9 | 27.0 | 30.6 | 37.7 | 44.8 | 51.0 | 50.1 | 42.0 | 33.4 | 25.7 | 19.6 | 33.7 |
| Average Total Precipitation (in.) | 0.61 | 0.59 | 0.80 | 1.00 | 0.85 | 0.61 | 0.22 | 0.68 | 0.50 | 0.58 | 0.78 | 0.69 | 7.91 |
| Average Total SnowFall (in.) | 2.1 | 2.2 | 2.0 | 0.8 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 1.3 | 2.0 | 10.7 |
| Average Snow Depth (in.) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Percent of possible observations for period of record.
Max. Temp.: 86.8% Min. Temp.: 86.4% Precipitation: 85.4% Snowfall: 82.6% Snow Depth: 79.4%
Note: This station is still operational, but the recorded period of record is the basis of the displayed data.

Table continued on next page.

**Table 14 (continued)**

**Andrews 7 NNE, Oregon (350189)**
**Monthly Climate Summary—Period of Record: 8/15/1969 to 3/31/1993**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (F) | 37.2 | 42.9 | 49.0 | 56.9 | 65.4 | 76.6 | 85.8 | 84.6 | 73.9 | 62.2 | 46.2 | 38.2 | 59.9 |
| Average Min. Temperature (F) | 22.4 | 27.1 | 31.2 | 36.2 | 42.5 | 51.4 | 59.3 | 58.9 | 49.7 | 40.6 | 30.6 | 23.6 | 39.5 |
| Average Total Precipitation (in.) | 2.04 | 1.79 | 2.09 | 1.55 | 1.18 | 0.99 | 0.51 | 0.73 | 0.94 | 1.08 | 2.39 | 2.47 | 17.76 |
| Average Total SnowFall (in.) | 10.7 | 7.6 | 3.4 | 1.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.1 | 1.3 | 7.4 | 13.9 | 46.2 |
| Average Snow Depth (in.) | 5 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 1 |

Percent of possible observations for period of record.
Max. Temp.: 99.1% Min. Temp.: 98.8% Precipitation: 99.3% Snowfall: 98.8% Snow Depth: 98.8%
Note: The Andrews weather station was not in the historic town of Andrews, but rather on the side of the Steens Mountain, 7 miles to the northeast of Andrews and 625 feet higher in elevation.

*Source: Western Regional Climate Center, wrcc@dri.edu*

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Climate and geology greatly influence the vegetation which will ultimately grow in any area. There are consequently significant implications to watershed functioning and health. The dry, desert-like nature of much of the sub-basin results in raw-appearing, stark landscapes. Natural bare ground is common in upland areas, and riparian zones are often naturally narrow and not well vegetated due to inconsistent surface water in the channels. Due to project restraints, HCWC has chosen not to emphasize these implications in this short discussion of climate. Some of the effects of climate are discussed in the sections on alluvial fans, the extent of perennial streams, Lahontan cutthroat trout populations and elsewhere in the report.

**Issues, concerns and action items.**

- Increase the understanding of land owners, land managers and the general public on the influence and limitations of the climate of the Alvord Lake Sub-basin on its watershed attributes and functioning.

# GEOLOGY

**Authors and information sources**

The text for this section was taken from the Andrews FEIS.

The Alvord Lake Sub-basin lies in the northwest portion of the Great Basin in the Basin and Range Physiographic Province. Drainage is internal with no outlet to the sea.

The oldest rocks in the area are found in the Pueblo Mountains. They consist of metamorphosed volcanic rocks that are approximately 150 to 200 million years old. They were intruded by quartz-rich rock approximately 180 million years ago.

The next oldest rocks in the area are approximately 18 to 23 million years old and are exposed only at the base of the east side of Steens Mountain. They consist primarily of rhyolitic and andesitic lava flows and tuffaceous sediments.

The Basin and Range Province began to evolve approximately 18 million years ago as a result of regional east-west extension. The regional extension includes all of the area and was accompanied by extrusion of Steens Basalt lava flows approximately 16 million years ago over an area 100 by 180 miles.

Approximately 15 million years ago, volcanic ash erupted from calderas located northeast of Pueblo Peak, south of present day Whitehorse Ranch, and in the vicinity of what is now McDermitt, Nevada. These eruptions resulted in thick deposits of welded tuffs in the eastern part of the area. Additional volcanic ash erupted from calderas located near present day Burns approximately 9.5 and 6.5 million years ago, resulting in welded tuffs in the northern half of the area.

About ten million years ago, regional uplift and movement on faults in the Basin and Range Province formed fault-block mountains and intervening broad valleys. Fault movement continues today. Steens Mountain is a fault-block mountain with an elevation of 9700 feet that dips gently westward and is characterized by its precipitous east-facing, 5500-foot high escarpment overlooking Alvord Valley.

Between 24,000 and 12,000 years ago, pluvial lakes occupied Alvord and Pueblo Valleys. The lakes formed due to increased precipitation and slightly warmer temperatures from a climate change that occurred several thousand years after the glaciers were at their peak. During this time, landslides formed along the east side of Steens Mountain and Ancient Lake Alvord spilled eastward into the Crooked-Rattlesnake drainage through Big Sand Gap. The Alvord Valley contains more than 1000 feet of sediment eroded from the surrounding mountains and hills.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Geology and climate greatly influence the vegetation which will ultimately grow in any area. There are consequently significant implications to watershed functioning and health associated with these factors. Due to project constraints, HCWC has chosen not to emphasize those implications in this short discussion of geology. Some of the effects of geology are indirectly discussed in the sections on alluvial fans, the extent of perennial streams and elsewhere.

**Issues, concerns and action items.**

- Increase the understanding of land owners, land managers and the general public on the influence and limitations of the geology of the Alvord Lake Sub-basin on its watershed attributes and functioning.

# SOILS

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more appropriate for this report.

Surface soils in semiarid southeastern Oregon are young and poorly developed. Chemical and biological soil-building processes such as rock weathering, decomposition of plant materials, accumulation of organic matter, and nutrient cycling proceed slowly in this environment. Since soil recovery processes are also slow, disruption of soils can lead to long-term changes in ecological status and productivity. In many areas, natural, or geologic erosion occurs too rapidly for distinct deep soil horizons to develop.

Soil productivity varies widely due to characteristics such as soil depth, nutrient status, available water-holding capacity, and site characteristics including elevation, aspect, and slope gradient. A productive ecosystem depends on maintenance of soil productivity. Current soil productivity reflects site specific natural conditions and past management practices.

Management practices may affect soil productivity by influencing soil characteristics and processes such as displacement, compaction, erosion, and alteration of organic matter and soil organism levels. Natural processes are slow to restore soil productivity in this semiarid region; therefore, prevention of soil degradation is an effective remedy.

Soil erosion varies throughout the area. In the semiarid portion of the area, bare soil between plants comprises between 40 and 80% of the total ground cover of a native plant community, leaving large areas of exposed soil between plants to erode naturally. In addition to this background erosion rate, management regimes affect the rate at which soil erodes from a landscape. Any activities that remove vegetative cover increase the erosion rate. If the surface layers of vulnerable soils are washed or blown away, the productivity potential may be lost.

Historically, erosion occurred on upland soils and in drainage channels as a result of uncontrolled land use, prolonged drought, and catastrophic storms. Ephemeral drainages were deeply incised by gully erosion more than 30 years ago. Some geologic and localized erosion caused by concentrated uses still occurs. Introduced annual and perennial plants currently occupy many of these highly disturbed sites.

Current management practices have reduced erosion in some allotments within the area. These practices include proper stocking rates for livestock, rotation of grazing, improved designs of roads, rehabilitation of severely disturbed areas, restriction of vehicles to roads and ways, and control of concentrated recreational activities.

After the implementation of the Pueblo-Lone Mountain AMP in 1996, which changed the season of use for livestock on the major riparian areas and meadows in the Pueblo Mountains, monitoring has shown that gullies are revegetating and wet meadows are healing.

Off-highway vehicle (OHV) and mechanized vehicle use on the Alvord Desert playa continues at an increasing but unknown rate; however, the soils that form the base of the lakebed heal each year by the natural action of wind and water on the site. The sand dunes adjacent to the Alvord Desert are not open for use by OHV and mechanized vehicles, however, vehicles occasionally stray onto the dunes past closure signs, making deep ruts in the sand and damaging many types of vegetation. This damage is limited to less than 10% of the dune area.

The National Resources Conservation Service (NRCS) General Soil Map Units from the soil survey for Harney County are named and described in Table 15. The map units found in, and mapped for the Alvord Lake Sub-basin are shown in Map 6. Note that parts of the Vale District have not had their soils mapped. In addition, only 10 of the 13 soil map units named and described in Table 15 are found in the mapped portion of the Alvord Lake Sub-basin (Map 6).

**Table 15. General NRCS Soil Map Units and Descriptions for Harney County.**

| Number | Soil Series | Description |
|---|---|---|
| 1 | Alvodest-Droval-Playas | Poorly to very poorly drained, very deep soils formed in lacustrine sediments on low lake terraces and basin floors; 0 to 3% slopes. |
| 2 | Spangenburg-Enko-Catlow | Well or moderately well-drained, very deep soils formed in lacustrine sediments and alluvium on middle lake terraces; 0 to 20% slopes. |
| 3 | Atlow-Tumtum-Deppy | Well drained, very shallow or shallow soils formed in old alluvium, residuum, or colluvium on high lake terraces and low hills; 2 to 50% slopes. |
| 4 | Gumble-Risley-Mahoon | Well drained, shallow or moderately deep soils formed in residuum and colluvium on hills and tablelands; 20 to 40% slopes. |
| 5 | Felcher-Skedaddle | Well drained, very shallow to moderately deep soils that formed in colluvium and residiuum on mountains; 20 to 70% slopes. |
| 6 | Fury-Skunkfarm-Housefield | Somewhat poorly to very poorly drained, very deep soils formed in alluvium and lacustrine sediments on stream terraces, and lake terraces; 0 to 2% slopes. |
| 7 | Poujade-Ausmus-Swalesilver | Moderately well and somewhat poorly drained very deep soils formed in lacustrine sediments, and alluvium on middle lake terraces; 0 to 5% slopes. |
| 8 | Reallis-Vergas-Lawen | Well drained, very deep soils that formed in alluvium and eolian material on high lake terraces and fan terraces; 0 to 8% slopes. |
| 9 | Baconcamp-Clamp-Rock outcrop | Well drained, shallow or moderately deep soils formed in residuum and colluvium; 5 to 80% slopes. |
| 10 | Raz-Brace-Anawalt | Well drained, shallow or moderately deep soils formed in residuum and colluvium on tablelands having 8 to 12 inches of precipitation; 0 to 30% slopes. |
| 11 | Ninemile-Westbutte-Carryback | Well drained, shallow or moderately deep soils that formed in residuum and colluvium on tablelands and hills having 12 to 16 inches of precipitation; 0 to 70% slopes. |
| 12 | Merlin-Observation-Lambring | Well drained, shallow to very deep soils formed in residuum and colluvium on shrub and grass covered hills; 0 to 70% slopes. |
| 13 | Gaib-Anatone-Royst | Well drained, shallow or moderately deep soils formed in residuum and colluvium on forested hills, tablelands, and canyonsides having 14 to 18 inches of precipitation, 2 to 60% slopes. |

Source: Burns BLM District

## Soil Crusts

Biological soil crusts are also known as cryptogamic, microbiotic, cryptobiotic, and microphytic crusts, leading to some confusion. The names are all meant to indicate common features of the organisms that compose the crusts. The most inclusive term is probably biological soil crust, as this distinguishes them from physical crusts while not limiting crust components to plants.

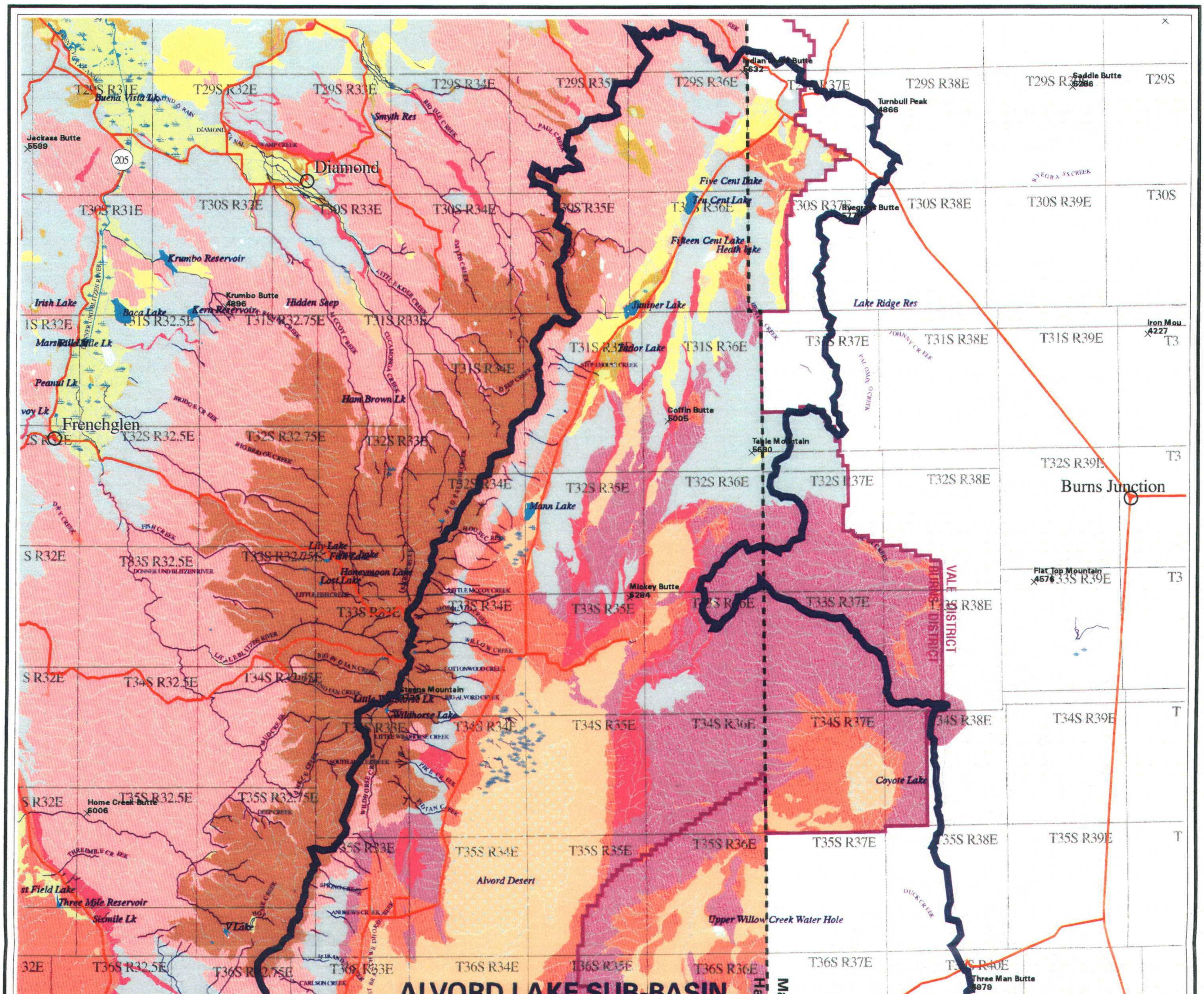
Biological soil crusts play a role in a functioning ecosystem. Carbon fixation, nitrogen fixation and increased soil oxygen content during active photosynthesis are beneficial contributions to the ecosystem resulting from biological soil crusts. The effect of crustal communities on soil/water relations is highly site dependent. Soil surface microtopography and aggregate stability are important contributions from biological soil crusts, as they increase the residence time of moisture and reduce erosional processes. The influence of biological soil crusts on infiltration rates and hydraulic conductivity varies greatly. Generally speaking, infiltration rates increase in pinnacled crusts and decrease in flat crust microtopographies. The northern Great Basin has a rolling biological soil crust microtopography, and the infiltration rates are probably intermediate compared to flat or pinnacled crustal systems. Factors influencing distribution of biological soil crusts include, but are not limited to the following: elevation, soils and topography, disturbance and timing of precipitation.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Like geology and climate, soils greatly influence the vegetation which will ultimately grow in any area. Due to project constraints, HCWC has chosen not to emphasize those implications in this short discussion of soils.

**Issues, concerns and action items.**

- Increase the understanding of land owners, land managers and the general public on the influence and limitations of the soils of the Alvord Lake Sub-basin on its watershed attributes and functioning.




## MAP # 6 - Alvord Lake Sub-basin - GENERAL SOILS (NRCS)

- 1 Alvodest-Droval-Playas
- 2 Spangenburg-Enko-Catlow
- 3 Atlow-Tumtum-Deppy
- 5 Felcher-Skedaddle
- 6 Fury-Skunkfarm-Housefield
- 7 Poujade-Ausmus-Swalesilver
- 8 Reallis-Vergas-Lawen
- 9 Baconcamp-Clamp-Rock outcrop
- 10 Raz-Brace-Anawalt
- 11 Ninemile-Westbutte-Carryback
- No Data Available

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Scale: 1 inch = 6.0 miles

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# VEGETATION

The existing vegetation in the Alvord Lake Sub-basin is discussed below under two different types of habitats: riparian/wetlands and uplands.

## Riparian and Wetland Vegetation

**Information sources and authors**

The text for this section is mostly from the Oregon TMDL. There is also a small section written by HCWC on data collected during our field work. In addition, HCWC has slightly altered and commented on parts of the Oregon TMDL text to make it applicable to this write-up.

Riparian vegetation communities in the area range from dominant woody tree/shrub species adjacent to moderate gradient streams to monotypic stands of sedge or rush associated with springs, saturated meadows, and low gradient stream reaches. Commonly observed woody riparian plant communities include cottonwood-willow, alder-willow, mixed willow, willow-chokecherry, and aspen. These communities may exhibit further diversity with additional shrub or herbaceous species associated with colonization opportunities, such as localized bank disturbance, canopy openings, and increased solar exposure. Herbaceous communities such as grasses, rushes and sedges, are often associated with finer textured soils with species composition associated with the duration of saturation.

**HCWC Field Work Riparian Vegetation Results.** During our riparian field work on private land for this project, HCWC collected data on the riparian vegetation types along 17 miles of inventoried streams. That data is presented in Table 11, page 88 and is discussed in associated text. There is a strong similarity between the vegetation types we recorded and the riparian/wetland species listed below in the section on System Potential and Ecological Provinces. We recorded vegetation types for all but two species listed as typical in the four provinces in the Oregon TMDL document. Those two species are high elevation plants which generally do not grow at the lower elevations where the HCWC work was performed.

**System Potential and Ecological Provinces.** As one part of their efforts, the authors of the Alvord Lake Sub-basin Total Maximum Daily Load (i.e. Oregon TMDL) document sampled and recorded riparian vegetation data, plus channel and floodplain information along selected streams in the sub-basin. Their efforts were aimed at characterizing riparian vegetation and channel/floodplain attributes for various regions of the sub-basin.

They divided the sub-basin into four regions, or what they called Ecological Provinces: East Steens, Pueblo Mountains, Trout Creek and Willow-Whitehorse. They sampled or used previous data on streams to characterize what they called the System Potential for the attributes within elevation ranges in each province.

The ultimate goal of the Oregon TMDL work was to determine the system potential vegetation along the sub-basins streams. To do that they characterized the vegetation and channel/floodplain factors. They defined the system potential as the climax life stage represented when 1) vegetation is mature and undisturbed, 2) vegetation height and density is at or near its potential, 3) vegetation is wide enough to maximize solar attenuation, and 4) vegetation width accommodates channel migrations. At system potential riparian vegetation provides effective shade to the stream and attenuates solar heating. In essence they defined the maximum, or ideal, shading situation they thought possible given the sampling they conducted.

The system potential information developed by the TMDL authors was for trout-bearing streams at climax stages of woody (tree and shrub) plant development. However, the riparian systems in the sub-basin have naturally occurring disturbance cycles, and therefore it is expected that the riparian habitats will naturally have various age classes of vegetation. Consequently, mature and undisturbed vegetation at potential height and density, and riparian zones at full width are not expected throughout a stream's length. Additionally some riparian zones are occupied by herbaceous vegetation and not by trees and shrubs.

This Alvord Lake Sub-basin assessment report has a broader focus than did the TMDL report. While we believe the TMDL data and the process they used to portray and assess circumstances within their sampled streams was good for their purpose, we are not convinced that the TMDL data should be used as an assessment tool for all situations on all streams in the respective provinces. However, due to its value in portraying at least some circumstances in parts of the sub-basin we are presenting the TMDL information on system potential and ecological provinces below. In addition we provide the ecological province vegetation data in our 5th Field Watershed Descriptions later in this chapter (pages 122-138).

**East Steens Mountain Ecological Province.** The data for this information was collected on Mosquito and Willow Creeks, adjacent drainages approximately in the middle of the province.

- A black cottonwood-Pacific willow vegetation zone lies above 5200 feet. Headwater streams can extend up to 6800 feet. Cottonwood-willow communities dominate with some aspen stands. Common species are black cottonwood, Pacific willow, quaking aspen, *Salix* spp., Scouler willow and common snowberry. The average overstory canopy height is 40 feet. Rosgen A-B channel types are dominant with variable flood prone widths.

- A Pacific willow-black cottonwood-aspen vegetation zone lies at mid-elevation from 4260 to 5200 feet. Willow-cottonwood communities dominate with some aspen stands. Pacific willow, black cottonwood, *Salix* spp. and quaking aspen are common. The average overstory canopy height is 25 feet. Rosgen B channel types are dominant with average flood-prone widths of 30 feet.

- A mixed willow vegetation zone lies at low-elevation from 4100 to 4260 feet. Willow communities dominate. Pacific willow, coyote willow, *Salix* spp. and black cottonwood are common. The average overstory canopy height is 20 feet. Rosgen B-C channel types are dominant with 33 to 43 foot flood-prone widths.

**Pueblo Mountains Ecological Province.** The data for this information was collected on Van Horn Creek, toward the southern end of the Oregon portions of the province.

- An aspen-alder-willow vegetation zone lies from 6100 to 6400 feet. Quaking aspen-willow communities dominate. Quaking aspen, alder, Scouler willow and other willows are common. The average overstory canopy height is 33 feet. Rosgen A-B channel types are dominant with variable flood-prone widths.

- An alder-cottonwood-willow vegetation zone lies at mid-elevation from 4300 to 6100 feet. Alder-cottonwood-*Salix* communities dominate. Alder, black cottonwood, *Salix* spp., Scouler willow, Lemmon's willow, chokecherry and red osier dogwood are common. The average overstory canopy height is 28 feet. Rosgen A-B channel types are dominant with average flood-prone widths of 13 to 20 feet.

- A mixed willow vegetation zone lies at low-elevation below 4300 feet. Willow communities dominate with coyote willow being very common. The average overstory canopy height is 14 feet. Rosgen B-C channel types are dominant with 20 foot average flood-prone widths.

**Trout Creek Mountains Ecological Province.** The data for this information at least partially came from field work performed in the 1980s. It was collected on significant lengths of all of the major streams in the province: Trout Creek, Big Trout Creek, Little Trout Creek and East Fork Trout

- A mesic graminoid-willow vegetation zone lies above 7218 feet. Willow communities (commonly Lemmon's willow) and a variety of mesic graminoids dominate. The average overstory canopy height is 8.5 feet. Rosgen B-E channel types are dominant with variable flood-prone widths up to 36 feet.

- An aspen-willow vegetation zone lies from 6562 to 7218 feet. Aspen-willow communities dominate. Quaking aspen, Pacific willow, Geyer willow and Lemmon's willow are common. The average overstory canopy height is 29 feet. Rosgen B channel types are dominant with average flood-prone widths of 25 feet.

- A willow-alder vegetation zone lies at mid-elevation from 4500 to 6562 feet. Willow-alder communities dominate. Mountain alder, Pacific willow, Lemmon's willow and Scouler willow are common. The average overstory canopy height is 24 feet. Rosgen B-C channel types are dominant with average flood-prone widths of 55 feet.

- A willow vegetation zone lies at low-elevation from 4240 to 4500 feet. Willow communities dominate. Coyote willow, yellow willow and Pacific willow are common. The average overstory canopy height is 18 feet. Rosgen B and C channel types are dominant with 70 foot average flood-prone widths.

**Willow-Whitehorse Ecological Province.** The data for this information was collected on Willow Creek for a TMDL published in 1999. Willow Creek is the western most perennial stream in the province.

- An aspen vegetation zone lies at elevations from 5800 to 7000 feet. Aspen communities dominate. The average overstory canopy height is 30 feet. The riparian buffer width is 20 feet.

- A mountain alder vegetation zone lies at elevations from 5000 to 5800 feet. Mountain alder communities dominate. The average overstory canopy height is 25 feet. The riparian buffer width is 30 feet.

- A mixed willow vegetation zone lies at elevations below 5000 feet. Willow communities dominate. The average overstory canopy height is 18 feet. The riparian buffer width varies from 40 to 60 feet.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

The combination of data from the Oregon TMDL on riparian vegetation and that collected on riparian vegetation types by HCWC during work for this report can be used to generally describe most riparian vegetation in the sub-basin. The Oregon TMDL authors further described ideal attributes related to potential stream shading. While HCWC does not feel the Oregon TMDL data should be used to judge all stream segments in the sub-basin, that data none-the-less has value in defining relatively undisturbed and mature vegetation along sub-basin streams. Long-term watershed health can be realized even with the influence of disturbances to riparian vegetation.

**Issues, concerns and action items.**

- Educate land owners, land managers and the general public on the strengths and limitations of the concept of system potential.
- Encourage the development of an evaluation methodology using the general concepts of system potential, but with allowances for the effects of natural disturbance cycles.

## Upland Vegetation

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. The Table and Map data is from the BLM. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

Upland vegetation is discussed below in two general sections: woodlands (tree dominated vegetation) and rangelands (shrub and grass dominated vegetation). Table 16 and Map 7 (below) both display information on “General Plant Communities” which is the BLM term for upland plant communities, as compared to riparian/wetland communities which are not shown in the table or map. See the separate discussions of woodland and rangeland plant communities following the table and map.

### Table 16. General Plant Communities in the Alvord Lake Sub-basin

| | Acres by Type by 5th Field HUC | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **General Plant Communities** | **901** | **902** | **903** | **904** | **905** | **906** | **907** | **908** | **Total** | **%** |
| | | | | | | | | | | |
| Quaking Aspen | 1 | 4,400 | 0 | 8,100 | 0 | 3,300 | 2,000 | 0 | 17,800 | 1.4% |
| Juniper/Big Sagebrush | 0 | 5,100 | 120 | 0 | 0 | 0 | 14,100 | 1,500 | 20,800 | 1.6% |
| Juniper/Low Sagebrush | 0 | 0 | 0 | 0 | 0 | 0 | 2,800 | 1,800 | 4,600 | 0.4% |
| Mountain Shrub/Grassland | 5,700 | 2,300 | 10 | 3,700 | 0 | 0 | 510 | 0 | 12,200 | 1.0% |
| Big Sagebrush/Perennial Grassland | 32,300 | 64,700 | 20,500 | 40,100 | 36,300 | 28,300 | 53,500 | 18,800 | 294,500 | 23.0 % |
| Mountain Big Sagebrush/Grassland | 2,400 | 16,800 | 10,900 | 30 | 0 | 1,200 | 5,300 | 0 | 36,600 | 2.9% |
| Low Sagebrush/Grassland | 8,900 | 28,700 | 1,100 | 21,900 | 13,700 | 5,400 | 12,000 | 0 | 91,700 | 7.2% |
| Silver Sagebrush/Grassland | 0 | 0 | 0 | 0 | 0 | 0 | 2,100 | 2,300 | 4,400 | 0.3% |
| Black Sagebrush | 0 | 0 | 0 | 0 | 11,900 | 0 | 0 | 0 | 11,900 | 0.9% |
| Big Sagebrush/Annual Grassland | 36,900 | 76,300 | 29,300 | 3,000 | 84,700 | 50,400 | 28,100 | 23,700 | 332,400 | 26.0 % |
| Big Sagebrush/Crested Wheatgrass | 0 | 2,900 | 790 | 10,400 | 2,700 | 5,600 | 5,700 | 36,600 | 64,700 | 5.1% |
| Salt Desert Shrub/Grassland | 24,200 | 93,100 | 36,600 | 19,600 | 22,100 | 38,000 | 33,500 | 0 | 267,100 | 20.9 % |
| Rabbitbrush/Grassland | 1,800 | 3,100 | 4,200 | 5,800 | 0 | 13,900 | 160 | 0 | 29,000 | 2.3% |
| Native Perennial Grassland | 440 | 960 | 80 | 0 | 2,100 | 0 | 530 | 0 | 4,100 | 0.3% |
| Annual Grassland | 1,400 | 180 | 2,200 | 0 | 2 | 70 | 0 | 680 | 4,500 | 0.4% |
| Crested Wheatgrass | 0 | 230 | 1,300 | 0 | 0 | 50 | 2,400 | 650 | 4,600 | 0.4% |
| Playa | 610 | 3,600 | 26,900 | 0 | 3,100 | 0 | 2,200 | 800 | 37,200 | 2.9% |
| Rock | 0 | 1,700 | 550 | 0 | 70 | 10 | 0 | 0 | 2,300 | 0.2% |
| Unknown | 3,200 | 5,700 | 7,200 | 5,800 | 1,500 | 6,300 | 3,400 | 4,200 | 37,300 | 2.9% |
| | | | | | | | | | | |
| **Totals** | **117,900** | **309,900** | **141,900** | **118,500** | **178,100** | **152,500** | **168,400** | **91,100** | **1,278,300** | |

Totals may not sum exactly due to rounding.
Source: BLM GIS data

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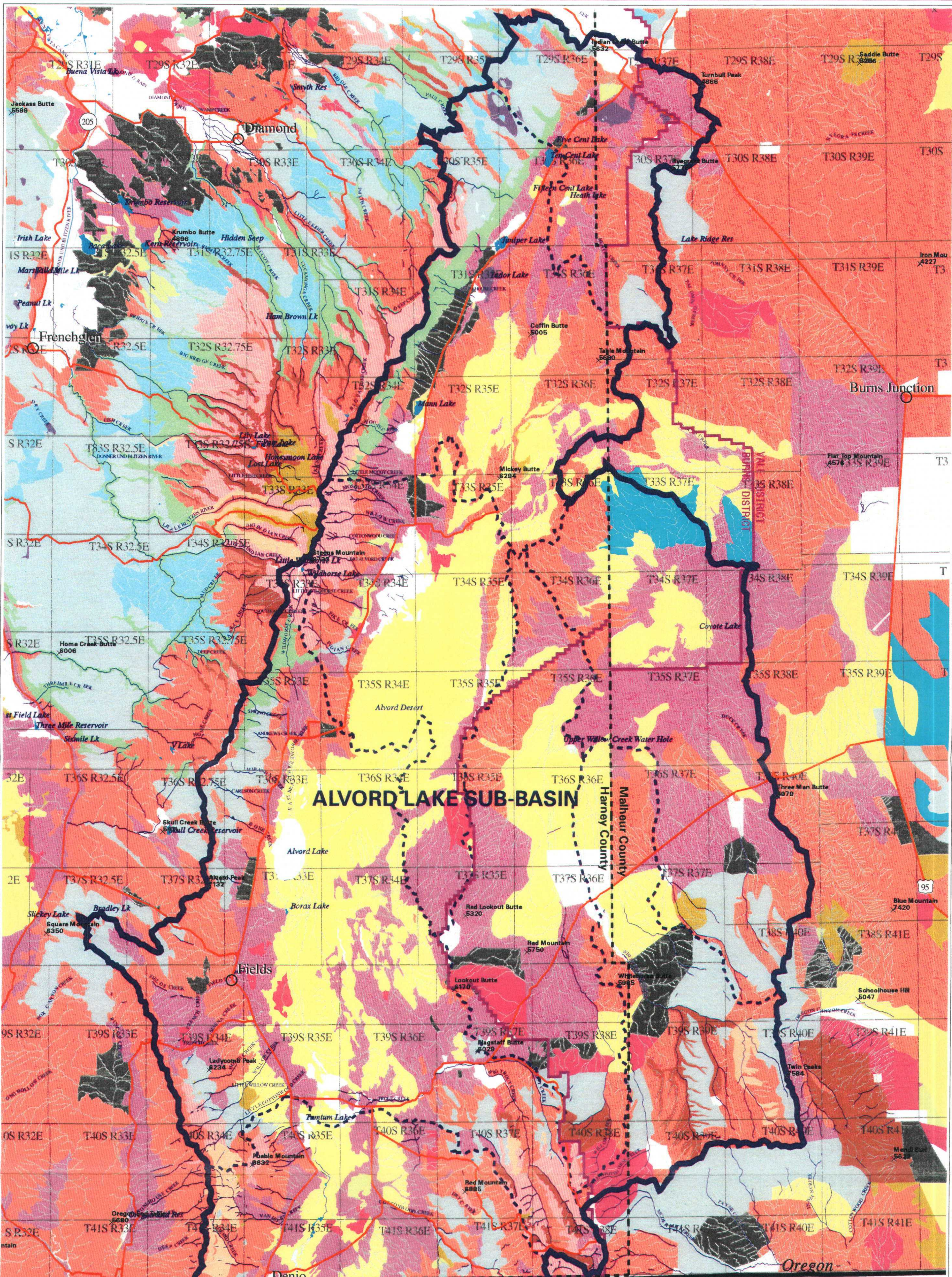


## MAP # 7 - Alvord Lake Sub-basin - GENERAL PLANT COMMUNITIES (BLM)

- Big Sagebrush/Annual Grassland
- Big Sagebrush/Perennial Grassland
- Annual Grassland
- Native Perennial Grassland
- Crested Wheatgrass/Sagebrush
- Juniper/Big Sagebrush
- Juniper/Low Sagebrush
- Low Sagebrush/Grassland
- Mountain Big Sagebrush/Grassland
- Mountain Shrub/Grassland
- Quaking Aspen
- Rabbitbrush/Grassland
- Salt Desert Shrub/Grassland
- Silver Sagebrush/Grassland
- Black Sagebrush
- No Data Available

Burns and Vale data were collected differently- See Appendix 1.

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Burns District, Oregon

Date: 21-MAR-2006, Pam Keller, alsveg11x17.aml/alvveg.ps

## Woodlands

**Quaking Aspen.** Quaking aspen is found throughout the Great Basin in small to moderately sized patches. This tree species is often found on north slopes or areas where snow accumulates and persists later into the spring than in adjacent areas. Quaking aspen has the ability to sucker (sprout) from numerous buds on the roots and rhizomes. The production of suckers greatly increases when overstory stems are removed by disturbances such as fire, wind, and cutting. Reproduction from seed is extremely uncommon due to exacting conditions required for germination and establishment (McDonough 1979). Quaking aspen form stands with an even-aged structure of dominant trees. These stands can be characterized as young, mature, or old (Wall 1999). Young stands are found shortly after disturbance, mature stands are often 80 to 100 years old, and stands older than 120 years in age are classified as old (Bartos and Mueggler 1981). Old stands have signs of deterioration present in the form of numerous standing dead trees and trees with large portions of their canopies dead. Younger stands may appear to be quite productive with healthy overstory trees and dense understory production. DeByle (1985) stated that quaking aspen stands regularly produce over 2,000 pounds per acre in forage, over ten times that of some adjacent plant communities. Quaking aspen stands are often focal points for animal activity, including grazing animals. Wild ungulates (mule deer and some Rocky Mountain elk) rely on the forage during times of the year when other forages have cured. Wild and domestic livestock will utilize these areas in the summer months for forage and relief from high temperatures. Invertebrate herbivores also utilize quaking aspen stands, but only a few result in severe damage to the overstory.

Quaking aspen communities constitute a small portion of the sub-basin (1.4%), but contribute to the biodiversity of wildlife and plant species. Within the area, quaking aspen is found on the Pueblo, Trout Creek, and Steens Mountains between 4500 and 7500 feet. Isolated stands occur as low as 4500 feet along creek corridors and around springs on protected north slopes. Maser and others (1984) identified 84 wildlife species that utilize quaking aspen stands for breeding and 117 species that utilize quaking aspen communities for forage. Plant communities dominated by quaking aspen are often considered to be more productive than adjacent sagebrush or forested communities. The vegetation occurs in multilayered mixtures of shrubs, forbs and grasses. Over 300 plant species have been identified growing in quaking aspen stands across the Great Basin. Common grass and grasslike genera found in quaking aspen stands include wheatgrass, bromes, wildrye, bluegrass, and sedges. Forb genera include *Thalictrum* sp., sweet cicely, geranium, aster, peavine, yarrow, bedstraw, and butterweed. Shrub genera typically found within quaking aspen stands are snowberry, rose, serviceberry, cherry, sagebrush, rabbitbrush, and Oregon grape. Soils located within aspen stands were formed from igneous rock and are typically deep loam Haploxerolls.

Quaking aspen communities are experiencing a general decline across the western United States (Bartos and Campbell 1998). Many factors are contributing to the decline, but two of the most common links are the lack of fire and the encroachment of conifers into the quaking aspen communities. Wet site conditions and short summer seasons reduce the likelihood of wildland fires. However, at lower elevations, quaking aspen is being actively replaced by western juniper. Three-fourths of all quaking aspen stands below 6500 feet studied by Wall (1999) were either dominated by western juniper or had western juniper present in the community. The lack of fire has permitted western juniper to establish and become dominant or co-dominant in many quaking aspen stands; this situation is limited to Steens Mountain. The Pueblo and Trout Creek Mountains do not have western juniper, except for isolated trees. Stands below 6600 feet on Steens Mountain are most susceptible to encroachment by western juniper (Wall et al. 2001).

**Western Juniper.** Western juniper is discussed in depth (pages 58-63) as a potential vegetation problem in the Alvord Lake Sub-basin. Please see that discussion. Western juniper is still relatively uncommon in the sub-basin, but it is very common in some adjacent areas just outside of the sub-basin where it is a major watershed health problem.

**Rangelands**

The Basin and Range Province in Oregon is dominated by sagebrush/native bunchgrass communities with site specific sagebrush species. In the Alvord Lake Sub-basin, the various sagebrush/grassland communities together comprise approximately 65% of the area.

The big sagebrush genera is divided into three subspecies based on physical appearance and habitat. Basin big sagebrush grows mainly on sites having moderately deep loamy soils such as droughty bottomlands and fans. Wyoming big sagebrush is present almost everywhere throughout the lower elevations of the province on slightly sandy or gravelly soils. Mountain big sagebrush occurs in similar soils, but at higher elevations.

Low sagebrush/bunchgrass communities are strongly dominant on shallow to very shallow stony upland lithic soils. Silver sagebrush dominates internally drained basins with seasonally saturated soils. Black sagebrush/bunchgrass communities are found on shallow soils with a calcareous layer. Perennial grassland communities do not form a major climax vegetation type, although they do dominate for a period following fire when the shrub component is eliminated. Although western juniper generally occurs as a vegetation type in many woodland communities, it has also invaded big sagebrush/bunchgrass and low sagebrush/bunchgrass communities on mesic sites where it has not been limited by wildland fires.

Rangeland plant groups are described below. The names used below do not exactly match those of Table 16 and Map 7. The name differences are due to lumping of some Table 16 and Map 7 plant communities in these discussions.

**Big Sagebrush Shrubland Communities.** Big Sagebrush shrubland is the most common vegetative cover type in southeastern Oregon. It appears as a mosaic with shrub-steppe communities over many of the unwooded areas along mountain range foothills and on the valley floor. The big sagebrush subspecies generally referred to in these communities are Wyoming big sagebrush and basin big sagebrush. There are several different mixtures of plants within the big sagebrush mosaics. The mixtures include big sagebrush with perennial grasslands, annual grasslands (cheatgrass), crested wheatgrass, bitterbrush, western juniper, black greasewood, shadscale, winterfat, and rabbitbrush.

Native grasses range from a mere presence of grass to an abundance of grass, depending on history of the site and beneficial soil/water relations. Native perennial grasses include bluebunch wheatgrass, Sandberg's bluegrass, Idaho fescue, basin wildrye, junegrass, needle and thread grass, Thurber's needlegrass, bottlebrush squirreltail, mountain brome, and Indian ricegrass. Introduced grasses are primarily cheatgrass and crested wheatgrass. The big sagebrush community in the area occurs primarily between 4200 and 5500 feet in elevation.

**Black Sagebrush/Grassland Communities.** Black sagebrush has a limited distribution in the Basin and Range Province and is considered a “rare type” in this province. It is found on only three percent of the area of this sub-basin. This plant community is found on shallow soil plateaus and gentle slopes. The sites have extensive areas of exposed rock. Wildland fire occurrence is rare, with a mean return interval (average number of years between fire events), of approximately 100 to 200 years. Sandberg’s bluegrass is usually the dominant grass, making up most of the vegetative cover; however, other bunch grasses also occur on these sites. Black sagebrush is the dominant shrub and often the only shrub present. In some areas, these black sage stands can be extensive or may occur in a mosaic with low or big sagebrush. Shadscale, squirreltail, and cheatgrass also occur on these sites.

**Silver Sagebrush/Grassland Communities.** The silver sagebrush/grassland community is usually found in valley bottomlands. Silver sage is the dominant and characteristic shrub of this community. This tall shrub community is moderately to widely spaced. It grows in areas that have been deflated (eroded by wind) and subsequently partially filled with ingrained sediments. Although species such as creeping wildrye occasionally occur, the understory can be dominated by widely spaced, often robust bunchgrasses such as Nevada bluegrass.

**Low Sagebrush/Grassland Communities.** Low sagebrush communities are found throughout eastern Oregon, generally on areas with shallow basalt soils. Low sagebrush is the dominant and often the only shrub in the stand. Western juniper is also commonly found on this site. Other associated grasses can be bluebunch wheatgrass, Idaho fescue, Thurber’s needlegrass, Nevada bluegrass, Sandberg's bluegrass, and cheatgrass. Plants such as lomatiums, onions, and Indian carrot are economically important to American Indian tribes and are found in this plant community. The low sagebrush plant communities usually occur on soils where rooting depth is restricted by bedrock or a heavy clay layer. The restricted rooting profile lowers the site productivity. Low sagebrush plant communities are found in a complex mosaic with other sagebrush plant communities such as Wyoming and mountain big sagebrush. The sites have extensive areas of exposed rock and often do not have enough vegetation to support wildland fires. Low sagebrush can also occur within an aspen mosaic. After the snow melts and soil warms in the spring, these areas are rich with colorful and diverse perennial and annual wildflowers.

**Mountain Big Sagebrush/Grassland Communities.** At elevations between 5500 and 8000 feet in the Basin and Range Province, mountain big sagebrush communities occur on plateaus and rocky flats with minimal soil development. Sandberg's bluegrass, bluebunch wheatgrass, Idaho fescue, Nevada bluegrass, cheatgrass, bitterbrush, wax currant, snowberry, and grey rabbitbrush are common in this community type. This medium to medium-tall shrubland varies from widely spaced to fairly dense shrubs occurring on deep-soiled to stony flats, ridges, and mountain slopes, and usually in cool moist areas receiving a large snowpack. In this community, Idaho fescue is the most common and diagnostic grass.

**Mountain Shrubland Communities.** Mountain shrubland is found on the steep rocky slopes of mountains in southeastern Oregon. It usually appears as a minor component within the juniper woodland types, or it grades in and out of sagebrush steppe. This cover type is commonly encountered but generally exists as units that are too small to be mapped. This widely dispersed tall shrubland grows in rock talus and rock outcrops, in soil pockets within rocky slopes, and in flatter areas with big sagebrush. The key shrub species in the mountain shrubland community are bitterbrush and snowberry, but others can be wax currant, ocean spray, chokecherry, and bitter cherry. Bitterbrush communities are found in medium-tall shrubland steppe with bunchgrass or cheatgrass understory. Bitterbrush can be dominant or co-dominant with big sagebrush. Idaho fescue is the characteristic native bunchgrass, with bluebunch wheatgrass co-dominant under bitterbrush at lower elevations. Western needlegrass is dominant at the higher elevations and where soils are sandier. Snowberry communities are found on steep slopes between alpine habitats and riparian or sagebrush steppe.

**Crested Wheatgrass and Cheatgrass Communities (Modified Grassland).** Both of these species originated in Eurasia and have adapted very well to these soils and climate. Cheatgrass, an annual, was inadvertently introduced into America with cattle and in hay used for ship ballast. It can out-compete the native grasses by germinating in the fall. Large expanses of cheatgrass can be the result of intense or repeated wildland fires, unsuccessful seedings, historic overgrazing, abandoned farming, or other disturbances. Cheatgrass dominated rangelands are grazed in the late winter and early spring by livestock and in some areas provide significant forage value. Weedy native and exotic annual forbs may also be present or even dominate on some sites. Some of the weedy forbs found on disturbed rangelands include tumble mustard, filaree, tumbleweed, burr buttercup, clasping peppergrass, halogeton, and bull thistle.

In the past, many acres were planted with crested wheatgrass for livestock forage and soil stability. Crested wheatgrass was seeded after wildland fires, or after the shrub cover was removed by plowing, disking, chaining or spraying herbicide. Some of these sites may remain in a dominant crested wheatgrass community for about ten years until sagebrush and rabbitbrush recolonize the site. Other sites, where the seed source for sagebrush has been depleted, have not changed for more than 30 years. This vegetation type is often restricted to foothill margins and gentle terrain in close proximity to valley bottoms. The undisturbed remnants of this type (primarily on steeper slopes) are dominated by native perennials. Green and gray rabbitbrush are common, and Wyoming big sagebrush occurs locally when the seedings have aged.

Other desirable non-native species as well as varieties and cultivars of native grass species have been seeded in modified grassland types following a wildland fire, to keep cheatgrass or other introduced annual species from becoming established. Some of the non-native species seeded include: forage kochia, appar blue flax, tall wheatgrass, secar bluebunch wheatgrass, siberian wheatgrass, paiute orchardgrass, ladak alfalfa, and nomad alfalfa. The varieties and cultivars of native grass species include: nezpar Indian ricegrass, goldar bluebunch wheatgrass, magnar basin wildrye, trailhead basin wildrye, and arriba western wheatgrass.

**Salt Desert Shrub/Grassland Communities.** Large portions of lower elevations in the sub-basin are dominated by salt desert shrub plant communities. These communities make up most of the types on the valley bottoms near playas and also occur on shallow soils in the foothills. The dominant shrub species in this type is black greasewood. Greasewood grows with Wyoming big sagebrush in the deeper soils at the edge of the foothills, and with saltgrass on the extremely alkaline soils of the valley bottom. Other shrub species common to the salt desert shrub community include shadscale, bud sage, spiny hopsage, fourwing saltbush, winterfat, rabbitbrush, and horsebrush. Some of the common understory grasses in this type include saltgrass, Indian ricegrass, basin wildrye, squirreltail and cheatgrass.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

This section is just descriptive of the general plant communities found within the Alvord Lake Sub-basin. As such it alone has little to do with watershed health, as it is the disturbance of those communities which detracts from watershed health. However, understanding the differences between potential vegetative communities as compared to disturbance-induced communities often allows a quick interpretation of possible watershed health issues.

**Issues, concerns and action items.**

- Educate the public as to the role of intact, healthy native plant communities in watershed health.

## Special Status Plant Species

**Information sources and authors**

The text for the first two paragraphs below was taken from the Andrews FEIC. HCWC wrote the third paragraph from information supplied by the BLM.

Special status species are plant or animal species known or suspected to be limited in distribution, rare or uncommon within a specific area, or vulnerable from activities which may affect their survival. Appendix 2 lists special status plant species found in the area. These species receive priority attention for inventory, research, and monitoring efforts. Federal, state, and non-governmental agencies have been consulted to assure their protection and management. Special status plant surveys are made prior to land exchanges, range and wildlife projects, proposed mining operations, and other surface disturbing activities.

Nearly all of the plants on the list are rare in Oregon, but common or stable in areas outside of Oregon. There are no known threatened or endangered plant species in the area. Special status plant species occur in a variety of plant associations and on a variety of physical habitats, many of which have distinctive soil types. Several special status species often occur together. When a new location for a special status plant species is observed, the information is documented and reported to the Oregon Natural Heritage Program (ONHP), where it is permanently recorded.

The BLM monitors the plants in Appendix 2 which grow on federal land in the sub-basin. In general, L1 plants are monitored most intensely, and L2, L3 and L4, less intensely. Similarly, those plants in Appendix 2 which are found in Research Natural Areas (page 158) are also monitored closely. Many of the rare plant species listed in Appendix 2 occur in unique habitats in the sub-basin, such as the fringes of playa lakes, sand dunes, alkali flats, riparian areas, and foothill sites with shallow soils.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Because of their limited distribution in the Alvord Lake Sub-basin, some special status plant species potentially have value as indicators or bellwethers of watershed health. Management activities which have significant, adverse affects on these plant populations should be evaluated for their overall impacts to watershed health.

**Issues, concerns and action items.**

- Encourage the ongoing monitoring of special status plant species, and for uncommon plant communities, to ensure the watershed health attributes needed to sustain those species and communities.

# WILDLIFE AND WILDLIFE HABITAT

**Information sources and authors**

The text for this section is mostly taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

The area provides diverse habitat including sagebrush steppe, riparian and wetlands, plus aspen and juniper woodlands. Wildlife species utilizing the habitat include upland game bird species, Rocky Mountain elk, mule deer, pronghorn antelope, California bighorn sheep, cougars, raptors, waterfowl, shorebirds, wading birds, neotropical migratory birds, reptiles, amphibians, and invertebrates. The following section describes the major wildlife species and habitat found in the area.

## Wildlife

**Mule Deer.** Mule deer are widespread throughout the area. They are typically associated with complex mid- to upper elevation plant communities supporting a wide variety of sagebrush, mountain shrubs, aspen, juniper, and herbaceous vegetation. Mule deer browse on shrubs and forbs, which provide most of their annual diet.

Thermal cover is critical on winter range to provide protection from wind and other adverse elements. Grassy slopes, meadows, brush fields, and other early successional stages (artificially created and otherwise) provide the majority of deer forage. During hot summer weather, aspen stands and juniper/big sage/antelope bitterbrush shrublands function as thermal cover, reducing heat stress on the animals.

Transition range can be divided into spring and fall. The vegetation of the spring transition range is similar to winter range and consists of sagebrush and juniper woodland. Grasses and forbs are important components of the spring transitional ranges. The fall transitional ranges are vegetatively similar to summer ranges and consist primarily of aspen, shrub steppe, and juniper woodland communities. Maintaining migratory routes is critical to the seasonal deer movements.

The winter range is concentrated along the east margin of Steens Mountain adjacent to the Alvord Desert, and in the lower elevations of the Pueblo Mountains and Trout Creek Mountains. The winter range occurs primarily in juniper woodland and sagebrush communities with interspersed grasses. Shrubs are a major component of the winter diet, primarily antelope bitterbrush, big sagebrush, curl-leaf mountain mahogany, and western juniper. When snow conditions make higher elevations unsuitable, deer will move to suitable habitat in lower elevations. Deer tend to remain at the highest possible elevations until forced to winter concentration areas by snowfall.

Mule deer numbers have been lower than management objective levels for several years. The decline in numbers is probably due to a combination of factors including but not limited to drought, predators and winter range condition.

**Rocky Mountain Elk.** The Rocky Mountain elk is one of Oregon's primary big game species found in the area. Since elk are also valued by the public for wildlife viewing, interest is high relative to the population levels and habitat conditions. The elk population remains near ODFW population objectives. Approximately 400 adult elk summer at mid to upper elevations on Steens Mountain and winter at mid to lower elevations. Juniper trees have allowed for the expansion of elk into areas not occupied in the past by providing hiding cover that allows for escape from human disturbance.

Winter range is an important consideration in managing elk populations. During winter, elk use south-facing slopes and lower elevations because of warmer temperatures, reduced snow depths, and available forage. During periods of hot summer weather, north-facing slopes, high elevation western juniper/shrub sites, and aspen stands provide important thermal cover.

**Pronghorn Antelope.** Pronghorn antelope are distributed throughout the area. Winter range for pronghorn antelope is concentrated in the southeast end of the Pueblo Mountains, the Fields area, and along the eastern base of Steens Mountain. During the summer, pronghorn antelope are widely distributed throughout the area in habitats having low structure and a mixture of grasses, forbs, and shrubs. Sagebrush is used for both cover and forage. Seedings and wildland fires have converted some previously dense stands of sagebrush into suitable range.

BLM livestock water developments, particularly pipelines, have allowed pronghorn antelope to expand into formerly unoccupied areas. Forage competition with cattle and wild horses is slight due to forage preferences (Vavra and Sneva 1978). Lack of water at natural or developed sites can be a serious problem during periods of drought. BLM fence construction specifications allow pronghorn to move freely by having smooth bottom wires spaced at least 16 inches above ground level.

**Raptors.** Raptors, which include predatory birds such as hawks, eagles, falcons, and owls, can be found throughout much of the area. Local areas provide exceptionally high-quality raptor habitat and support high-density breeding populations. Common breeding species include the red-tailed hawk, Swainson’s hawk, prairie falcon, American kestrel, golden eagle, northern harrier, sharp-shinned hawk, Cooper’s hawk, and long-eared owl. Other less common breeders that may be found locally include the ferruginous hawk, burrowing owl, and northern goshawk. Important nesting habitats are in juniper and quaking aspen vegetation types. Volcanic ledges and buttes are often excellent nesting sites for many species. Prey species are more likely to be available for a wide range of raptors when plant communities are structurally diverse and support mixtures of grasses, forbs, and shrubs.

Many breeding species also winter within the area. Species that only winter in the area include the roughlegged hawk and northern bald eagle. Rangeland treatments and power line locations and configurations are examples of actions that potentially threaten raptor reproduction and survival. Local utility companies have cooperated in the past to design power facilities which have greatly reduced the number of raptor electrocutions.

**Neotropical Migratory Birds.** The area supports a wide variety of neotropical migratory bird species (more than 110 species) that breed in the United States and winter in Central or South America. Populations of some of these species are declining as a consequence of global land use practices and other factors. Neotropical migratory birds exhibit variable habitat requirements and are found in several habitat types. Some of the birds in this category include song sparrow, chipping sparrow, Brewer’s sparrow, downy woodpecker, hairy woodpecker, yellow-rumped warbler, yellow warbler, dusky flycatcher, Bullock’s oriole, American robin, mourning dove, Cassin’s finch, rufous hummingbird, Western tanager, pine siskin, violet-green swallow, and lesser goldfinch.

**Waterfowl and Shorebirds.** As many as 70 species of waterfowl, shorebirds, and wading birds may use the area due to the nearby wetland habitat of the Malheur NWR and private lands. Representative species include Canada goose, cinnamon teal, mallard, gadwall, American avocet, white-faced ibis, Wilson’s phalarope, greater sandhill crane, great blue heron, and spotted sandpiper. These species exhibit variable habitat requirements and are found in several habitat types.

**Chukar.** Chukars are one of the main upland game bird species found in the sub-basin. They inhabit sparsely vegetated rocky canyons, slopes, and hillsides and can be found in sagebrush flats, grasslands and open juniper canyon lands. Chukars are an introduced species to Oregon and are primarily a seed eater with cheatgrass seed being a favored food. Insects may also be part of the adult diet but chick diets may consist largely of insects. Seasonal use areas vary with climatic conditions and the availability of water.

## Wildlife Habitat

The sagebrush steppe includes several upland vegetation communities with a shrubland character and a variable understory of grasses and forbs. The presence of a shrub overstory is associated with wildlife community diversity.

Shrubby plants are important to most small and large wildlife because they supply food as well as hiding cover and structure. Within the sagebrush steppe community, grasses and forbs provide food and cover for wildlife. Habitats that provide a mix of grasses and forbs meet the needs of a wide range of species.

Riparian areas consist of plant communities associated with streams and rivers. The structure, food, and water available in these areas make them the single most diverse and productive wildlife habitat. Well-developed riparian areas with trees, shrubs, grasses, forbs, sedges, and rushes provide valuable habitat for a wide array of wildlife species. Wetlands, consisting of either permanently or seasonally wet areas, are associated with various landscape settings including reservoirs, sloughs, playas, meadows, springs, and seeps. Wetlands typically provide succulent green forage, insects, and drinking water for wildlife. Riparian and wetland areas that do not support diverse plant communities still provide important sources of water and food for wildlife.

The juniper woodlands provide habitat for a large number of species supported within the area. These woodlands vary greatly in their habitat value depending on factors such as height, density, and age of trees. Older trees may provide cavities for nesting birds while deer and elk use juniper for thermal and escape cover. The distribution of juniper (normally between 5700 to 6560 feet elevation) influences the condition and quality of neighboring wildlife habitat.

## Special Status Animal Species

Special status animal species are known or suspected to be limited in distribution, rare or uncommon within a specific area, or vulnerable from activities which may affect their survival. Appendix 3 lists special status animals known or suspected to use the Alvord Lake Sub-basin. Special status designations are assigned for many reasons including limited distribution, habitat loss resulting from environmental impacts, suspected or documented population declines, or some combination of these factors. These are priority species for various surveys to determine their distributions, abundance, and habitat preferences.

**Northern Bald Eagle.** The bald eagle was listed in 1978 as a federal threatened species in Oregon under the Federal ESA of 1973. The area supports a wintering population of northern bald eagles, but no breeding pairs, primarily in areas associated with major river systems and large reservoirs.

**American Peregrine Falcon.** The American peregrine falcon was federally listed as an endangered species throughout its range under the Federal ESA of 1973, and as a state endangered species under the Oregon ESA (ORS 1987). The peregrine falcon was delisted in 1999 after reaching the recovery goals set forth in the 1982 Pacific Coast Recovery Plan for the American peregrine falcon. The peregrine falcon is a cliff-nesting species. Nest sites are usually associated with cliffs near water with an abundant population of nongame birds, shorebirds, and waterfowl, the peregrine’s primary prey.

**Northern Kit Fox.** The northern kit fox is a state threatened species that is present within some of the salt desert shrub habitat of the area. According to ODFW data, kit fox populations are currently low but are higher than when the species was added to the state list of threatened species. Kit fox populations in Oregon are thought to be naturally limited by the amount of salt desert habitat available. The kit fox is common in

Nevada and some other western states. USDA-APHIS animal damage control actions avoid kit fox occupancy areas.

**Greater Sage-Grouse.** The western subspecies of the Greater sage-grouse was federally listed as a Category 2 candidate species by the USFWS until the classification was dropped from the list. The Greater sage-grouse is currently a BLM sensitive species. On pages 56-57 there is discussion of sage-grouse and their habitat needs.

**California Bighorn Sheep.** California bighorn sheep were eliminated from Oregon by 1915. Current populations are the result of numerous ODFW directed reintroductions and supplemental releases during the past two decades. Bighorns from Steens Mountain have been captured and used for relocations within Oregon and in other western states. Although populations within the analysis area have recently increased, the current distribution in Oregon still represents a small percentage of the former historic bighorn range (Oregon's Bighorn Sheep Management Plan 1992-1997).

Summering bighorns from the Alvord Peak area and Pueblo Mountains usually winter in the low mountains east of Fields. This is the only major migratory bighorn movement known in eastern Oregon. Disease transmission between domestic sheep and bighorns can cause rapid and massive bighorn losses, which results in public controversy. No licensed sheep grazing permits overlap with currently occupied bighorn range, nor has the ODFW indicated any problems with disease transmission between cattle and bighorn sheep. In accordance with an approved state management plan, the ODFW wishes to continue releasing bighorns into suitable unoccupied habitat and to conduct supplemental releases into currently occupied habitat. Should bighorn populations exceed management objectives in the future, the ODFW would like to continue removing bighorns by capture for release into other suitable habitat in Oregon and elsewhere.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Like sage-grouse, other wildlife species in the Alvord lake Sub-basin do best in habitats with good watershed health attributes. As such, those species can be used as indicators of watershed health. For the most part wildlife species do not harm watershed health. The exception to this is when the larger species become too numerous.

**Issues, concerns and action items.**

- Encourage the maintenance of wildlife species numbers at levels which are supported by, and which allow, healthy native plant communities.

# Wild Horses

Photo HCWC

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

The Wild Free-Roaming Horses and Burros Act of 1971 (PL 92-195), as amended, states: "It is the policy of Congress that wild free-roaming horses and burros shall be protected from capture, branding, harassment, or death; and to accomplish this they are to be considered in the area where presently found as an integral part of the Public Lands." After passage of this act in 1971, the area was inventoried for free-roaming horses and burros, and Herd Management Areas (HMAs) were designated where wild horses were found. No burros were found in these areas.

The Alvord Lake Sub-basin has all or major portions of five HMAs: Riddle Mountain, Heath Creek, Sheepshead, Alvord-Tule, and Coyote Lake. A small portion of the South Steens HMA lies in the sub-basin where it overlaps the east rim of the Steens Mountain.

Wild horses in the Heath Creek and Sheepshead HMAs mix and are one population. These HMAs were administered as two units due to the political District boundary between the Burns and Vale Districts. The Southeast Oregon Resource Management Plan (SEORMP, USDI 1998b) determined that these two HMAs would be managed as one unit and provided guidelines and decisions for management of the combined Heath Creek-Sheepshead/Sheepshead HMA.

Wild horses in the Alvord-Tule Springs HMA have access to and freely mix with horses located in the adjacent Coyote Lake HMA that is in the Vale District. The two HMAs are separated by a partially unfenced political boundary between the Burns District and the Vale District.

To prevent resource overuse and to maintain a thriving ecological balance, gathering takes place as herd numbers exceed the maximum established for the area. Depending on reproductive rates, results of rangeland monitoring data, death rates, funding, public concern, and other special management considerations, horses are gathered and removed every three to four years.

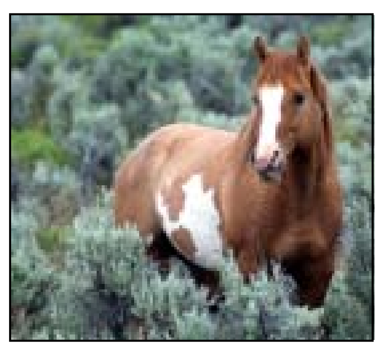

Photo courtesy of BLM

Horse populations are normally reduced to a minimum number to avoid the need for frequent and costly gathering. Excess animals removed from the range are made available to the public through the BLM's Wild Horse Adoption Program.

The fencing that exists in the HMAs for control of livestock movement serves to contain wild horses within the HMAs, but also creates barriers to wild horse movement when livestock are present and gates are closed. After the livestock are removed at the end of the grazing season, gates are left open to provide the opportunity for horse movement within the HMA. The absence of reliable year-round water, especially in drought years, is a limiting factor in some HMAs.

Mature horses are 14 to 16 hands tall (in common horse terminology one hand equals four inches) and weigh 950 to 1,250 pounds. Mature stallions are usually larger than mares. Wild horses in these HMAs exhibit saddle stock conformation, but each herd has its own unique characteristics. Two herds exhibit Spanish mustang characteristics, one herd has a large component of horses with pinto coloration, and the other herds display a variety of colors.

Dominant colors in the Alvord-Tule Springs herd are bay, black, brown, sorrel, palomino, and buckskin. Historically, many of these horses have appeared to be of thoroughbred ancestry with some evidence of draft blood. Major colors in the Heath Creek-Sheepshead herd are dun, black, brown, bay, sorrel, and an occasional paint. All are of saddle stock conformation.

**Table 17. Herd Management Areas in the Alvord Lake Sub-basin Acres by 5$^{th}$ Field Watersheds.**

| 5th Field Watershed | Name | HMA | Acres |
|---|---|---|---|
| 902 | Alvord Lake | Alvord-Tule | 113,746 |
| | | Coyote Lake | 59 |
| | | South Steens | 1,424 |
| 903 | Big Alvord | Alvord-Tule | 83,956 |
| | | Coyote Lake | 1,603 |
| 904 | Whitehorse Creek | Coyote Lake | 5,543 |
| 905 | Twelve Mile Creek | Alvord-Tule | 54,177 |
| | | Coyote Lake | 67,801 |
| 906 | Willow Creek | Alvord-Tule | 15,828 |
| | | Coyote Lake | 55,445 |
| 907 | Summit | Alvord-Tule | 50,548 |
| | | Heath Creek | 30,821 |
| | | Riddle Mountain | 19,530 |
| | | Sheepshead | 111 |
| 908 | Quail Creek | Alvord-Tule | 152 |
| | | Heath Creek | 37,704 |
| | | Riddle Mountain | 6,970 |
| | | Sheepshead | 22,400 |

Source: BLM

***Note:*** During production and publishing of this document, the BLM has altered HMAs (combining some, changing the size of some, etc.) Parts of the Table 17 data and the text in this section are not current as of June, 2006. In contrast, Map 8 is current. Please contact the BLM if further, specific information is needed.

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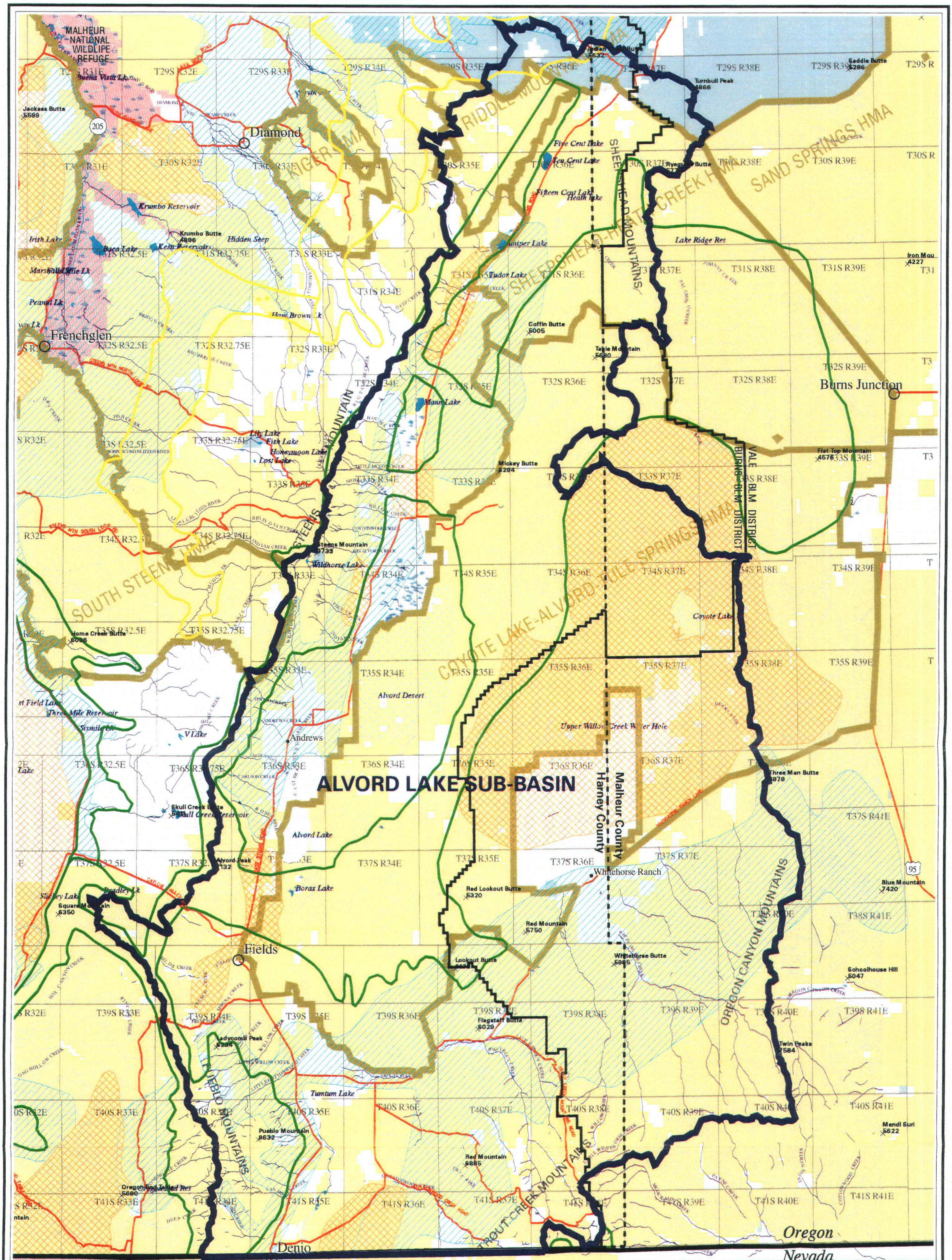


## MAP # 8 - Alvord Lake Sub-basin - WILDHORSE HMAs and BIG GAME WINTER RANGE

- Mule Deer
- Antelope
- Elk
- Bighorn Sheep
- Active Wild Horse & Burro Herd Management Areas (HMA) The Riddle Mountain, Heath Creek, Sheepshead, Alvord-Tule, Coyote Lake and South Steens HMAs all lie at least partially within the sub-basin.
- Sub-basin Boundary
- Major Roads
- Perennial Streams
- Intermittent Streams

0 1 2 3 4 5 6 MILES

Scale: 1 inch = 6.0 miles

Note: No warranty is made by Harney County or the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

See Appendix 1 for specific data disclaimers.

US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon

Date: 21-MAR-2006, Pam Keller, subbasin11x17.aml/alvbgame.ps

# WILD AND SCENIC RIVERS

**Information sources and authors**

The text for this section is taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

The Wild and Scenic Rivers Act (PL 90-542 and amendments), section 1(b), states that certain selected rivers of the nation that possess outstandingly remarkable values (ORVs): scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.

Under the Wild and Scenic Rivers (WSRs) Act, rivers are classified by Congress as either Recreational, Scenic or Wild depending on the extent of development and access along each river at the time of designation. River segments with a Wild classification are generally inaccessible except by trail, with watersheds and shorelines essentially primitive and waters unpolluted.

The peak use season for most of the WSRs is from June to late October. The most common recreational activities include hiking, fishing, hunting, and backpacking along the river corridors. Trails provide the main access to many of the rivers, and visitor use data described for the trails best represent current visitation to the river corridors.

Currently, there are only two WSR segments in the sub-basin—Wildhorse Creek and Little Wildhorse Creek flowing off the east flank of Steens Mountain. Other rivers in the sub-basin have undergone eligibility and suitability evaluations but have not been designated as Wild and Scenic Rivers.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Wild and scenic rivers have long-term watershed health value due to their protected status, making them potentially important locations for watershed health research.

**Issues, concerns and action items.**

- Encourage the use of the two WSR segments as sources of information as to the potential of other similar streams and rivers in the sub-basin.

# FIFTH FIELD WATERSHED DESCRIPTIONS

Table 18 shows the approximate surface area administration/ownership amounts within the Alvord Lake Sub-basin (Oregon). Following Table 18 is a series of general descriptions and maps of the eight 5th Field HUCs in the sub-basin.

**Table 18. BLM, State of Oregon and Private Acres in the Alvord Lake Sub-basin 5th Field Watersheds.**

| HUC | Name | BLM | % | State | % | Private | % | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 1712000901 | Cottonwood Creek | 102,500 | 87% | 0 | 0.0% | 15,400 | 13% | 117,900 |
| 1712000902 | Alvord Lake | 256,900 | 83% | 270 | 0.1% | 52,700 | 17% | 309,900 |
| 1712000903 | Big Alvord | 109,700 | 77% | 160 | 0.1% | 32,000 | 23% | 141,900 |
| 1712000904 | Whitehorse Creek | 88,200 | 74% | 0 | 0.0% | 30,300 | 26% | 118,500 |
| 1712000905 | Twelve Mile Creek | 160,000 | 90% | 80 | 0.0% | 18,000 | 10% | 178,100 |
| 1712000906 | Willow Creek | 125,000 | 82% | 480 | 0.3% | 27,000 | 18% | 152,500 |
| 1712000907 | Summit | 147,400 | 88% | 50 | 0.0% | 20,900 | 12% | 168,400 |
| 1712000908 | Quail Creek | 63,000 | 69% | 22,000 | 24.1% | 6,100 | 7% | 91,100 |
| | **Totals** | **1,052,700** | **82%** | **23,040** | **2%** | **202,400** | **16%** | **1,278,300** |

Totals may not sum due to rounding. Also, differences between these numbers and those in Map 3 are due to rounding methods.
Source—BLM GIS data

## Cottonwood Creek (5th Field HUC 1712000901—Burns BLM District)

The Cottonwood Creek 5th field watershed is the southern most in the Alvord Lake Sub-basin, with 117,900 acres in Oregon and 94,800 acres in Nevada. Data for the area in Nevada are not included in this report. This area includes portions of both the Trout Creek Mountains and the Pueblo Mountains and the area between.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the 5th field watershed (87%).

**Perennial Streams.** This 5th field watershed contains 74 miles of perennial streams.

**PFC Assessment.** Of 39.8 miles of streams assessed in the fifth field watershed, 74% were determined to be in proper functioning condition. Less than 2% of stream miles assessed were determined to be in nonfunctional condition.

**Elevation Extremes**. 8632 feet—Pueblo Peak, 4040 feet—TumTum Lake.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the Pueblo Mountains Ecological Province. Riparian vegetation and Rosgen stream type in this region is characterized as follows:

- An aspen-alder-willow vegetation zone lies from 6100 to 6400 feet. Quaking aspen-willow communities dominate. Quaking aspen, alder, Scouler willow and other willows are common. The average overstory canopy height is 33 feet. Rosgen A-B channel types are dominant with variable flood-prone widths.

- An alder-cottonwood-willow vegetation zone lies at mid-elevation from 4300 to 6100 feet. Alder-cottonwood-*Salix* communities dominate. Alder, black cottonwood, *Salix* spp., Scouler willow, Lemmon's willow, chokecherry and red osier dogwood are common. The average overstory canopy height is 28 feet. Rosgen A-B channel types are dominant with average flood-prone widths of 13-20 feet.

- A mixed willow vegetation zone lies at low-elevation below 4300 feet. Willow communities dominate with coyote willow being very common. The average overstory canopy height is 14 feet. Rosgen B-C channel types are dominant with 20 foot average flood-prone widths.

**Upland Vegetation.** The predominant vegetation types in this 5th field watershed are big sagebrush/grasslands (59%); and salt desert shrub/grassland (21%). This watershed also has the largest area of mountain shrub/grassland (5,700 acres, or 5% of the area).

**Special Management Areas.** This is the only 5th field watershed in the sub-basin that does not have a wild horse herd management area, but it does contain 38,000 acres of wilderness study areas.

**Areas of Critical Environmental Concern (ACEC).** This watershed has two ACECs, the Pueblo Foothills RNA and the Tum Tum Lake RNA, together comprising 1,697 acres.

**303(d) Listed Streams.** Two of this watershed's streams are listed for temperature: Denio Creek (RM 0-6.1), and Van Horn Creek (RM 0-8.2).

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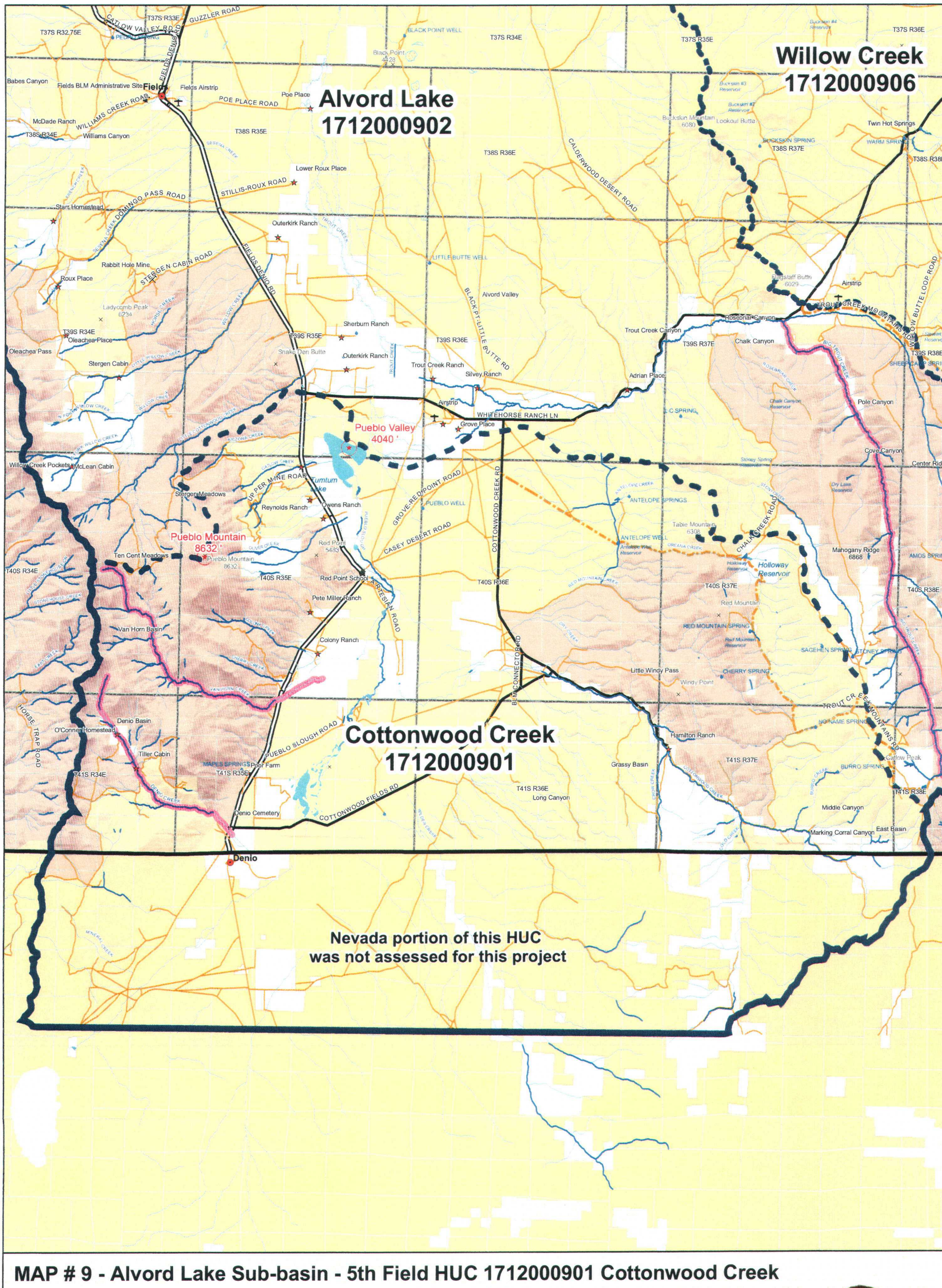


**MAP # 9 - Alvord Lake Sub-basin - 5th Field HUC 1712000901 Cottonwood Creek**

1 inch equals 2.25 miles

Prepared by: Bryce Mertz Date: March 2006

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## Alvord Lake (5th Field HUC 1712000902—Burns and Vale BLM Districts)

At 309,900 acres, this 5th field watershed is the largest in the sub-basin. The area includes part of the east face of the Steens Mountain, part of the Pueblo Mountains and the Alvord Lake area. It extends to the Trout Creek Mountains in the southeast.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the sub-basin (83%).

**Perennial Streams.** This 5th field watershed contains 161 miles of perennial streams.

**PFC Assessment.** Of 113.8 miles of streams assessed in the fifth field watershed, 68% were determined to be in proper functioning condition. Only 8% of stream miles assessed were determined to be in nonfunctional condition.

**Elevation Extremes.** 9733 feet—Steens Mountain peak, 4000 feet—Alvord Desert.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed ranges from the Steens Mountain and the Pueblo Mountains in the west, across Alvord Lake to the Trout Creek Mountains in the southeast. The diversity of terrain includes three different ecological provinces: the East Steens Mountain Ecological Province in the west, the Pueblo Mountains Ecological Province in the southwest, and the Trout Creek Mountains Ecological Province to the southeast. The riparian vegetation and Rosgen stream type in these regions is characterized as follows:

East Steens Mountain Region Ecological Province

- A black cottonwood-Pacific willow vegetation zone lies above 5200 feet. Headwater streams can extend up to 6800 feet. Cottonwood-willow communities dominate with some aspen stands. Common species are black cottonwood, Pacific willow, quaking aspen, *Salix* spp., Scouler willow and common snowberry. The average overstory canopy height is 40 feet. Rosgen A-B channel types are dominant with variable flood-prone widths.

- A Pacific willow-black cottonwood-aspen vegetation zone lies at mid-elevation from 4260 to 5200 feet. Willow-cottonwood communities dominate with some aspen stands. Pacific willow, black cottonwood, *Salix* spp. and quaking aspen are common. The average overstory canopy height is 25 feet. Rosgen B channel types are dominant with average flood-prone widths of 30 feet.

- A mixed willow vegetation zone lies at low-elevation from 4100 to 4260 feet. Willow communities dominate. Pacific willow, coyote willow, *Salix* spp. and black cottonwood are common. The average overstory canopy height is 20 feet. Rosgen B-C channel types are dominant with 33 to 43 foot flood-prone widths.

Pueblo Mountains Region Ecological Province

- An aspen-alder-willow vegetation zone lies from 6100 to 6400 feet. Quaking aspen-willow communities dominate. Quaking aspen, alder, Scouler willow and other willows are common. The average overstory canopy height is 33 feet. Rosgen A-B channel types are dominant with variable flood-prone widths.

- An alder-cottonwood-willow vegetation zone lies at mid-elevation from 4300 to 6100 feet. Alder-cottonwood-*Salix* communities dominate. Alder, black cottonwood, *Salix* spp., Scouler willow, Lemmon's willow, chokecherry and red osier dogwood are common. The average overstory canopy height is 28 feet. Rosgen A-B channel types are dominant with average flood-prone widths of 13 to 20 feet.

- A mixed willow vegetation zone lies at low-elevation below 4300 feet. Willow communities dominate with coyote willow being very common. The average overstory canopy height is 14 feet. Rosgen B-C channel types are dominant with 20 foot average flood-prone widths.

Trout Creek Mountains Region Ecological Province

- A mesic graminoid-willow vegetation zone lies above 7218 feet. Willow communities (commonly Lemmon's willow) and a variety of mesic graminoids dominate. The average overstory canopy height is 8.5 feet. Rosgen B-E channel types are dominant with variable flood-prone widths up to 36 feet.

- An aspen-willow vegetation zone lies from 6562 to 7218 feet. Aspen-willow communities dominate. Quaking aspen, Pacific willow, Geyer willow and Lemmon's willow are common. The average overstory canopy height is 29 feet. Rosgen B channel types are dominant with average flood-prone widths of 25 feet.

- A willow-alder vegetation zone lies at mid-elevation from 4500 to 6562 feet. Willow-alder communities dominate. Mountain alder, Pacific willow, Lemmon's willow and Scouler willow are common. The average overstory canopy height is 24 feet. Rosgen B-C channel types are dominant with average flood-prone widths of 55 feet.

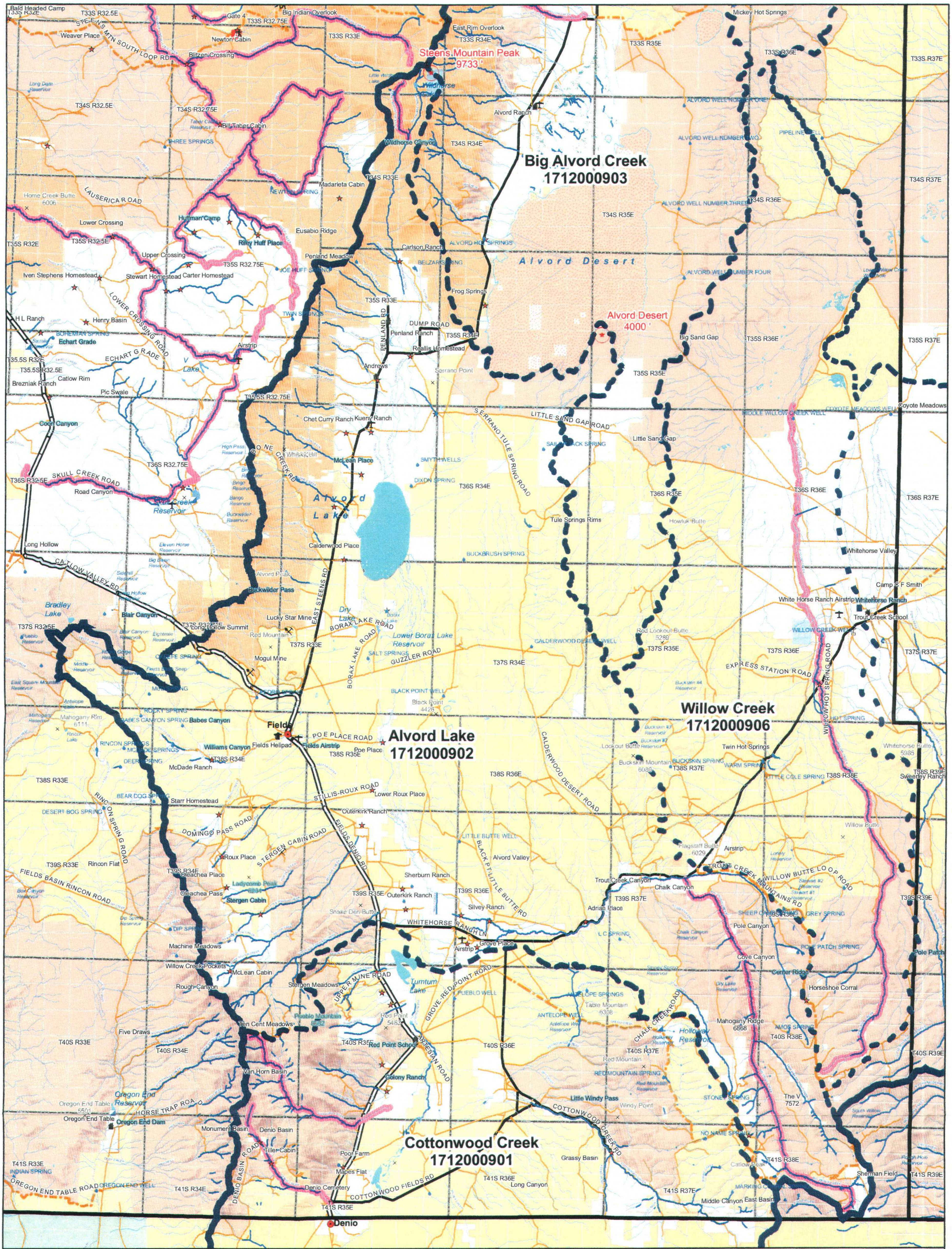
- A willow vegetation zone lies at low-elevation from 4240 to 4500 feet. Willow communities dominate. Coyote willow, yellow willow and Pacific willow are common. The average overstory canopy height is 18 feet. Rosgen B and C channel types are dominant with 70 foot average flood-prone widths.

**Upland Vegetation.** The predominant vegetation types in this 5$^{th}$ field watershed are big sagebrush/grasslands (46%); and salt desert shrub/grassland (30%), which is the largest area of salt desert shrub/grassland (93,100 acres) in any of the watersheds in this sub-basin. This area also has 46% of all of the mountain big sagebrush in the sub-basin (16,800 acres).

**Special Management Areas.** A portion (35,240 acres) of the Steens Mountain Wilderness overlaps in this watershed, and there are another 56,100 acres of wilderness study areas. Portions of three wild horse management areas overlap the watershed also, together covering 115,230 acres. The only two wild and scenic rivers designated in the Alvord Lake Sub-basin are in this watershed, Wildhorse Creek and Little Wildhorse Creek.

**Areas of Critical Environmental Concern (ACEC).** This watershed contains six ACECs, the Borax Lake ACEC, East Fork Trout Creek RNA, Little Wildhorse Lake RNA, Pueblo Foothills RNA, Serrano Point RNA, and Tum Tum Lake RNA, with a total acreage of 4,398.

**303(d) Listed Streams.** Two of this watershed's streams are listed for temperature: Big Trout Creek (RM 0-16.6), and Little Wildhorse Creek (RM 0-2.5).




## MAP # 10 - Alvord Lake Sub-basin - 5th Field HUC 1712000902 Alvord Lake

1 inch equals 3.50 miles

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Prepared by: Bryce Mertz Date: March 2006



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## Big Alvord (5th Field HUC 1712000903—Burns and Vale BLM Districts)

The 141,900 acres of this watershed includes part of the east face of the Steens Mountain, and the Alvord Desert.

**Land Ownership.** The federal government (BLM) is the majority landowner in this watershed (77%).

**Perennial Streams.** This 5$^{th}$ field watershed contains 59 miles of perennial streams.

**PFC Assessment.** Of 47.6 miles of streams assessed in the 5$^{th}$ field watershed, 94% were determined to be in proper functioning condition. No stream miles were determined to be in nonfunctional condition.

**Elevation Extremes**. 9733 feet—Steens Mountain peak, 4000 feet—Alvord Desert. The shown high elevation on Map 11 of 9600 feet is a GIS anomaly. The watershed divide goes over the Steens Mountain peak and it consequently is the high point in both HUC 1712000902 and 1712000903.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the East Steens Mountain Ecological province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- A black cottonwood-Pacific willow vegetation zone lies above 5200 feet. Headwater streams can extend up to 6800 feet. Cottonwood-willow communities dominate with some aspen stands. Common species are black cottonwood, Pacific willow, quaking aspen, *Salix* spp., Scouler willow and common snowberry. The average overstory canopy height is 40 feet. Rosgen A-B channel types are dominant with variable flood prone widths.

- A Pacific willow-black cottonwood-aspen vegetation zone lies at mid-elevation from 4260 to 5200 feet. Willow-cottonwood communities dominate with some aspen stands. Pacific willow, black cottonwood, *Salix* spp. and quaking aspen are common. The average overstory canopy height is 25 feet. Rosgen B channel types are dominant with average flood prone widths of 30 feet.

- A mixed willow vegetation zone lies at low-elevation from 4100 to 4260 feet. Willow communities dominate. Pacific willow, coyote willow, *Salix* spp. and black cottonwood are common. The average overstory canopy height is 20 feet. Rosgen B-C channel types are dominant with 33-43 foot flood prone widths.

**Upland Vegetation.** The predominant vegetation types in this 5$^{th}$ field watershed are big sagebrush/grasslands (36%) and salt desert shrub/grassland (26%). This watershed also has the largest area of playa in the sub-basin (26,900 acres, 19% of the watershed).

**Special Management Areas.** Some 18,267 acres of the Steens Mountain Wilderness overlaps in this watershed, which also contains 67,800 acres of wilderness study areas. Two different wild horse herd management areas comprise 85,560 acres.

**Areas of Critical Environmental Concern (ACEC).** There are five ACECs in this watershed, the Alvord Desert ACEC, Big Alvord Creek RNA, Mickey Basin RNA, Mickey Hot Springs ACEC, and South Fork Willow Creek RNA, which together comprise 22,476 acres.

**303(d) Listed Streams.** One stream in this watershed is listed for temperature: Willow Creek (RM 0-5.3), flowing off the east flank of the Steens Mountain.

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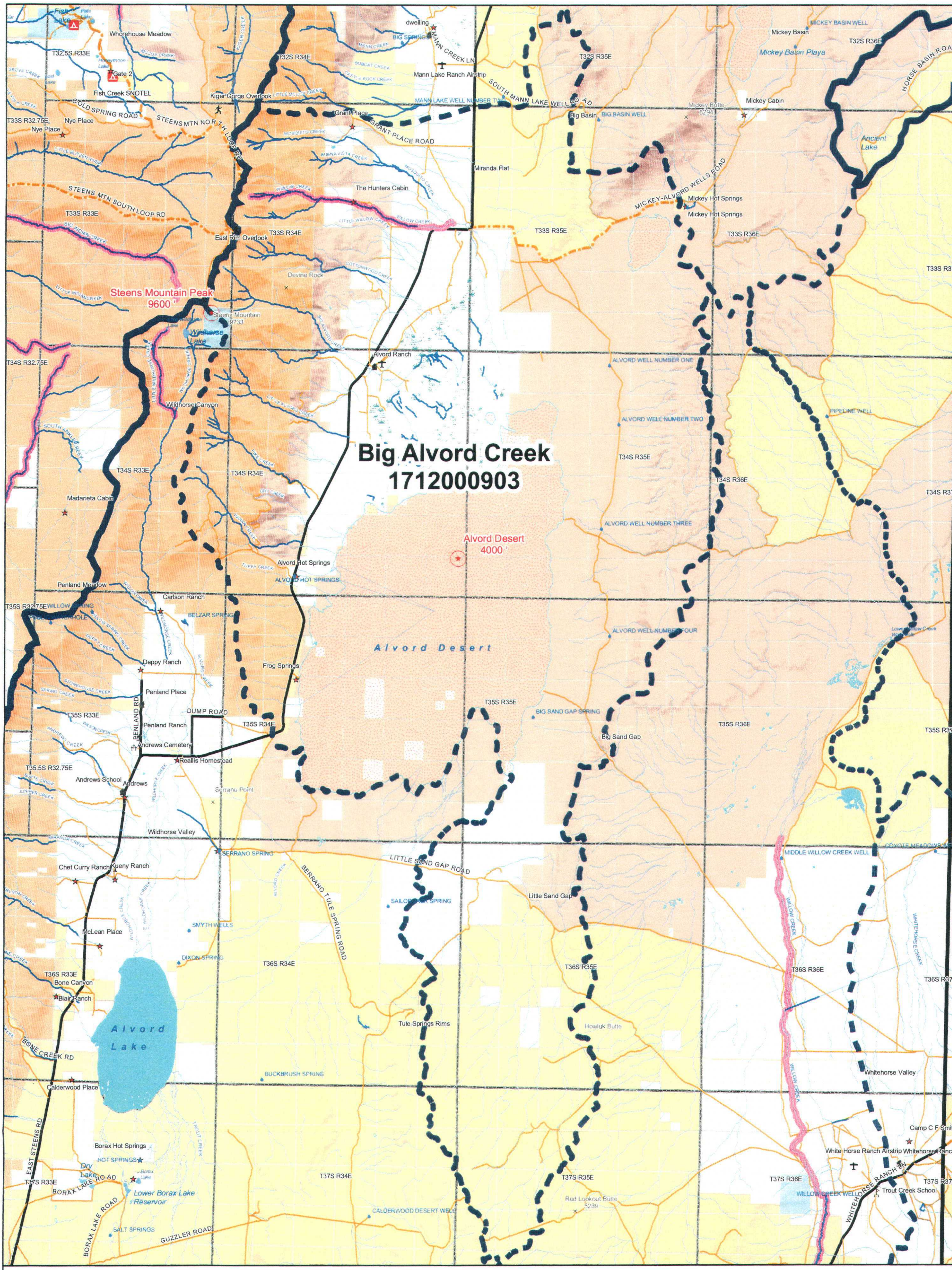


# MAP # 11 - Alvord Lake Sub-basin - 5th Field HUC 1712000903 Big Alvord Creek

1 inch equals 2.25 miles

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Prepared by: Bryce Mertz Date: March 2006

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## Whitehorse Creek (5th Field HUC 1712000904—Burns and Vale BLM Districts)

This 118,500 acre watershed is in the southeast corner of the sub-basin. Whitehorse Creek and its tributaries drain the west side of the Oregon Canyon Mountains and the east side of the Trout Creek Mountains.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in this fifth field watershed (74%). This watershed has the largest percentage of private land holdings of all the fifth field watersheds in the Alvord Lake Sub-basin (26%, 30,300 acres).

**Perennial Streams.** This 5th field watershed contains 84 miles of perennial streams.

**Riparian Trend Assessment.** Of 85 miles of streams assessed in the fifth field watershed, it was determined that the riparian trend was upward for 99%.

**Elevation Extremes**. 8000 feet—unnamed ridge in Trout Creek Mountains, 4120 feet—Coyote Meadows.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the Willow-Whitehorse Ecological Province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- An aspen vegetation zone lies at elevations from 5800 to 7000 feet. Aspen communities dominate. The average overstory canopy height is 30 feet. The riparian buffer width is 20 feet.

- A mountain alder vegetation zone lies at elevations from 5000 to 5800 feet. Mountain alder communities dominate. The average overstory canopy height is 25 feet. The riparian buffer width is 30 feet.

- A mixed willow vegetation zone lies at elevations below 5000 feet. Willow communities dominate. The average overstory canopy height is 18 feet. The riparian buffer width varies from 40-60 feet.

**Upland Vegetation.** The predominant vegetation types in this 5th field watershed are big sagebrush/grasslands (36%); and salt desert shrub/grassland (17%). This watershed also has the most quaking aspen in the sub-basin (8,100 acres, 7% of the 5th field).

**Special Management Areas.** Wilderness study areas comprise 63,600 acres in this watershed, and there are 5,540 acres in wild horse management areas.

**Areas of Critical Environmental Concern (ACEC).** The small (61 acres) Little Whitehorse Creek RNA is the only ACEC in this watershed.

**303(d) Listed Streams.** None

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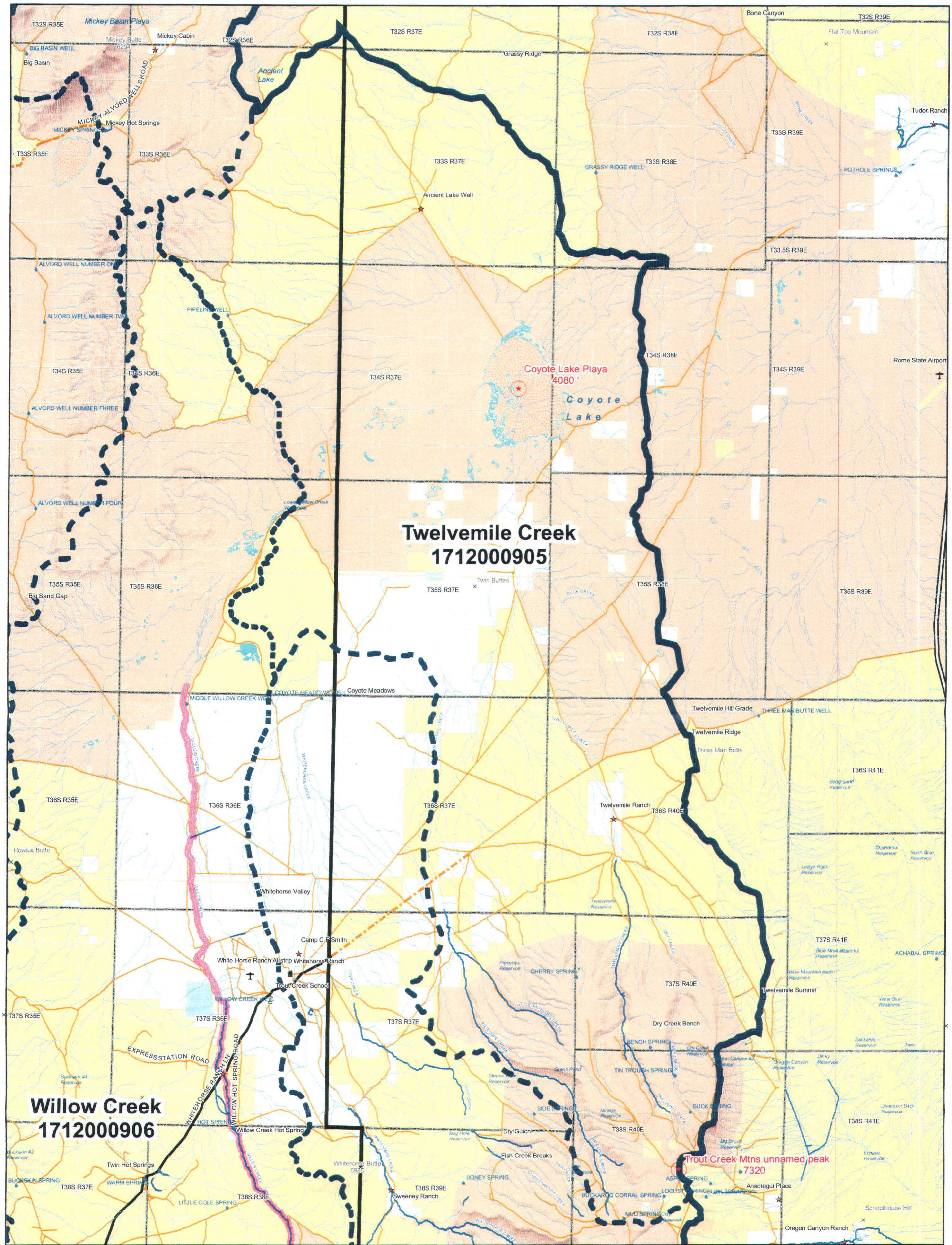


## MAP # 13 - Alvord Lake Sub-basin - 5th Field HUC 1712000905 Twelve Mile Creek

1 inch equals 2.50 miles

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5th Field Watersheds
Alvord Lake Sub-Basin
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BLM Wilderness
BLM Wilderness Study Area
State Land
Private Land
303D Listed Streams

Perennial Lake
Intermittent Lake
Dry Lake
Marsh
Perennial Streams
Intermittent Streams

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Arterial Roads
Collector Roads
Local Roads

Prepared by: Bryce Mertz Date: March 2006

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## Twelve Mile Creek (5th Field HUC 1712000905—Burns and Vale BLM Districts)

The 178,100 acres of this watershed on the east side of the Alvord Lake Sub-basin include the Coyote Lake area.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the fifth field watershed (90%).

**Perennial Streams.** This 5th field watershed contains 26 miles of perennial streams.

**Riparian Trend Assessment.** For all 36.3 miles of streams assessed in the 5th field watershed, a riparian trend was not determined.

**Elevation Extremes.** 7320 feet—unnamed peak in Trout Creek Mountains, 4080 feet—Coyote Lake Playa.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the Willow-Whitehorse Ecological Province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- An aspen vegetation zone lies at elevations from 5800 to 7000 feet. Aspen communities dominate. The average overstory canopy height is 30 feet. The riparian buffer width is 20 feet.
- A mountain alder vegetation zone lies at elevations from 5000 to 5800 feet. Mountain alder communities dominate. The average overstory canopy height is 25 feet. The riparian buffer width is 30 feet.
- A mixed willow vegetation zone lies at elevations below 5000 feet. Willow communities dominate. The average overstory canopy height is 18 feet. The riparian buffer width varies from 40-60 feet.

**Upland Vegetation.** The predominant vegetation types in this 5th field watershed are big sagebrush/grasslands (69%); and salt desert shrub/grassland (12%). This watershed is the only one containing the black sagebrush vegetative type (11,900 acres, or 7% of the 5th field watershed area). Twelve Mile Creek also has 51% of the sub-basin's native perennial grasslands (2,100 acres).

**Special Management Areas.** This watershed contains 89,800 acres of wilderness study area, and 122,000 acres in two wild horse herd management areas.

**Areas of Critical Environmental Concern ACEC).** The Dry Creek Bench RNA totals 1,592 acres in this watershed.

**303(d) Listed Streams.** None.

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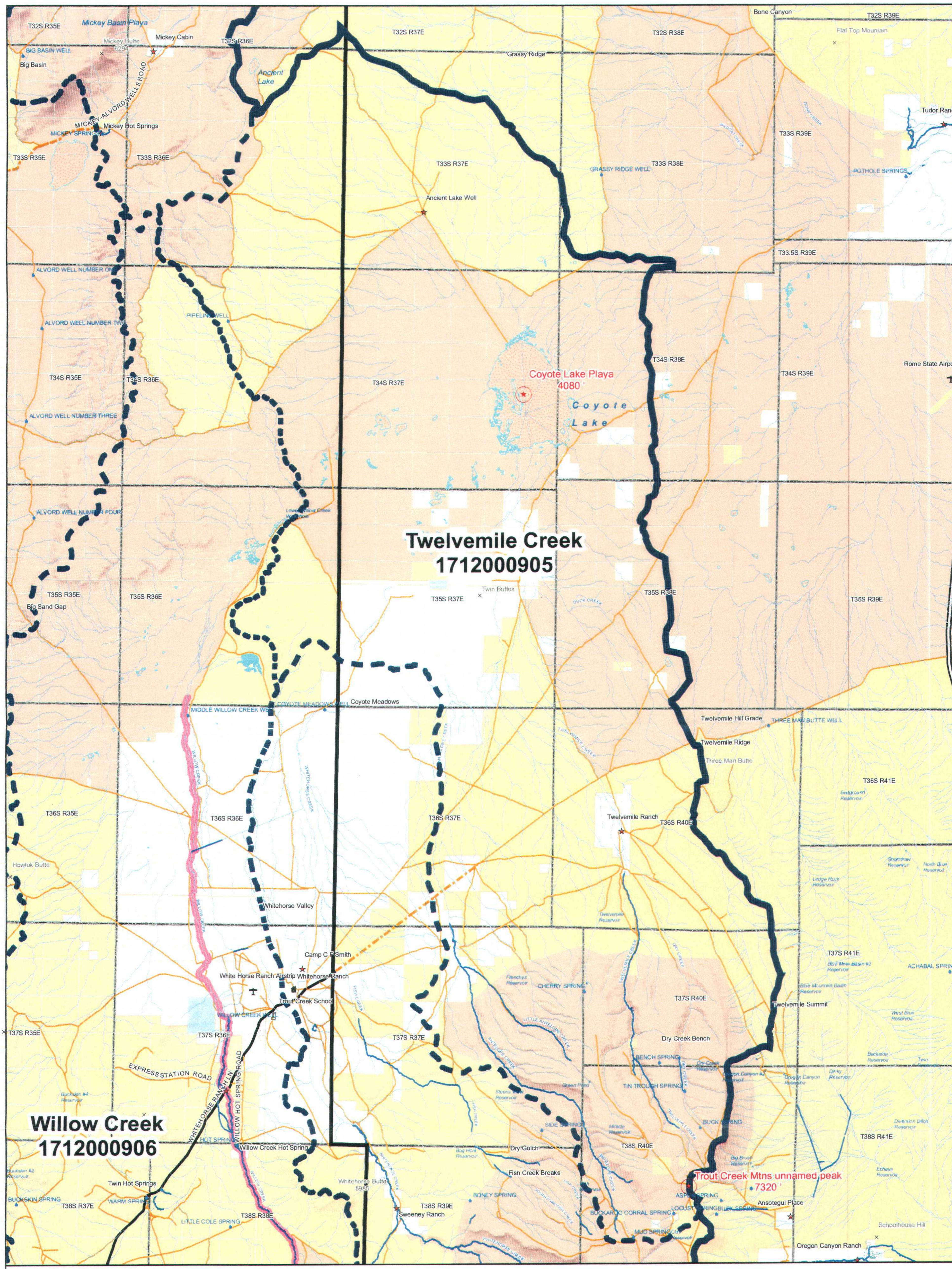


## MAP # 13 - Alvord Lake Sub-basin - 5th Field HUC 1712000905 Twelve Mile Creek

1 inch equals 2.50 miles

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## Willow Creek (5th Field HUC 1712000906—Burns and Vale BLM Districts)

This long, narrow watershed of 152,500 acres lies in the interior of the sub-basin. Willow Creek is the dominant stream that flows northerly from the Trout Creek Mountains into the Coyote Lake basin.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the 5th field watershed (82%).

**Perennial Streams.** This 5th field watershed contains 31 miles of perennial streams.

**Riparian Trend Assessment.** Of 29 miles of streams assessed in the fifth field watershed, the riparian trend was upward for 90%.

**Elevation Extremes.** 7879 feet—Chick Peak in Trout Creek Mountains, 4160 feet—Upper Willow Creek Waterhole Flats.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the Willow-Whitehorse Ecological Province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- An aspen vegetation zone lies at elevations from 5800 to 7000 feet. Aspen communities dominate. The average overstory canopy height is 30 feet. The riparian buffer width is 20 feet.

- A mountain alder vegetation zone lies at elevations from 5000 to 5800 feet. Mountain alder communities dominate. The average overstory canopy height is 25 feet. The riparian buffer width is 30 feet.

- A mixed willow vegetation zone lies at elevations below 5000 feet. Willow communities dominate. The average overstory canopy height is 18 feet. The riparian buffer width varies from 40-60 feet.

**Upland Vegetation.** The predominant vegetation types in this 5th field watershed are big sagebrush/ grasslands (55%); and salt desert shrub/grassland (25%). This watershed also has 48% of the sub-basin's rabbitbrush/grassland communities (13,900 acres).

**Special Management Areas.** Wilderness study areas comprise 53,000 acres in this watershed. There are also 71,300 acres in two wild horse herd management areas.

**Areas of Critical Environmental Concern (ACEC).** This watershed has only one ACEC, a small portion (1,018 acres) of the Alvord Desert ACEC.

**303(d) Listed Streams.** The Willow Creek TMDL was drafted by ODEQ in 1999 after data collection indicated that the watershed was not meeting the state's temperature and dissolved oxygen standards. The TMDL applies to all streams in the Willow Creek watershed, including Willow Creek, Jawbone Creek and an unnamed tributary to Jawbone Creek.

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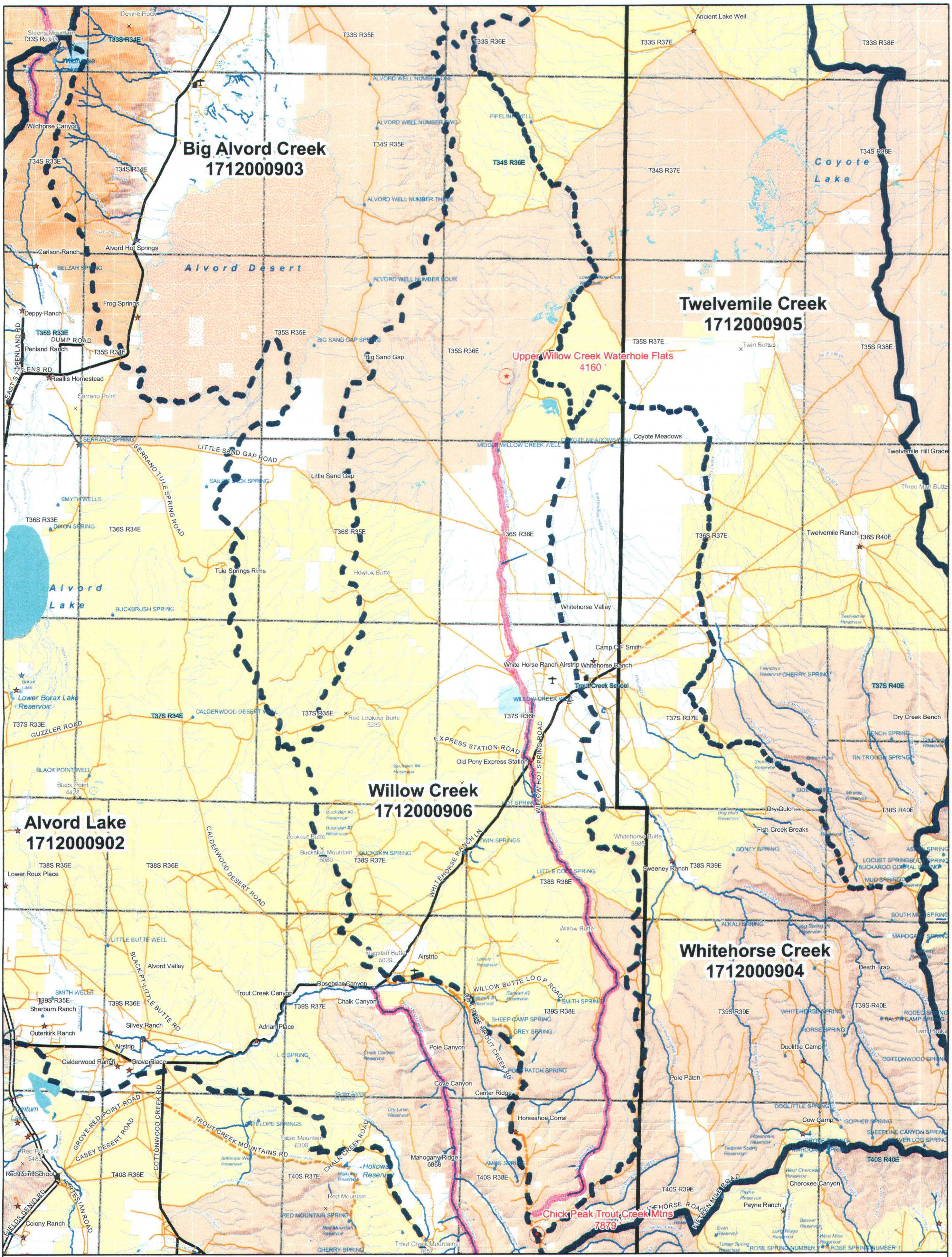


# MAP # 14 - Alvord Lake Sub-basin - 5th Field HUC 1712000906 Willow Creek

1 inch equals 3.00 miles

High and Low Elevations
5th Field Watersheds
Alvord Lake Sub-Basin
Township and Range
Sections
County Boundary

BLM Land
BLM Wilderness
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Prepared by: Bryce Mertz Date: March 2006

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## Summit (5th Field HUC 1712000907—Burns and Vale BLM Districts)

This 168,400 acre watershed drains the east face of the north end of the Steens Mountain, and from the Table Mountain area to the east.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the 5th field watershed (88%).

**Perennial Streams.** This 5th field watershed contains 50 miles of perennial streams.

**PFC Assessment.** Of 12 miles of streams assessed in the fifth field watershed, 78% were determined to be in proper functioning condition. No stream miles were determined to be in nonfunctional condition.

**Elevation Extremes**. 9348 feet—northern peak of Steens Mountain, 3920 feet—Mickey Basin.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the East Steens Mountain Ecological province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- A black cottonwood-Pacific willow vegetation zone lies above 5200 feet. Headwater streams can extend up to 6800 feet. Cottonwood-willow communities dominate with some aspen stands. Common species are black cottonwood, Pacific willow, quaking aspen, *Salix* spp., Scouler willow and common snowberry. The average overstory canopy height is 40 feet. Rosgen A-B channel types are dominant with variable flood-prone widths.

- A Pacific willow-black cottonwood-aspen vegetation zone lies at mid-elevation from 4260 to 5200 feet. Willow-cottonwood communities dominate with some aspen stands. Pacific willow, black cottonwood, *Salix* spp. and quaking aspen are common. The average overstory canopy height is 25 feet. Rosgen B channel types are dominant with average flood-prone widths of 30 feet.

- A mixed willow vegetation zone lies at low-elevation from 4100 to 4260 feet. Willow communities dominate. Pacific willow, coyote willow, *Salix* spp. and black cottonwood are common. The average overstory canopy height is 20 feet. Rosgen B-C channel types are dominant with 33 to 43 foot flood-prone widths.

**Upland Vegetation.** The predominant vegetation types in this 5th field watershed are big sagebrush/ grasslands (52%); and salt desert shrub/grassland (20%). This watershed is one of the two northern most watersheds (907 and 908). These two watersheds the only two in the sub-basin which have the silver sagebrush/grassland plant community (2,100 acres in this watershed). This 5th field watershed also has the largest area of juniper/sagebrush plant community (16,900 acres, or 10% of the 5th field watershed area).

**Special Management Areas.** Some 2,477 acres of the Steens Mountain Wilderness overlaps into this watershed, and there are 100,000 acres of designated wilderness study areas. Portions of four wild horse herd management areas cover 101,000 acres of the watershed.

**Areas of Critical Environmental Concern (ACEC).** Portions of the Kiger Mustang ACEC, Mickey Basin RNA and the Mickey Hot Springs ACEC comprise 18,565 acres of this watershed.

**303(d) Listed Streams.** None.

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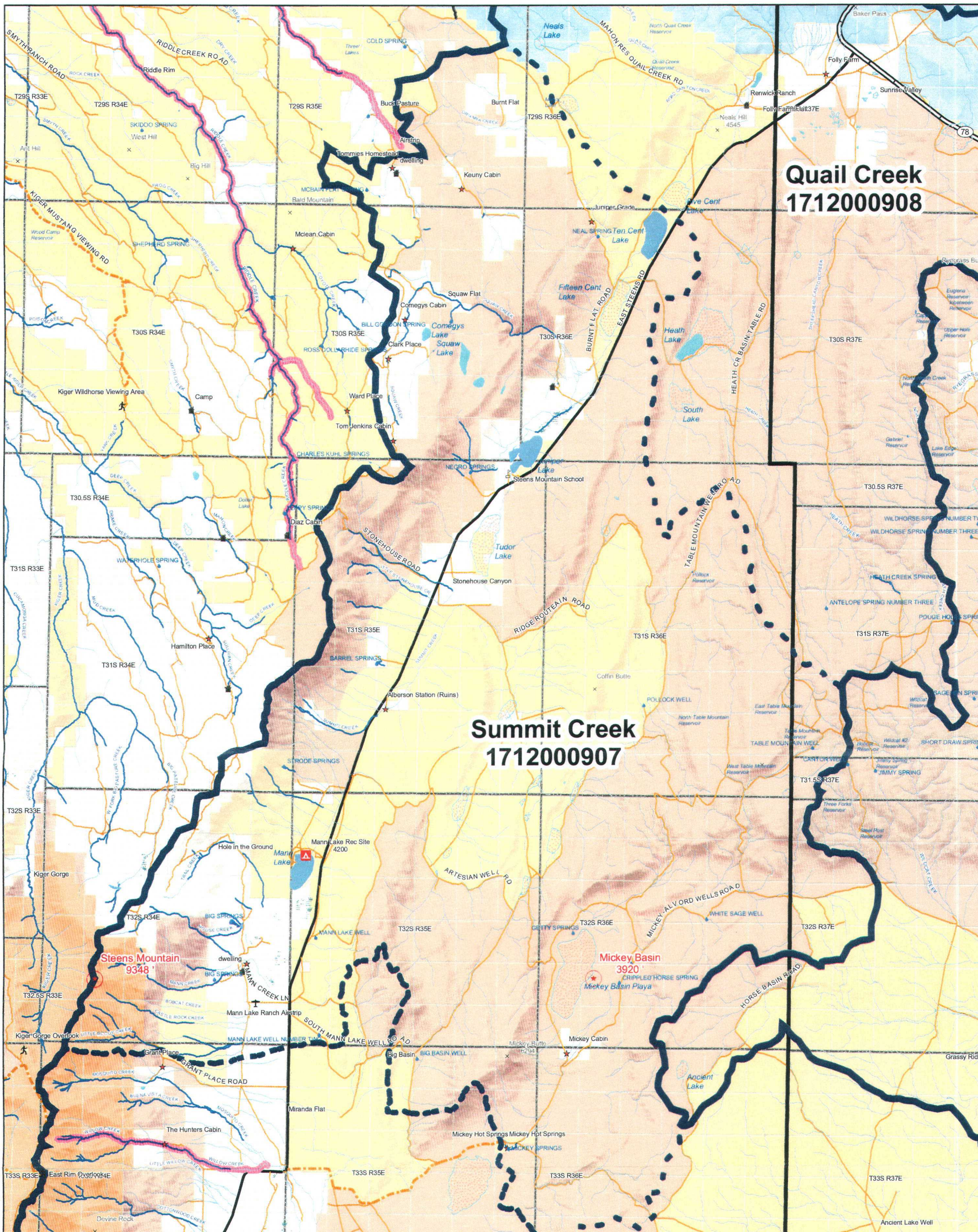


## MAP # 15 - Alvord Lake Sub-basin - 5th Field HUC 1712000907 Summit Creek

1 inch equals 2.25 miles

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Prepared by: Bryce Mertz Date: March 2006

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## Quail Creek (5th Field HUC 1712000908—Burns and Vale BLM Districts)

At 91,030 acres, the Quail Creek watershed is the smallest and most northern in the Alvord Lake Sub-basin.

**Land Ownership.** The Federal Government (BLM) is the majority landowner in the 5$^{th}$ field watershed (69%). Twenty-four percent (22,000 acres) of this watershed is state land. These 22,000 acres are 95% of all of the state land in the sub-basin. Seven percent of the watershed is private land—the lowest percentage of private land of all eight 5$^{th}$ field watersheds.

**Perennial Streams.** This 5$^{th}$ field watershed contains 0.8 miles of perennial streams.

**PFC Assessment.** None.

**Elevation Extremes**. 6289 feet—unnamed peak in Sheepshead Mountains, 4080 feet—Folly Farm Flat.

**Riparian Vegetation and Rosgen Stream Types** (from Oregon TMDL document, see discussion page 39-45). This watershed lies in the East Steens Mountain Ecological province. Riparian vegetation and Rosgen stream type in this province is characterized as follows:

- A black cottonwood-Pacific willow vegetation zone lies above 5200 feet. Headwater streams can extend up to 6800 feet. Cottonwood-willow communities dominate with some aspen stands. Common species are black cottonwood, Pacific willow, quaking aspen, *Salix* spp., Scouler willow and common snowberry. The average overstory canopy height is 40 feet. Rosgen A-B channel types are dominant with variable flood prone widths.

- A Pacific willow-black cottonwood-aspen vegetation zone lies at mid-elevation from 4260 to 5200 feet. Willow-cottonwood communities dominate with some aspen stands. Pacific willow, black cottonwood, *Salix* spp. and quaking aspen are common. The average overstory canopy height is 25 feet. Rosgen B channel types are dominant with average flood-prone widths of 30 feet.

- A mixed willow vegetation zone lies at low-elevation from 4100 to 4260 feet. Willow communities dominate. Pacific willow, coyote willow, *Salix* spp. and black cottonwood are common. The average overstory canopy height is 20 feet. Rosgen B-C channel types are dominant with 33 to 43 foot flood-prone widths.

**Upland Vegetation.** The predominant vegetation type in this 5$^{th}$ field watershed is big sagebrush/grasslands (87%). This watershed is one of the two northern most watersheds (907 and 908). These two watersheds the only two in the sub-basin which have the silver sagebrush/grassland plant community (2,300 acres in this watershed). This is the only watershed in the sub-basin without the salt desert shrub/grassland plant community.

**Special Management Areas.** Wilderness study areas comprise 51,700 acres in this watershed, along with 67,200 acres in portions of four wild horse herd management areas.

**Areas of Critical Environmental Concern (ACEC).** This watershed contains only a portion of one ACEC, the Kiger Mustang ACEC (6,850 acres).

**303(d) Listed Streams.** None.

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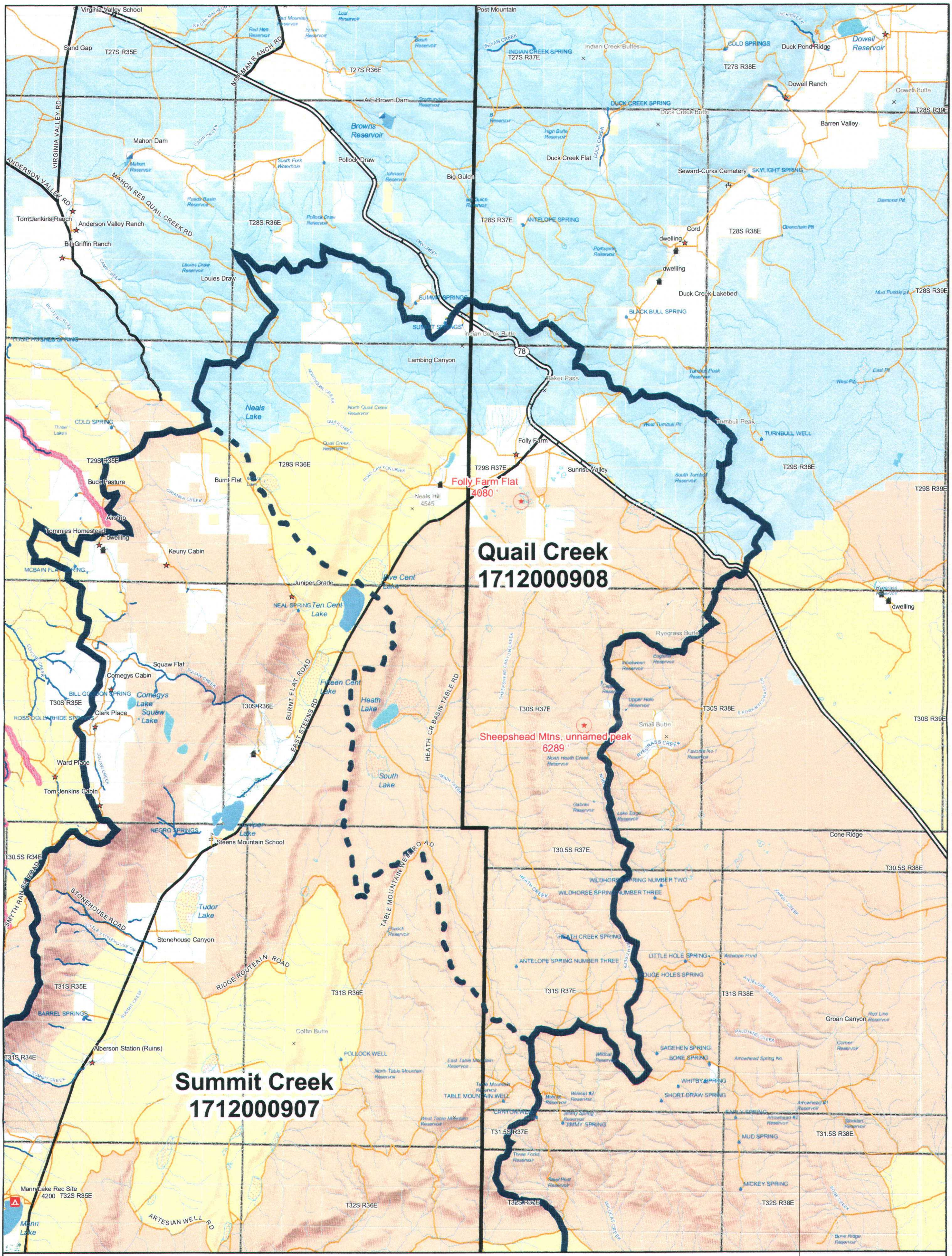


## MAP # 16 - Alvord Lake Sub-basin - 5th Field HUC 1712000908 Quail Creek

1 inch equals 2.25 miles

N W E S

High and Low Elevations
5th Field Watersheds
Alvord Lake Sub-Basin
Township and Range
Sections
County Boundary

BLM Land
BLM Wilderness
BLM Wilderness Study Area
State Land
Private Land
303D Listed Streams

Perennial Lake
Intermittent Lake
Dry Lake
Marsh
Perennial Streams
Intermittent Streams

Paved Roads
County Roads
Arterial Roads
Collector Roads
Local Roads

Prepared by: Bryce Mertz Date: March 2006



HARNEY COUNTY GIS
In cooperation with
The Bureau of Land Management
Burns District Office; Burns, Oregon
541-573-8195
www.co.harney.or.us

# Chapter 4 - Land and Resources: Use and Management

This chapter contains information on various land use and management topics not previously discussed. Many of the topics have little effect on watershed health in the Alvord Lake Sub-basin.

Photo courtesy of BLM

## HISTORICAL LAND USE

**Information sources and authors**

Most of the text for this section was taken directly from the Andrews FEIS. A small amount was summarized and rewritten by HCWC.

### Archaeological Resources

Archaeological evidence indicates that the area has been inhabited by humans for the last 10,000 years. Prehistoric occupation has been continuous, although population density and patterns of use have varied according to changing climatic cycles. Small, highly mobile family groups of hunters and gatherers were the norm during most of the year, though larger groups gathered at winter camps in the valley bottoms.

Archaeological sites, the material remains of this prehistoric presence, are a commonplace yet fragile reminder of prehistoric activity in the area. Prehistoric sites include stone flake scatters, larger more complex campsites, toolstone quarries, rock shelters and caves, rock art and rock structures such as rock rings (wickiup supports), rock cairns, and hunting blinds. Many Paiute elders and younger tribal members have continued traditional practices such as marmot hunting, root gathering, and fruit harvesting.

Fur trappers were the first Euro-Americans to visit the area in a brief foray in 1826. The next visitors came in the 1840s and 1850s. The area was settled in the 1870s and the most arable land with water was claimed shortly thereafter. By 1920 most settlers were driven away from the area by cold winters, summer frost, and drought. Historic sites in the area include wagon roads, homesteads, the town site of Andrews, Basque sheep camps with carved aspen, Rose Valley Borax Works at Borax Lake, and historic trash dumps.

## Paleontological Resources

Paleontological resources are defined as the fossilized remains of plants and animals. Of particular interest are vertebrate fossils such as those of camels, saber toothed cats, rhinos, mammoths, giant sloths, turtles, and horses. Fossil localities have been reported on public land in the area. Most of the finds have been exposed by wind or water erosion, and are widely dispersed. Several localities are the subject of ongoing academic research. Small exposures of Miocene sedimentary rocks are exposed at the base of the east face of Steens Mountain, west of the East Steens Road. Known locations of plant fossils are on private and public land, as well as several unexplored exposures that are likely to contain animal fossils.

Animal remains from sabertooth cats, mastodons, giant camels, small camels (llama-like), horses, and horned rodents are found in the area. A plant locality within the area yielded a flora composed of the following plants: true fir, spruce, pine, Douglas fir, juniper, cottonwoods, willow, hornbeam, barberry, serviceberry, mountain mahogany, cherry, rose, mountain ash, indigo bush, sumac, maple, buckbrush, and madrona. This flora would normally occur in a small lake environment in a slightly warmer, more temperate climate than exists in the area today.

These fossil localities, especially the known and potential localities, are highly significant because they are a window to an environment that existed millions of years ago. They are non-renewable, extremely fragile, and usually small in extent. The precise number of acres encompassed by these localities is unknown because they have not been completely described and mapped.

## Cultural Resources

A cultural resource is generally defined by federal agencies as any location of human activity that occurred at least 50 years ago, and that is identifiable through field survey, historical documentation, or oral evidence. Native American traditional practice areas are a special category of cultural resources. Some cultural resources may be less than 50 years old, but have cultural or religious importance to American Indian tribes or paramount historic interest to the public.

Federal antiquity laws require consideration of cultural resource values through consultation, a process designed to encourage protection of cultural properties prior to project approval. This often necessitates intensive surveys and recording where existing data are insufficient to make an assessment. If significant sites cannot be avoided during construction activities, the adverse effects are mitigated through data recovery by excavation, surface collection, photography and recording, and analysis.

Prehistoric, or pre-Euro-American contact, cultural resources include lithic scatters, rock shelters, midden deposits, house depressions, petroglyphs, hearths, and rock alignments. Historic cultural resources include buildings and building ruins, wagon roads, irrigation ditches and associated structures, dams, and archaeological deposits such as trash scatters.

Almost all of the cultural resource inventories in the area have been for project-specific activities, rather than initiated by the Cultural Resource Program; therefore, the surveys are not necessarily in areas of highest site potential. Only seven percent of the public land in the area has been inventoried for cultural resources. Earliest inventories and site records are of poor quality and do not conform with more recently approved data standards of the State Historic Preservation Office or the BLM Cultural Resource Program.

The archaeological record in the area is extensive in terms of the numbers of sites and their antiquity. Evidence exists in the area of some of the earliest occupation in North America, 11,500 years ago. Prehistoric sites are those older than about 1850 A.D. and include the following: stone flake scatters, habitation sites, toolstone quarries, rock shelters and caves, rock art and rock structures such as rock rings (wickiup supports), and hunting blinds. Historic sites post-date 1850 A.D. and include the following: abandoned and intact townsites, homesteads, buildings, stone or wood structures, wagon roads, military sites, and trash scatters.

Cultural resources become degraded by 1) natural processes such as erosion, 2) by human actions such as road construction, livestock grazing, rangeland development, recreation, and mechanized vehicle travel, and 3) by illegal artifact collection and excavation. The majority of archaeological sites are reported good to excellent condition in the Steens Mountain CMPA (76%) and the Andrews Management Unit (66%). Where impacts have been reported, the largest percentage by cause was illegal collecting and excavation in the CMPA (26%), and erosion in the Andrews Management Unit (32%).

## Native American Traditional Practices

Prior to Euro-American settlement, the area was occupied and used by Northern Paiute bands. Many of their descendants now live on the Burns Paiute Reservation in Burns, Oregon; the Warm Springs Reservation in Warm Springs, Oregon; and the Fort McDermitt Reservation in McDermitt, Nevada.

No specific Native American traditional practice areas have been identified in the area. However, according to the Burns Paiute Tribal Cultural Resource Manager, traditional resource areas and spiritual locations are used by tribal members and known tribal historic sites do exist in the Steens Mountain area. In addition, Steens Mountain served as a hideout or refuge during and after the Bannock War of 1878. Some of the Burns Paiute Elders refer to Steens Mountain as “Old Man” and consider it a sacred site. Specific traditional practice site location information has not been released to the BLM because the tribe is concerned about data security.

Resources traditionally used in the area include a wide variety of plant and animal foods, as well as materials for making tools and shelter. Edible roots include biscuitroot, bitterroot, camas, carrots, and onions. Available in the area are seeds of goosefoot, Indian rice grass, Great Basin wild rye, and berries such as chokecherry, currants, and elderberry. Game animals include various waterfowl, trout and chub, marmots, antelope, and big horn sheep, which are found in specific habitats in the Steens Mountain area. Other game such as mule deer, waterfowl, sage-grouse, rabbit, and ground squirrel have more widespread distribution. Plants such as red osier dogwood, willow, tules, and cattails are found in riparian or marshland settings, while grasses for basketry and food seeds are encountered in upland and sand dune environments. The bands of quaking aspen on the mid-slopes of the sub-basin’s mountains are sources of posts for hide working, and mountain mahogany for bows and digging sticks grows on the rocky ridges at and above the juniper zone. Basalt and cryptocrystalline silicate toolstone sources are found at various locations in the area.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

The topics discussed in this section are generally not considered by HCWC to now have any significant effects on watershed attributes and health. However, HCWC believes maintaining good watershed health attributes will in general help reduce degradation of archeological, paleontological and cultural resources.

**Issues, concerns and action items.**

- Proper management for preservation of archeological, paleontological and cultural resources should be encouraged, as that management should result in positive watershed health attributes.

# ENERGY AND MINERAL RESOURCES

**Information sources and authors**

The text for this section comes mostly from the Andrews FEIS. That document was written for an area within the Burns BLM District which includes most of, but is larger than, the Alvord Lake Sub-basin. HCWC has rewritten parts of this text to make it more specifically applicable to the sub-basin. We have left other parts intact from the original document where those parts are informative about the sub-basin in relation to the surrounding lands.

The BLM manages energy and mineral resources on federal lands in the Alvord Lake Sub-basin which have either federal surface or federal subsurface (mineral estate) ownership. There is some non-federal mineral estate ownership on land within the sub-basin. For these discussions, minerals are considered to be in three categories: locatable, leasable, and salable. See definitions for these three mineral types in the Glossary and the discussions below starting on the next page.

A Mineral Withdrawal Area was designated by the Steens Mountain Cooperative Management and Protection Act (2000) (called Steens Act hereinafter) which encompasses over 1.18 million acres and includes the entire Cooperative Management and Protection Area (CMPA) and Steens Mountain Wilderness, as well as the eastern portion of the Andrews Management Unit, a section of the Jordan Resource Area in the Vale District, and the Diamond Craters area of the Three Rivers Resource Area. The portion of the Alvord Lake Sub-basin within the Mineral Withdrawal Area is shown in Map 17, page 163.

Subject to valid existing rights, no mining or exploration will be permitted anywhere in the Mineral Withdrawal Area except at those sites specifically identified in the Steens Act as follows: Section 401(b) of the Steens Act ". . . The Secretary may permit the development of salable mineral resources, for road maintenance only, in those locations identified . . . as an existing 'gravel pit' within the mineral withdrawal boundaries (excluding the Steens Mountain Wilderness, WSAs, and designated segments of the National WSR System) where such development was authorized before the date of enactment of this Act." The salable minerals sites specifically identified in the Steens Act cover 513 acres within the Mineral Withdrawal Area. There are six grandfathered mining claims covering 120 acres in the Mineral Withdrawal Area. They are outside of the Steens Mountain Wilderness, WSRs, and WSAs in the eastern part of the sub-basin. Those mining claims are undergoing a validity exam to determine valid existing rights.

No grandfathered mining claims, mineral leases, or salable mineral sites are located in the Steens Mountain Wilderness, WSRs, or WSAs except for one salable minerals source. Red Point School Materials Source is a grandfathered sand and gravel source in the Pueblo Mountains WSA and it is located approximately 15 miles south of Fields adjacent to the paved Fields-Denio Road.

Historic mining (for mercury, thundereggs, and moss agate) and prospecting (for mercury, uranium, gold, and copper) were almost entirely located in areas that are now within the Mineral Withdrawal Area and WSAs. Most of the potentially hazardous sites are within the Mineral Withdrawal Area and WSAs. Some of the potentially hazardous sites are abandoned mine shafts and adits that will be remediated after activity-level analysis and some are areas of naturally occurring levels of arsenic and mercury detected in sediment analyses by USGS that are typical of mineralized areas.

Most of the ACECs (pages 158-159) in the sub-basin are within the Mineral Withdrawal Area and are already withdrawn from locatable, leasable, and salable mineral exploration and development. Three ACECs are outside of the Mineral Withdrawal Area but inside WSAs: Dry Creek Bench, RNA, Pueblo Foothills

RNA, and East Fork Trout Creek RNA and they are open to mining claims but closed to surface disturbing exploration and development activities for locatable minerals under a notice or plan of operations; they are closed to leasable and salable mineral exploration and development activities.

Creeks that contain federally-listed threatened or endangered fish species (Lahontan cutthroat trout) outside of the Mineral Withdrawal Area are Denio Creek and Van Horn Creek. Van Horn Creek is within the Pueblo Mountains Wilderness Study Area (WSA). There are no grandfathered claims, leases, nor salable mineral sources along Van Horn Creek. Periodically there are mining claims along Denio Creek. No minerals activities, including casual use activities, may result in harm to the threatened or endangered fish or its habitat. Activities that would cause harm to habitat include water withdrawal from the creek and its tributaries and excavation operations that result in increased siltation to the creek.

As discussed in the section on special status fish (page 53) the public land around Borax Lake is within the Mineral Withdrawal Area. This legal reclassification of that land has removed the once real threat of geothermal exploration in the area and the possible consequences to the thermal properties of Borax Lake and to the Borax Lake chub.

## Locatable Minerals

Locatable minerals in the area are gold, mercury, uranium, diatomite, copper, molybdenum, and sunstones. Exploration is sporadic. Currently, one exploration/mining area is active, containing sunstones. The sunstone claims are within the Mineral Withdrawal Area and are undergoing a validity exam to determine valid existing rights. In October 2001, 31 mining claims were located in the sub-basin outside of the Mineral Withdrawal Area and there was no surface disturbing activity on those claims.

The USGS reports indicate that a typical gold deposit in this area would require mining of twice as much rock to obtain half as much gold compared to a typical gold deposit in the Oregon-Idaho Graben south of Vale, Oregon, so it is unlikely that a gold mine will be developed here. It is reasonably foreseeable that there will be a relatively small amount of locatable mineral exploration, mining, and occupancy in the future that may cover up to approximately five acres per proposal and there may be five such proposals in the next 20 years.

## Leasable Minerals

No oil, gas, or coal resources have been documented, and potential for oil and gas resources is low throughout the sub-basin. A Known Geothermal Resource Area (Alvord KGRA) with high potential for geothermal resources exists in the Planning Area, but the Alvord KGRA is located within the Mineral Withdrawal Area except for 332 acres northwest of Fields. Twelve deep (greater than 1000 feet) geothermal wells were drilled within the Alvord KGRA before the Mineral Withdrawal Area was designated under the Steens Act. The remainder of the sub-basin has moderate potential for geothermal resources.

Sodium mineral resources have high potential in the Alvord Lake area; Rose Valley Borax Company mined borax in that area 100 years ago. The borax mining operation lasted for ten years and shut down when sodium borate levels fell below economic levels. The Alvord Lake area is now within the Mineral Withdrawal Area. There is low potential for sodium mineral resources outside of the Mineral Withdrawal Area. Currently, there are no mineral leases in the sub-basin.

It is reasonably foreseeable that there may be leasable minerals activities on approximately 300 acres over the next 20 years. It is likely that those activities would consist of geophysical exploration and drilling wells for exploration and development of geothermal resources for direct heat applications such as heating of a business, residence, greenhouse, or swimming pool.

## Salable Minerals

This group of minerals includes sand, gravel, and rock aggregate in this area. Petrified wood and obsidian are rare in the area. Demand for salable minerals is relatively low within the sub-basin. The uses that do exist are for road materials.

The Steens Act allows for development of salable mineral resources within the Mineral Withdrawal Area, for road maintenance only, at locations identified in the Steens Act. Some of those identified sites are located in exchanged land or are exhausted and in reclamation status. Within the Mineral Withdrawal Area are three designated rock aggregate sources and four sand and gravel sources that may be developed.

Large amounts of sand, gravel, and rock aggregate are available in the area, but they are generally located in visually or ecologically sensitive areas. It is BLM policy to allow development of salable mineral sources to meet demand provided that adequate measures are taken to protect the environment based on the judgment of the BLM authorized officer. It is reasonably foreseeable that the existing sand, gravel, and rock aggregate sources will be expanded over the next 20 years and approximately ten new sites will be identified for development covering approximately 40 acres each.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

With the passage of the Steens Mountain Cooperative Management and Protection Act in 2000 and the creation of the Mineral Withdrawal Area, many of the potential threats to watershed health in the sub-basin from mineral exploration were reduced or eliminated. Additionally, the potential for other mineral activity outside of the Mineral Withdrawal Area is relatively low. Activities related to mineral exploration and use in the sub-basin should not be a large threat to watershed health in the sub-basin.

**Issues, concerns and action items.**

- No issues, concerns or actions items were written for this section.

# RANGE AND GRAZING MANAGEMENT

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIS. The Oregon BLM Manual Supplement (1988) was used to define some terms. HCWC has altered parts of this text where appropriate to make it more directly applicable to this report and to the Alvord Lake Sub-basin.

## Range and Grazing History

The Taylor Grazing Act was passed on June 28, 1934 to protect public land resources from degradation and also to provide orderly use and improvement/development of public rangelands. Following various homestead acts, the Taylor Grazing Act established a system for the adjudication of grazing privileges to livestock operators based on grazing capacity and priority of use, and for the delineation of allotment boundaries. This act also established standards for rangeland improvements and implemented grazing fees. Approximately 142 million acres of land in the western United States were placed under the jurisdiction of the Grazing Service, which became the BLM in 1946. The Federal Land Policy and Management Act (FLPMA), passed in 1976, and the Public Rangelands Improvement Act (PRIA), passed in 1978, also provide authority for the management of livestock grazing on public lands.

Prior to the 1960s, grazing policy focused on allotment boundaries and seasons of use; however, in the mid-1960s, grazing management which considered the maintenance and establishment of plant communities was implemented. This management focused on individual approaches needed for each allotment to protect and maintain plant community diversity and other resource values on public land. Livestock grazing allotments are categorized and managed according to the following three selective management categories:

- **Improve (I)** category allotments are managed to improve current unsatisfactory resource conditions and will receive the highest priority for funding and management actions upon approval of the land use plan.

- **Maintain (M)** category allotments are managed to maintain current satisfactory resource conditions and will be actively managed so that resource values do not decline.

- **Custodial (C)** category allotments include a high percentage of private lands and are managed custodially while protecting existing resource values.

Recent land use plans have developed and implemented grazing management primarily through Allotment Management Plans (AMPs) and agreements with permittees. An AMP is a documented program that directs grazing management on specified public land toward reaching goals and objectives regarding resource conditions, sustained yield, multiple use, and ranch economics. AMPs are considered to be implemented when incorporated into term grazing permits or leases and when accepted by the permittee or lessee. These AMPs are now NEPA (National Environmental Policy Act) documents which require public review before approval. Temporary non-renewable (TNR) grazing use is periodically authorized to qualified applicants when additional forage is temporarily available and the use is consistent with multiple use objectives.

The rangeland reform process of 1994 modified the grazing regulations identified in 43 CFR part 4100. A new regulation was developed in August of 1995, and is currently being implemented throughout the BLM. The regulation at 43 CFR 4180, addresses the fundamentals of rangeland health. In August 1997, the Standards for Rangeland Health and Guidelines for Livestock Grazing Management (S & Gs) for public lands managed by the BLM in Oregon and Washington were developed in consultation with the Resource Advisory Council (RAC), Provincial Advisory Committees (PACs), American Indians, and others. The S & Gs provide the basis for assessing rangeland health.

Specific types of field indicators of rangeland health are identified for each standard. The quantitative thresholds for these indicators vary according to soil, climate, and landform, as stated in the standards. An ID Team, with participation from permittees and other interested parties, conducts assessments to evaluate the standards according to field indicators. The five standards are as follows:

**Standard 1: Watershed Function—Uplands**
Upland soils exhibit infiltration and permeability rates, moisture storage and stability appropriate to soil, climate, and land form.

**Standard 2: Watershed Function—Riparian/Wetland areas**
Riparian/wetland areas are in properly functioning physical condition appropriate to soil, climate, and land form.

**Standard 3: Ecological Processes**
Healthy, productive, and diverse plant and animal populations and communities appropriate to soil, climate, and landform are supported by ecological processes of nutrient cycling, energy flow, and the hydrologic cycle.

**Standard 4: Water Quality**
Surface water and ground water quality influenced by agency actions complies with state water quality standards.

**Standard 5: Native, Threatened and Endangered and Locally Important Species**
Habitats support healthy, productive, and diverse populations and communities of native plants and animals (including special status species and species of local importance) appropriate to soil, climate, and landform.

Oregon and Washington BLM act to comply with the standards above, and doing so fulfills the requirements of 43 CFR part 4180.

## Range and Grazing Inventory, Evaluation and Monitoring

Various methods have been used to inventory, evaluate and monitor grazing since the passage of the Taylor Grazing Act (1934). The earliest of these methods have now been replaced. As mentioned above, in the mid-1960s, the maintenance and establishment of plant communities was emphasized in grazing management. From that emphasis, rangelands methods were developed to evaluate the effects of grazing and other land uses on plant communities.

The most widely used rangeland inventory method is the Ecological Site Inventory (ESI), a process developed in the 1970s. ESI is an inventory of present and potential vegetation on rangeland sites. It utilizes soils, the existing plant community and ecological site data to determine the appropriate ecological site for a specific area of rangeland and to assign the appropriate ecological status (seral stage). The ecological status is the present state of vegetation of a range site in relation to the potential natural community (PNC) for that site. Ecological status is classified as one of four seral stages. These are PNC, Late Seral, Mid Seral and Early Seral for plant communities which are 76-100%, 51-75%, 26-50% and 0-25% similar to PNC.

Ecological status is use-independent—i.e. the outcome does not change based on changing management or use goals. Because of this use-independence, this inventory method can be used for monitoring with repeated use. In contrast use-dependent classifications can change if land management objectives change, even though the resource may not have changed. Ecological status will not change unless there is an actual change in the resource.

In the semi-arid environment of the most Oregon rangelands, ecological status usually changes very slowly. Therefore, the minimum standard for updating ecological status is keyed to the estimated land-use planning cycle of around 15-20 years unless monitoring studies indicate the need for more frequent updating.

The ecological status of the rangelands in the Alvord Lake Sub-basin were determined in the 1980s for the Burns BLM District and in the 1990s for the Vale BLM District. These data are summarized in Table 19, page 150. These data are the same as when completed approximately 20 and 10 years ago respectively, and do not depict changes since original data collection. Trend studies have shown that the ecological status of many vegetative communities in the sub-basin have advanced to a higher seral status. In addition, due to fires and other disturbances, some areas now are in lower ecological status. The Table 19 data do not reflect all of the BLM acreages in the two BLM Districts due to various reasons of some parcels not being rated. In addition, there are differences in the way the data were collected between the Districts. Users should consider these Table 19 data amounts as approximate.

In more recent years, land management has become more site specific to deal with changing management objectives. Increasing threats, such as those brought by invasive species, plus the need to manage for special status species, have required that new monitoring and evaluation procedures be used. The development of new procedures is ongoing, and results are not available for the Alvord Lake Sub-basin in total. The monitoring data is used for periodic evaluations of management actions and active grazing authorizations in allotments. To maintain or improve public land resources, adjustments are made by agreement or decision in accordance with legislation, regulations, and policy.

Current management practices have reduced erosion in some allotments within the area. These practices include proper stocking rates for livestock, rotation of grazing, improved designs of roads, rehabilitation of severely disturbed areas, restriction of vehicles to roads and ways, and control of concentrated recreational activities. For example, after the implementation of the Pueblo-Lone Mountain AMP in 1996, which changed the season of use for livestock on the major riparian areas and meadows in the Pueblo Mountains, monitoring has shown that gullies are revegetating and wet meadows are healing.

## Rangeland Improvements

As mandated in the FLPMA and the PRIA, a portion of grazing fees is to be used on range improvements for the benefit of wildlife, watersheds, and livestock management. Emergency fire rehabilitation funds have also been expended to protect resource values by converting exotic annual vegetative community types back to native and adapted non-native, perennial plant communities to improve plant community and watershed health. Livestock operators, state and federal agencies, and other cooperators have also continued to fund construction of rangeland improvement projects.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Livestock grazing is the most widespread land use in the Alvord Lake Sub-basin. It is mandated on public lands by various federal and state laws. Control of grazing and the consequent improvement in rangeland condition began over 70 years ago with the passage of the Taylor Grazing Act in 1934. In the last 30-40 years, grazing management and the evaluation and monitoring of grazing have become more site specific, with a primary focus of maintaining healthy plant communities. This focus on healthy plant communities is compatible with, and enhances other more site specific management goals. Grazing management continues to evolve and the impacts on long-term watershed health in the sub-basin continue to decrease.

**Issues, concerns and action items.**

- HCWC supports the focus on healthy plant communities as the way to promote watershed health.

**Table 19. Seral Stage Ratings by the Vale and Burns BLM Districts.** The amounts are approximate acres.

| 5th Field Watershed | Vale Early Seral | Vale Mid Seral | Vale Late Seral | Vale Potential Native Community | Burns Early Seral | Burns Mid Seral | Burns Late Seral | Burns Potential Native Community | Totals |
|---|---|---|---|---|---|---|---|---|---|
| 901 | 0 | 0 | 0 | 0 | 13,800 | 49,700 | 34,200 | 2,400 | 100,100 |
| 902 | 0 | 20 | 0 | 0 | 32,200 | 137,200 | 73,600 | 4,700 | 247,720 |
| 903 | 0 | 1,200 | 0 | 0 | 9,500 | 32,400 | 31,600 | 2,700 | 77,400 |
| 904 | 3,790 | 58,600 | 11,900 | 540 | 70 | 490 | 0 | 0 | 75,390 |
| 905 | 14,900 | 57,700 | 14,700 | 240 | 10,200 | 33,600 | 22,600 | 0 | 153,940 |
| 906 | 3,000 | 72,200 | 5,100 | 5,400 | 2,300 | 9,300 | 11,200 | 0 | 108,500 |
| 907 | 0 | 110 | 0 | 0 | 20,000 | 60,400 | 61,400 | 1,400 | 143,310 |
| 908 | 250 | 14,800 | 7,200 | 0 | 8,300 | 10,500 | 19,600 | 800 | 61,450 |
| | | | | | | | | | |
| **Totals** | **21,940** | **204,630** | **38,900** | **6,180** | **96,370** | **333,590** | **254,200** | **12,000** | **967,810** |

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# FIRE AND FIRE MANAGEMENT

**Information sources and authors**

This text was largely taken from the Andrews FEIC. HCWC has altered a small amount of this text and added comments where appropriate. In addition to this section, fire and its role in the ecology of juniper, cheatgrass, noxious weeds and various other individual topics is discussed in other parts of this document.

Photo HCWC

Fire has played an important role in the development of most plant communities in the area. The role that fire plays depends on the severity, intensity, and frequency of burning as well as elevation and locally influenced climatic patterns. Fire changes plant community structure and species composition, and alters site nutrient dynamics. The area has a wide variety of plant communities with varied fire histories. Approximately 90% of the fires are caused by lightning and about 10% are caused by humans. Since 1980, over 100,000 acres in the sub-basin have been burned by wildfires. A large percentage of these fires are less than ten acres in size.

## Fire Ecology of Major Vegetation Types in the Planning Area

Sagebrush is the dominant vegetation type throughout the area. Big sagebrush (all three subspecies: mountain, Wyoming and basin), low sagebrush, and silver sagebrush are the most common species found. Black sagebrush may also be found in specialized habitats in the sub-basin. Silver sagebrush is the only sagebrush species found in the area that will sprout following top removal. Other sagebrush species will recolonize areas from the seed bank or by emigration from unburned areas. This process may be slow in larger burned areas because of sagebrush seed dispersal. Sagebrush seeds are extremely small and have no specialized dispersal mechanism. Seeds rarely move more than three feet from parent plant. Size and shape of burned areas become important under these conditions. Burned areas with irregular boundaries will facilitate sagebrush establishment, while large burned areas with little sinuosity to the perimeter must rely on the soil seed bank and seed transport.

Mean fire return intervals (average number of years between fire events) for sagebrush plant communities are difficult to determine because the plants are typically entirely consumed by fire and do not leave evidence that can be used to determine historical fire regimes. Until recently, the extent and dates of fires have not been recorded and post-fire succession has not been studied in detail. However, site productivity affects the fire behavior and frequency in these sagebrush stands. Sites with higher productivity (deep soils, high cover of understory grasses and forbs) will carry fire easier and more frequently than sites with low productivity. Low sagebrush can be found in areas with higher productivity. Rooting depth in these areas is often limited by a heavy clay layer. Low sagebrush is usually found on less productive sites compared to mountain, basin, or Wyoming big sagebrush. Silver sagebrush, however, may also be associated with wetland species in areas of high productivity where fire history is more likely to be related to adjacent vegetation than to characteristics of the silver sagebrush plant communities themselves. Silver sagebrush is also found in a mosaic of vegetation types; it does not occupy large areas within the Planning Area.

Juniper woodlands are the most widely distributed woodland type in the area. Ancient western juniper stands are located in rocky areas where fire return intervals are more than 150 years. Historically these stands occupied less than 1% of the total landscape. The location of these stands provides insufficient understory vegetation to carry fire. If fires did occur, they were often limited to one or two trees and areas of less than one acre. Under certain circumstances, large fires did move across these stands, but such events were rare.

The mountain big sagebrush fire regime, where much juniper has encroached today, typically burned every 15 to 25 years, a return interval similar to other shrub communities in the arid West. Young western junipers have thin bark and are readily killed by surface fires. Fire will carry through juniper stands with grass and shrub understory. As trees mature, they displace shrub and grass vegetation, leaving little surface vegetation. The stand then becomes more susceptible to erosion due to reduction in near-surface root systems of the lower stature plants. Older stands become resistant to fire because low productivity limits available fuel. Western juniper does not sprout after fire; reestablishment is from seed dispersed by water and animals, and the trees may be slow to regenerate.

Cheatgrass is an invasive non-native annual grass that creates a fire hazard in limited parts of the area. Cheatgrass thrives in disturbed environments, especially with fine-textured soils. Past land and fire management decisions have created a condition where cheatgrass thrives. Heavy grazing, especially in the early to middle portions of the 20th century, help to provide safe sites for cheatgrass establishment. Once cheatgrass became established, it provided a continuous fuel bed in areas that historically had a discontinuous fuel bed. Fire return intervals have been decreasing (less time between fire events) in areas dominated by cheatgrass, and other introduced annuals. Cheatgrass is a more efficient competitor for soil moisture and nutrients. Native grasses, forbs, and shrubs in some cases, cannot compete with cheatgrass for these resources and are suppressed or eliminated from the plant community. Increases of cheatgrass have also altered the growth stage (phenology) calendar of the plant communities. Cheatgrass begins and completes growth earlier than the associated native vegetation. Areas dominated by cheatgrass now have the potential to burn earlier in the year than plant communities dominated by native vegetation. Earlier fires, especially if repeated every three to seven years, burn native plants when they are actively growing and most susceptible to injury. Fire does not increase cheatgrass production, but it does eliminate other plants and provides an opportunity for cheatgrass to increase at the expense of native grasses, forbs, and shrubs. Cheatgrass invasion substantially reduces biodiversity and the land’s value for livestock forage and wildlife habitat. Reversal of this ecological cycle probably requires human intervention and alteration of current land management. In some areas the conversion to cheatgrass and other introduced annuals has pushed the ecological system through a threshold. Passive restoration practices in these situations will only maintain the current plant community and not move toward pre-disturbance communities.

## Fire Management Needs, Status, and Alternatives

The area fire management strategy focuses on wildland fire suppression, prescribed fire, and wildland fire use for resource benefits. The wildland fire season generally runs from mid-May through mid-September, while prescribed fires are usually planned for periods before and after the wildland fire season, depending on weather conditions. Prescribed burning can be used to meet resource and fire management objectives such as stimulation of plant growth, changes in species composition, or reduction in amounts of fuels and slash. A large proportion of the plant communities within the area evolved with periodic fires. All wildland fires ignited by lighting will be evaluated. Generalized policy and procedures for fire planning, assessment, and response are guided by BLM Manual 9102.

In lower elevation sagebrush plant communities, factors such as fuel conditions, proximity to sensitive habitats or presence of introduced annuals may make prescribed fire impractical. In these areas, the Burns BLM is using a technique known as “brush beating” in which a large mower kills large sagebrush, but leaves smaller shrubs and herbaceous plants relatively unharmed. Cutting the brush in irregular shapes is another way to create a complex pattern or mosaic. The brush beating also interrupts the structure and continuity of the fuels, reducing the potential for large fires by limiting spread.

## Prescribed Fires

There has been no prescribed fire on public lands to-date in the Alvord Lake Sub-basin. However prescribed fire remains a management option for future use. The following text was written mainly about nearby areas which are outside of the sub-basin. It is indicative of various factors about the potential use of prescribed fire in the sub-basin.

Prescribed fire has successfully reintroduced fire to sagebrush and aspen plant communities. These management actions are improving habitat for numerous wildlife species and are providing higher quality forage for domestic and wild herbivores. Prescribed fires have occurred primarily in the fall. Burning at this time emulated the natural fire occurrence to some degree. Wildland fires historically occurred in the late spring, summer and early fall. Prescribed burning in the fall occurred because conditions would be less severe and fires could be held in units. Recently the timing of prescribed fires has shifted toward the late summer. Burning in August and September produced fire effects closer to the historic conditions. Burning in the winter and early spring has also proven to be a good tool in areas where there are large accumulations of fuel (i.e. juniper cuts). Soils are frozen during this time of year and heat from the fire is adsorbed by the frozen soils. Prescribed burning, and other fuels reduction actions, are helping to reestablish appropriate fire regimes based on site potential and current social/political direction.

## Wildland Fires

Wildland fire risk depends on the intensity and size of the wildland fire as well as the location, time of season, and time of day. Historically these ecosystems experienced a variety of fire severities and intensities. The variety of intensities and severities was controlled by changing climatic conditions across the season. Early and late in the wildland fire season, conditions were cooler and potentially wetter than during the hot dry summer months. Fires that burned at these times may have had fewer impacts than those that burned in the middle of the hot dry summer. Conditions also changed within a single day. Severity and intensity can be much higher during the middle of the burning period than during night when temperatures are lower and relative humidity is higher. However, conditions today have changed somewhat. The amount of woody vegetation across the sub-basin is greater today than 100 years ago. Increases in western juniper and sagebrush density and cover have altered the characteristics of most wildland fires. Fires today are larger in most cases than they were historically due to a simplification of the vegetation (fuels) structure. Large, catastrophic wildland fires are much more common today than 100 years ago. These fires are occurring at an increasing rate across the western United States. Impacts to plants and animals can be dramatic following these large fires. Large grazing animals, domestic and wild, may be displaced for several years following large fires. Wildlife species that depend on sagebrush for part or all of their entire life cycle will decline following burning. Severely burned landscapes lose soil, seed bank, and microflora; consequently, they are more susceptible to invasions of weedy species. Fire may also have adverse effects on recreational and visual resources. The impacts of burning on plant community processes and functions can be naturally mitigated, but social values often require rehabilitation actions be taken to assist recovery.

In case of multiple fires, suppression priority is given in decreasing order of importance to fires threatening life, property, and resources. Fires occurring within wilderness and WSAs and other environmentally sensitive areas have received full suppression responses, but these responses are generally limited, regarding the use of mechanical equipment and retardant. If a fire is likely to become large or to threaten life or property, the line officer can approve the use of mechanical equipment to assist in suppression. In that case, immediate rehabilitation occurs on all areas of ground disturbance.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Fire plays an important natural role in the long-term ecology and health of plant communities in the Alvord Lake Sub-basin. However, with introduced species such as cheatgrass and various noxious weeds becoming more problematic in the area, fires are often undesirable in terms of both short and long-term watershed health. Our understanding of the effects of fire on the native communities is increasing. Similarly, fire control and management is becoming more sophisticated. Prescribed fires will likely become a part of management in at least parts of the sub-basin in the future. Managing for the maintenance of the native plant communities will be managing for watershed health.

**Issues, concerns and action items.**

- Educate the public on the roles of fire in the ecology of various areas and habitats of the sub-basin. Include in that education the reasons fires in some locations are suppressed, while fire is often purposefully used in other situations.

# WILDERNESS

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

The Federal Land Policy and Management Act (FLPMA) directs the BLM to manage the public lands and their resources under principles of multiple use and sustained yield. The FLPMA also identifies wilderness values as part of the spectrum of public land resource values and uses to be considered in the BLM's planning, inventory and management activities. A BLM wilderness area is an area of public lands that Congress has designated for the BLM to manage as a component of the National Wilderness Preservation System in accordance with the Wilderness Act of 1964.

The only designated wilderness in the Alvord Lake Sub-basin is a portion of the Steens Mountain Wilderness, approximately 56,000 acres in HUCs 902, 903 and 907.

## Wilderness Study Areas

A wilderness study area (WSA) is a parcel of public land determined through intensive inventories to meet the definition of wilderness in Section 2(c) of the Wilderness Act. Public lands were inventoried in the late 1970s and early 1980s to determine whether they contained wilderness values. Those areas found to have wilderness values were identified as WSAs and all other land was eliminated from further consideration in the wilderness review. Some of the criteria used in the wilderness inventory and study were naturalness, solitude, primitive and unconfined recreational opportunities, special features, and manageability.

All or portions of 20 WSAs are located within the sub-basin (see Table 20 below), containing about 519,790 acres. Until Congress acts on the wilderness recommendations or otherwise releases the WSAs for other purposes, they will continue to be managed in accordance with the Wilderness Study Act, the Steens Act, and other applicable laws and policies.

**Table 20. BLM Wilderness Study Areas in the Alvord Lake Sub-basin.**

| WSA Name | Acres |
|---|---|
| Stonehouse | 21,300 |
| Lower Stonehouse | 5,800 |
| Sheepshead Mountains | 42,000 |
| Wildcat Canyon | 1,100 |
| Heath Lake | 21,200 |
| Table Mountain | 38,500 |
| West Peak | 8,600 |
| East Alvord | 22,200 |
| Winter Range | 11,900 |
| Alvord Desert | 144,100 |
| Mahogany Ridge | 27,300 |
| Red Mountain | 15,700 |
| Pueblo Mountains | 41,700 |
| Rincon | 1,600 |
| High Steens | 8,000 |
| Willow Creek | 29,800 |
| Disaster Peak | 1,800 |
| Fifteen Mile Creek | 50,300 |
| Oregon Canyon | 690 |
| Twelve Mile Creek | 26,200 |
| **Total** | **519,790** |
| | |
| **WSAs by HUC** | **Acres** |
| 901 Cottonwood Creek | 38,000 |
| 902 Alvord Lake | 56,100 |
| 903 Big Alvord | 67,800 |
| 904 Whitehorse Creek | 63,600 |
| 905 Twelve Mile Creek | 89,800 |
| 906 Willow Creek | 53,000 |
| 907 Summit | 100,000 |
| 908 Quail creek | 51,700 |

Source: BLM GIS

## Other Parcels with Wilderness Characteristics

Four additional areas have been identified as having wilderness characteristics: Alvord Desert (2,033 acres), Bridge Creek (1,526 acres), High Steens (629 acres), and Lower Stonehouse (2,176 acres). All four parcels with wilderness characteristics are adjacent to existing WSAs. All four parcels are also within the Mineral Withdrawal Area.

The Alvord Desert parcel is natural and, when considered with the Alvord Desert WSA, has outstanding opportunities for solitude and primitive and unconfined recreation. The vegetation is primarily big sagebrush, perennial grasses, and annual grasses with some salt desert shrubs. The parcel is within kit fox and bighorn sheep habitat, is pronghorn antelope winter range, and is part of the Alvord-Tule Spring-Coyote Lake HMA for wild horses. The Alvord milkvetch, a BLM tracking species, is found in the parcel. There are no range improvements inside this parcel. There are three two-track roads in the northern half of the parcel.

The Bridge Creek parcel is natural and, when considered with the Bridge Creek WSA, has outstanding opportunities for solitude and primitive and unconfined recreation. This parcel in within the CMPA. The vegetation is primarily juniper with some mountain big sagebrush, quaking aspen, and low sagebrush. The parcel is within elk and deer winter range. The section of Little Bridge Creek in the parcel was rated at PFC. Range improvements inside the parcel include three pit reservoirs, a fence along the north boundary, and an old fence along the south boundary. There are also several two-track roads into the parcel from the east and south boundaries.

The High Steens parcel is natural and, when considered with the High Steens WSA, has outstanding opportunities for solitude and primitive and unconfined recreation. This parcel in within the CMPA. Vegetation is primarily native perennial grassland with quaking aspen stands. The parcel contains habitat for Preble’s shrew and Sierran springbeauty. The section of McCoy Creek in the parcel was rated at PFC. There are no range improvements associated with this parcel. There are two two-track roads in the parcel.

The Lower Stonehouse parcel is natural and, when considered with the Lower Stonehouse WSA, has outstanding opportunities for solitude and primitive and unconfined recreation. This parcel is within the CMPA. Vegetation is primarily big sagebrush and grasses with juniper, mountain big sagebrush, and quaking aspen. The lower elevations are deer winter range, while the higher slopes are bighorn sheep habitat. There are no special status plant or animal species. Range improvements include a fence along the east boundary. There is one two-track road in the parcel and a pack trail across the western portion.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Wilderness and wilderness study areas have long-term watershed health value due to their protected status, making them potentially important locations for watershed health research.

**Issues, concerns and action items.**

- Improve public awareness of the Steens Mountain Wilderness and the 20 wilderness study areas in the sub-basin.

# AREAS OF CRITICAL ENVIRONMENTAL CONCERN

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

Areas of Critical Environmental Concern (ACECs) are parcels of public land that require additional management attention to protect special features or values. ACECs may be established to protect important historic, cultural, or scenic values; fish, wildlife, or other natural resources; or human life and safety. Resource Natural Areas (RNAs) are a specific type of ACEC that always contain natural resource values of scientific interest and are managed primarily for research and educational purposes. Outstanding Natural Areas are another specific type of ACEC that exhibit outstanding scenic splendor, natural wonder or scientific importance.

Thirteen designated ACECs, nine of which are RNAs, are located in the sub-basin. These ACECs were designated to provide special management and protection to areas with special characteristics such as diverse ecosystems, landforms, plant communities, and critical wildlife habitat. See Map 17, page 163 for the locations of ACECs. The existing ACECs, as well as their location and size, are listed in Table 21.

**Table 21. Areas of Critical Environment Concern in the Alvord Lake Sub-basin.**

| 5th Field Watersheds, Numbers and Names | | ACEC | Acres |
|---|---|---|---|
| 1712000901 | Cottonwood Creek | Pueblo Foothills RNA | 573 |
| | | Tum Tum Lake RNA | 1,124 |
| 1712000902 | Alvord Lake | Borax Lake ACEC | 760 |
| | | East Fork Trout Creek RNA | 361 |
| | | Little Wildhorse Lake RNA | 183 |
| | | Pueblo Foothills RNA | 1,851 |
| | | Serrano Point RNA | 679 |
| | | Tum Tum Lake RNA | 564 |
| 1712000903 | Big Alvord | Alvord Desert ACEC | 20,597 |
| | | Big Alvord Creek RNA | 1,676 |
| | | Mickey Basin RNA | 28 |
| | | Mickey Hot Springs ACEC | 0.3 |
| | | South Fork Willow Creek RNA | 175 |
| 1712000904 | Whitehorse Creek | Little White Horse Creek RNA | 61 |
| 1712000905 | Twelve Mile Creek | Dry Creek Bench RNA | 1,592 |
| 1712000906 | Willow Creek | Alvord Desert ACEC | 1,018 |
| 1712000907 | Summit | Kiger Mustang ACEC | 17,991 |
| | | Mickey Basin RNA | 532 |
| | | Mickey Hot Springs ACEC | 42 |
| 1712000908 | Quail Creek | Kiger Mustang ACEC | 6,850 |

Source: BLM GIS

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

Some ACECs, especially RNAs may have long-term watershed health value due to their protected status, making them important locations for watershed health research. Together, the 13 designated ACECs total less than 5% of the sub-basin's area.

**Issues, concerns and action items.**

- Improve public awareness of ACECs, their resources, management and values.

# RECREATION

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. This text was written for a much larger area – in many cases all of Harney County – and comparable information is generally not available for the Alvord Lake Sub-basin alone. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

Photo courtesy of BLM

Federal agencies including the BLM, USFS, and USFWS, administer over 51% of the lands in Oregon, 70% of the lands in southeast Oregon (Harney, Malheur, and Lake Counties), and 82% of the lands in the Alvord Lake Sub-basin, making them the largest managers of outdoor recreation and land facilities in the state (Oregon Parks and Recreation Department 2000). Therefore, these agencies play a major role in providing dispersed recreation opportunities as well as resource protection of some of the state's most unique and important scenic, natural, and cultural resources. BLM recreation management objectives for the area include:

- Encourage a wide range of recreation activities in addition to hunting and fishing;
- Cooperate with development of High Desert Trail;
- Limit vehicle use in campgrounds to ingress and egress;
- Provide quality recreational opportunities for the public;
- Protect, preserve, and promote recreational resources;
- Provide facilities, information, and services to promote safety and a maximum recreational experience.

Dispersed recreation opportunities exist throughout the entire area. A State Scenic Byway/Tour Route runs through area. Although the majority of visitors to the area are from Oregon, an increasing number are from out of state and abroad. Recent publications and broadcasts featuring BLM attractions have increased visitation to the area. Sightseeing, driving for pleasure, fishing, and hunting are among the most popular types of dispersed recreation, according to the Southeast Oregon Recreation Plan for Harney, Lake and Malheur Counties. Nonmotorized boating, horseback riding, camping, hiking, wildlife viewing, and OHV use are also popular activities in the area. The Alvord Desert attracts land sailers, hang gliders, para-sailers, experimental and light aircraft of all kinds.

## Recreation Activities

**Hunting/Fishing.** Overall hunting and fishing information is not readily available for just the Alvord Lake Sub-basin. However, information is available for the Andrews Management Unit/Steens Mountain Cooperative Management and Protection Area, which encompasses part of the Alvord Lake Sub-basin and other areas to the west and north. That area includes all or portions of the Beatys Butte, Juniper, Steens Mountain, and Whitehorse ODFW Wildlife Management Units (WMUs). Deer, pronghorn antelope, bighorn sheep, and elk are hunted with rifle, muzzleloader, and bow in this area. During the 2000 Hunting Season in the three WMUs combined, 8,323 hunter days were spent hunting deer with a 47% success rate; 3,237 hunter days were spent hunting elk with a success rate of 13%; and 923 hunter days were spent hunting pronghorn antelope with an 87% success rate (ODFW 2002). Upland bird hunting, primarily for chukar, is a popular late fall and winter activity. Fishing is a popular activity in the area with its variety of fish species including Lahontan cutthroat trout, and several others. There are several lakes, reservoirs, and streams in the area that provide fishing as well as sightseeing, camping, hiking, and wildlife viewing opportunities.

**Hiking.** Several hiking trails are located in the area. The High Desert Trail, a component of the National Recreation Trails System, begins at Denio Canyon near the Nevada border south of Fields, Oregon and is 240 miles long. The High Desert Trail uses a corridor concept with no clearly defined or maintained path to follow. Hikers choose their own route with the help of a printed guide and strategically placed cairns. Portions of the trail are open year round. The corridor is cooperatively managed with the Desert Trail Association.

**Camping.** Camping occurs throughout the area, but primarily on the Alvord Desert; camping is mainly primitive and dispersed. The Alvord Desert playa, part of the Alvord Desert WSA, is a popular land sailing destination in the spring. At Mann Lake, camping is allowed in two areas near the shore. The recreation site has vault toilets and a boat ramp. It is located approximately 22 miles south of Highway 78 on the East Steens Road. The lake is stocked with hatchery Lahontan cutthroat trout. Boats with 12 horsepower motors or less are permitted.

**Winter Recreation.** The primary winter activities are cross-country skiing, snowshoeing, and limited snowmobiling. Ski and snowshoe use is not limited.

## Special Recreation Permits

Special recreation permits (SRPs) are required for specific recreational uses of the public lands and related waters. They are issued as a means to manage visitor use, protect natural and cultural resources, and provide a mechanism to accommodate commercial recreational uses. The types of permits are listed below:

1. **Commercial:** Recreational use of public lands and related water for business or financial gain. Examples are scenic tours, outfitters and guides, trail rides, cattle drives, photography associated with recreational activity, and use by scientific, educational, and therapeutic or nonprofit organizations when certain criteria are met.

2. **Competitive:** Any organized, sanctioned, or structured use, event, or activity on public lands in which two or more contestants compete and either 1) participants, register, enter or complete an application for the event, or 2) a predetermined course or area is designated. Examples are OHV races, horse endurance rides, or mountain bike races.

3. **Organized Group:** Permits for noncommercial and noncompetitive group activities and recreation events. Examples include a scout campout, a large family reunion, or a school group activity.

4. **Commercial Day Use:** Special commercial permit provided by the Burns BLM for use within limited locations in the area. It is a one-day permit available for commercial activities such as vehicle tours. Commercial Day Use permit stipulations are developed on a case-by-case basis.

5. **Special Area:** Officially designated by statute or Secretarial order. Examples include camping in long-term visitor areas in California and Arizona or floating many BLM managed rivers.

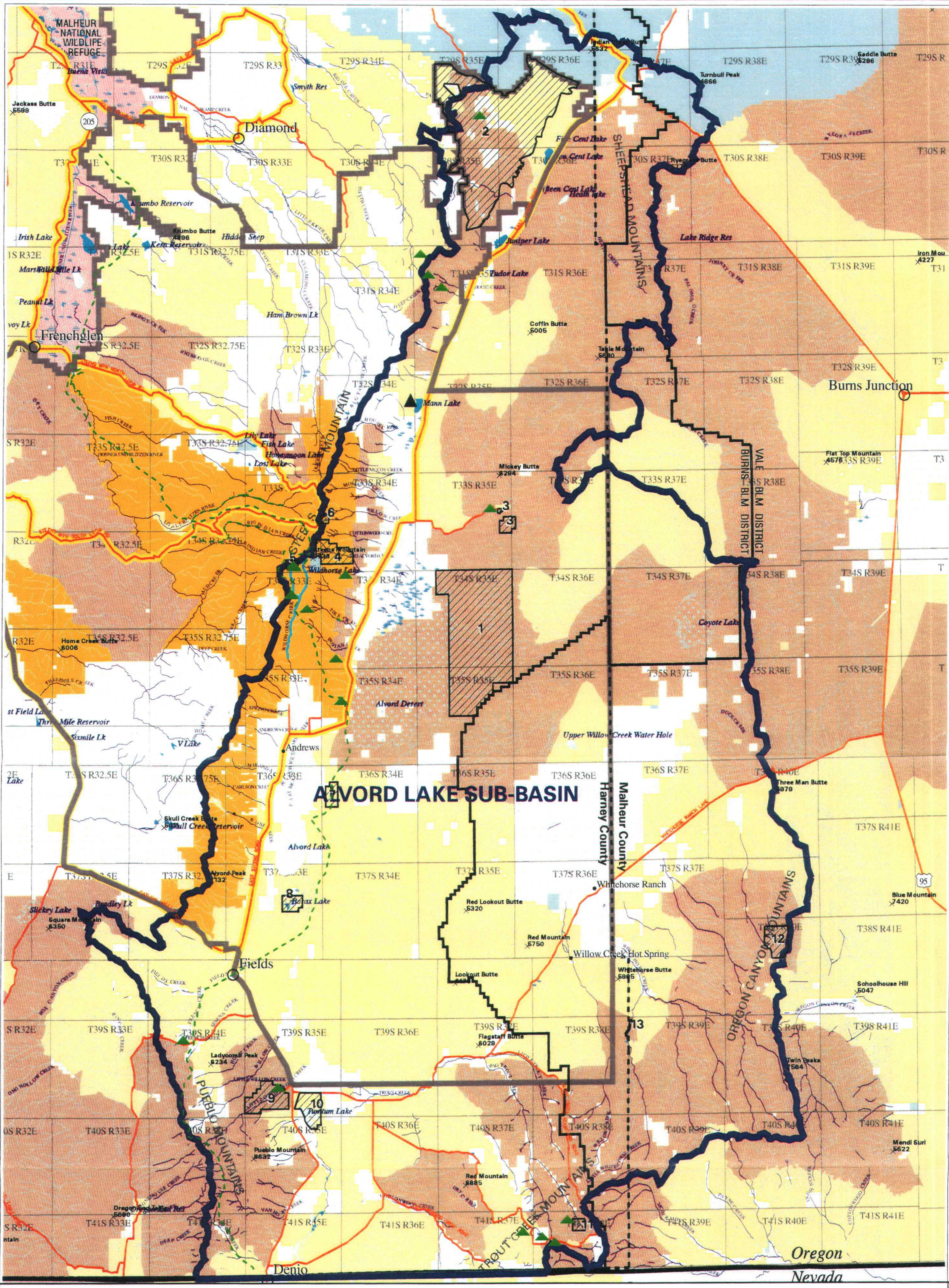
6. **Vending:** Temporary, short-term, nonexclusive, revocable authorizations to sell goods or services on public land in conjunction with a recreation activity. Examples are T-shirt sales in conjunction with an OHV race, a hot dog stand at a motocross event, firewood sales in a BLM campground, and shuttle services.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

With good management planning and public cooperation, recreation should have little or no negative effects on long-term watershed health in the sub-basin.

**Issues, concerns and action items.**

- HCWC supports the written BLM recreation management objectives for the sub-basin.




# MAP # 17 - Alvord Lake Sub-basin - RECREATION and SPECIAL MANAGEMENT AREAS

- BLM Lands
- BLM Wilderness Study Areas
- BLM Wilderness
- Private Lands
- State Lands
- USFWS Lands

- Scenic Byways
- Wild & Scenic Rivers
- Desert Trail (unsigned)
- Steens Mineral Withdrawal

OHV use regulations and areas are complex, contact the appropriate BLM office.

Areas of Critical Environmental Concern:
1 Alvord Desert ACEC
2 Kiger Mustang ACEC
3 Mickey Hot Springs ACEC
4 Big Alvord Creek RNA
5 Little Wildhorse Lake RNA
6 South Fork Willow Creek RNA
7 Serrano Point RNA
8 Borax Lake ACEC
9 Pueblo Foothills RNA
10 Tum Tum Lake RNA
11 East Fork Trout Creek RNA
12 Dry Creek Bench RNA
13 Little Whitehorse Creek RNA

- Mann Lake Recreation Site
- Primitive Campsites

Note: No warranty is made by Harney County or the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual or aggregate use with other data. Original data was compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

See Appendix 1 for specific data disclaimers.

0 1 2 3 4 5 6 MILES
Scale: 1 inch = 6.0 miles

N S

US DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Burns District, Oregon

Date: 21-MAR-2006, Pam Keller, subbasin11x17.aml/alvrec.ps

# TRANSPORTATION

**Information sources and authors**

The text for this section is generally taken from the Andrews FEIC. HCWC has altered parts of this text where appropriate to make it more directly applicable to the Alvord Lake Sub-basin.

The area has private, state, county, and BLM roads. Some roads are maintained to a high standard while others are more primitive routes receiving very little maintenance. Road uses include rancher access for livestock management, access to private lands, the general public seeking recreational opportunities, and agency administration. Many of the roads serve as important access routes to public lands. Since traffic control signing is limited or nonexistent along BLM roads, caution is required when traveling these routes.

Priorities for maintenance in the area are established as follows: 1) safety of users, 2) high-use roads, 3) resource protection, and 4) all other roads and routes. Road construction has been limited to upgrading segments of existing routes to improve access or alleviate maintenance or environmental problems.

OHV (off-highway vehicle) use is frequently associated with hunting, fishing, and driving for pleasure and also occurs for administrative purposes such as management of livestock and maintenance of range projects. In accordance with 43 CFR 8342.1, all public land in the area is designated as open, limited, or closed with regard to vehicle use. In an open area, all types of motorized and mechanized vehicle use are permitted at all times (43 CFR 8340.0-5(f)). The BLM designates areas as "open" for intensive OHV and mechanized vehicle use where no compelling resource protection needs, user conflicts, or public safety issues exist to warrant limiting cross-country travel. In a limited area, motorized and mechanized vehicle use is restricted at certain times, in certain areas, to designated routes, to existing routes, to certain vehicular uses, or seasonally (43 CFR 8340.0-5(g)). The BLM designates areas as "limited" where it must restrict OHV and mechanized vehicle use in order to meet specific resource management objectives. In a closed area, motorized and mechanized vehicle use is prohibited (43 CFR 8340.0-5(h)). Areas are designated as "closed" if closure to all motorized and mechanized vehicular use is required by law or designation or is necessary to protect resources, promote visitor safety, or reduce use conflicts.

OHV use of the Alvord Desert playa is managed for all legitimate public land uses as well as ORV [OHV] use. Recreation vehicles and commercial uses which do not impair the wilderness values of the Alvord WSA [sic] would be allowed until Congress makes its final determination on wilderness." This statement is a recognition of prior OHV and mechanized vehicle use on the playa. OHV and mechanized vehicle use of the Alvord Desert playa does not cause permanent impairment of the wilderness values and does not preclude Congress from eventually designating the area as part of the national wilderness system. The BLM has allowed this use to continue based on the determination that managed OHV and mechanized vehicle use would not preclude future wilderness designation. Should the Alvord Desert playa be designated as wilderness, OHV and mechanized vehicle use would not be allowed on the playa.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

OHV use is increasing throughout the sub-basin. When that use is off designated roads, damage to the vegetation and landscape may occur with accompanying watershed health problems such as erosion, soil compaction, etc. The long-term watershed health will be effected to the degree that significant off road use occurs in non-permitted areas.

**Issues, concerns and action items.**

- Educate the public as to the potential effects of OHV use in non-permitted areas.
- Educate the public that different areas have various OHV use designations and that the public has access to areas of varying types of OHV use.

# ECONOMIC ACTIVITY

**Information sources and authors**

The text and data for this section is generally taken from the Andrews FEIC. A small amount of the agricultural dollar figures are from the Oregon Agricultural Information Network (2005). The text was originally written for a much larger area – in many cases all of Harney County, and in one case the entire state of Oregon. Comparable information is generally not available solely for the Alvord Lake Sub-basin. There is also similar information available for Malheur County but that is not included as it would be repetitious and also not available solely for the Alvord Lake Sub-basin portion of that county. HCWC has altered minor parts of this text.

The BLM makes commodities available for use by the private sector. The BLM rangelands are available to private ranching concerns on a renewable permit basis. A fee is collected for each grazing head of livestock. Salable minerals sources are a small source of revenue where sand, gravel and rock aggregate are sold for use on private land and they contribute to the economy of the area where they are used on state, county, and BLM roads under a free use permit. Since there are no commercial forest lands or operations, or no locatable or leasable energy or minerals facilities in this area, these resources are not a source of economic revenue. There are many other uses of the lands in the sub-basin that generate revenue.

## Wild Horses

The BLM conducts wild horse gathers approximately every three to four years. These animals are made available for adoption through the Wild Horse Adoption Program. The contractors hired to conduct the gathers, are from out of the area and the money raised through the adoption fees is sent directly back to the national program. Harney County does not see a direct economic benefit from these activities; however, there are indirect benefits associated with the rare horse breeds and the adoption activities, which attract visitors and attention to the area and lead to local spending that would not otherwise occur.

## Agriculture

Agricultural activities in Harney County are not considered highly labor intensive, and are limited primarily to production of hay, forage, and livestock. Harney County agriculture focuses on the following products: 1) beef, with sales of $50,000,000 in 2005 and 2) hay and forage, with 2005 sales of $15,659,000 (Oregon Agricultural Information Network 2005). The highest individual agricultural sales revenue in Harney County is derived from cattle ranching, which is inextricably linked to the commodity value of public rangelands. The BLM collected an average of approximately $145,000 annually in livestock grazing fees over the past ten years. This number is based on 107,000 AUMs at $1.35 per AUM. The 2004 AUM was valued at $1.43. The average number of livestock grazing public land each year is 24,500. The BLM spent $93,680 on range improvement projects in 2002, of which 84% went to local contractors.

The 1997 Census of Agriculture stated that there were 504 farms in Harney County and that approximately 75% were owned by families or individuals. Total gross farm sales in Harney County totaled $68,399,000 in 2005. Crop sales were $16,562,000 and animal product sales made up the rest ($51,837,000). The United States Bureau of Economic Analysis estimated a net farm income of $2,716,000 for Harney County in 2000, which had gross sales of $50,418,000. According to Harney County web site the cattle industry is counted on to provide an average of $28,000,000 per year to the economy of the county and nearly half of the county taxes come from the ranching community (www.harneycounty.com 2003).

## Fire Fighting

The fire management strategy focuses on wildland fire suppression and prescribed fire. The wildland fire season generally runs from mid-May through mid-September, while prescribed fires are usually planned for periods before and after the wildland fire season. Approximately 55 to 60 temporary firefighters are employed each year during the fire season. In addition, local contractors are hired to assist with fire suppression and prescribed fire activities. Between $25,000 and $275,000 is spent each year on local contracts for fire management depending on the severity of the fire season.

## Land Management

Management of the lands, realty authorizations, and Right-of-Ways (ROWs) in the area have economic implications for the county and local economy. Fees are collected by the BLM for land use authorizations and ROWs. Land sales and retention and purchases can affect property tax revenues and potential commodity production; Payments in Lieu of Taxes (PILT) are paid directly to the county. The average annual fees collected for land use authorizations and ROWs are $15,000. Property taxes collected in Harney County in 2002 totaled $4.9 million. Harney County also received $518,880 in PILT in 2002.

## OHV Use

Off-highway vehicle (OHV) and mechanized vehicle use is a form of recreation and is often associated with hunting and fishing. No data are available on OHV and mechanized vehicle use in the area or expenditures by OHV and mechanized vehicle enthusiasts in the local economy. However, it can be assumed that these recreationists contribute to the economy through the purchase of goods and services such as gas, food, equipment, and lodging.

## Hunting and Fishing

Hunting and other types of recreation also provide income to the county and local communities. According to data obtained from ODFW hunter surveys, Oregon's Mule Deer and Elk plans, and the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (published by the USFWS), annual hunting trip-related expenditures were estimated at approximately $3,905,312 and $530,987 for Harney County and Steens Mountain, respectively. These expenditures include such things as transportation, food, and lodging and are based on 13,924 hunters in Harney County and 2,607 hunters in the Steens Mountain area spending 74,743 and 11,386 recreation days in Harney County and the Steens Mountain area, respectively.

## Wildlife Viewing

Numbers for wildlife viewing were not available for the county; however, estimates indicate that 1,680,000 participants spent $304,990 on trip-related expenses in 2001 in the State of Oregon.

## Tourism

The tourism industry in this area is small compared to other Oregon regions; however, tourism in Harney County provides a critical monetary inflow to the economy. For people seeking outdoor recreation and solitude, public lands in Harney County have much to offer. A 2001 report prepared for the Oregon Tourism Commission, Oregon Travel Impacts, 1991-2000, estimated that travel-related spending in Harney County totaled $18,000,000 with $2,500,000 attributed to travelers staying in public campgrounds during 2000 (Dean Runyan and Associates 2001). Travel is responsible for 6.5% of the employment in Harney County. Updated estimates show that travel-related spending in Harney County in 2001 was $18,300,000 and was responsible for 7.4% of employment. Travel-related spending in Harney County increased 5.2% between 1991 and 2001. Revenues from travel accounted for $3,900,000 in earnings and 340 jobs in Harney County for 2001 (Oregon Tourism Commission 2003).

The 1994 Oregon High Desert Interpretive Center Economic Feasibility and Impact Analysis for Harney County and Burns, Oregon (Dean Runyan and Associates et al. 1994) stated that approximately 50,000 people visited both the Steens Mountain area and the Malheur NWR in 1993. Assuming visitation has remained similar between the two destinations and based on numbers determined in the Regional Economic Benefits of Ecotourism and Operations Associated with the Malheur NWR (Northwest Economic Associates [NEA] 2002), visitation to the CMPA may have been as high as 62,700 between October 1, 1999 and September 30, 2000. The NEA analysis found that visitor expenditures in Harney County amounted to over $1,900,000; this equated to $1,200,000 of direct spending within the county (NEA 2002).

It is likely that tourism and visitation to the area will continue to increase in the long term due to 1) population growth within a day's driving time of the area, 2) the increased publicity the Steens Mountain area is receiving, and 3) the recent designation of the Oregon High Desert Discovery Scenic Byway and Tour Routes.

**Importance of topic to long-term watershed health in the Alvord Lake Sub-basin.**

This topic generally has little to due with long-term watershed health in the sub-basin.

**Issues, concerns and action items.**

- Help educate the public as to the economic benefits of healthy watershed attributes..

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# Appendix 1 – Watershed Boundary Systems, Sub-basin Reporting and Mapping Data.

**Watershed boundary systems and Alvord Lake Sub-basin reporting area.** There are currently two systems commonly used in Oregon to define watershed boundaries and basins. The Oregon Department of Water Resources developed one system and the other was developed at the federal level. The state system has traditionally been used by state and county entities. Its use is declining as these groups now are commonly using the federal system. At the federal level the U.S. Geological Survey (USGS) developed the Hydrologic Unit Code (HUC) system in the 1970s. That USGS system has evolved and is the national interagency standard. Its use is mandated by the Federal Geographic Data Committee (FGDC). FGDC implements the National Spatial Data Infrastructure (established by Executive Order 12906 in 1994) in cooperation with state, local and tribal governments, the academic community and the private sector.

The HUC system is used by the USDI Bureau of Land Management (BLM) and consequently it is the system used for this project. This system uses HUCs to name watersheds. In the HUC system various levels of watersheds are defined. The Alvord Lake Sub-basin is a 4$^{th}$ field watershed (HUC) and there are eight 5$^{th}$ field watersheds (HUCs) within the sub-basin (see Maps 3, and 9 through 16).

The Alvord Lake Sub-basin lies mostly (93%) in Oregon and partially (7%) in northern Nevada (see Maps 1, 2 and 9). In both states the majority of the land is federally owned and managed by the BLM. In Oregon that BLM land is managed by two BLM Districts—one based in Burns and one based in Vale.

However, the BLM in the two states do not digitized the same set of land management attributes into their geographical information systems (GIS). This makes information exchange difficult. Given the land size and information type disparities this assessment only covers the Oregon section of the Alvord Lake Sub-basin 4$^{th}$ field HUC. Data from the Nevada portion is not included. Please note that references to the Alvord Lake Sub-basin in this document are generally meant to address only the Oregon portion of the sub-basin. Map 3 provides acreage data for the Nevada and Oregon portions of the sub-basin.

The Burns BLM office has closely collaborated on this watershed assessment with the Harney County Watershed Council to produce maps and compile data. The Vale BLM office has also been very helpful. In general, the Burns and Vale BLM offices have similar data in their GIS systems and they easily share that electronic information. This has allowed map production for a variety of attributes across the sub-basin. In a few cases the Vale District either collected attribute data in a different manner or they do not have the same type of data as does the Burns BLM. Consequently some map attributes vary at or near the Vale/Burns District line. In addition to mapped data, both BLM Districts have supplied the HCWC with tabular and text information. Note that the Vale District land is generally in the southeast portion of the sub-basin and that it encompasses most of the 1712000904, 905 and 906 5$^{th}$ field watersheds. It also encompasses smaller parts of 1712000902, 903, 907 and 908.

**Mapping data.** The maps in this report, except Map 1 and 2 which show the entire state of Oregon, show and use USGS attributes and labels. Features are commonly displayed and named on these maps in the same ways they are on USGS maps. This is sometimes not true when HCWC goals for a map required that the USGS attributes be either turned off or altered.

The interpretation of some sub-basin features and the data that has been compiled about them requires an understanding of the USGS map-making process. The first step in that process is that aerial photos are taken of the area. Those photos are put together in composite photos in manners which reduce distortion, etc. Those composite photos are then interpreted mechanically and by humans, and the information is transferred to paper and electronic versions of the map. Many factors influence the accuracy of the final products, and ground truthing of the maps is not regularly performed.

On many of the USGS maps of the Alvord Lake Sub-basin it is well understood by local map users that some features are misidentified. A noticeable example of this is the fact that some water features in general are shown to be 'wetter' than they really are. At least two lakes which are considered to only be intermittent (contain water for only a part of most years) are shown to be perennial (have water year-around). Similarly, the perennial portions (have water year-around) of many streams appear to often be drawn too long, extending into stream reaches that do not have year around water. Errors such as these can easily occur when the aerial photos for a map are taken in wet years. See pages 34-38 for further discussions of perennial and non-perennial streams.

The result of this type of error is that some maps in this document show more perennial lakes and probably more miles of perennial streams than exist in the sub-basin. Users should understand that the data which we present which comes from the USGS maps, such as the miles of perennial stream length, may be inaccurate for the reasons discussed.

**Specific mapping information and disclaimers.** The 17 maps in the report can be divided into three groups of map types, with the following features:

- Maps 1 and 2—produced by Burns BLM (Pam Keller, GIS Coordinator, 573-4400). These statewide maps show very few features, and are intended primarily to put the Alvord Lake Sub-basin in perspective to the State of Oregon and to the other six sub-basins under the purview of the Harney County Watershed Council.

- Maps 3-8, and 17—produced by Burns BLM GIS (Pam Keller GIS Coordinator, 573-4400). These seven maps show various features for the entire sub-basin. The following discrepancies are found on many of these maps:
    - Perennial streams are shown in some map legends to be a relatively heavy blue lines, but on the maps they are shown instead as thin, purple lines.
    - Juniper and Ten Cent Lakes are shown to be perennial lakes (contain water year around), but in fact they often do not have year around water. They should be designated as intermittent lakes.

- Maps 6-16—produced by Harney County GIS (Bryce Mertz, GIS Specialist, 573-8195). These eight 5$^{th}$ field watershed maps were produce on the Harney County GIS system which is interactive with the Burns BLM GIS system. A consistent set of data is shown in these eight maps, unlike maps 3-8 and 17, which have various themes. Because of a larger scale, more features are shown on these maps than on 3-8 and 17, plus many features are easier to see. The perennial streams are marked both on these maps and in their legends as relatively heavy blue lines. Again though, Juniper and Ten Cent Lakes are shown to be perennial. Please note the text on page 128 about the GIS anomaly for the high elevation in the Big Alvord 5$^{th}$ field watershed and the displayed map data in Map 11.

**Appendix 2 – Special Status Plant Species in the Alvord Lake Sub-basin.** The information in the table is for the Burns BLM District only; Vale BLM data was not available.

| Common Name | Scientific Name | BLM Status | ONHP Status |
|---|---|---|---|
| alpine fescue | *Festuca brachyphylla* | T | L3 |
| alpine lily | *Lloydia serotina* | T | L3 |
| Alvord milk vetch | *Astragalus alvordensis* | T | L4 |
| Bellard's kobresia | *Kobresia bellardii* | T | L3 |
| Biddle's lupine | *Lupinus biddlei* | S | L4 |
| Bigelow's four-o'clock | *Mirabilis bigelovii var. retrorsa* | A | L2 |
| Cusick's draba | *Draba cusickii* | T | L4 |
| Cusick's hyssop | *Agastache cusickii* | A | L2 |
| Davidson's penstemon | *Penstemon davidsonii var. praeteritus* | T | L4 |
| Davis' peppergrass | *Lepidium davisii* | S | L1 |
| desert needlegrass | *Achnatherum speciosum* | A | L2 |
| desert chaenactis | *Chaenactis xantiana* | A | L2 |
| foetid sedge | *Carex vernacular* | A | L2 |
| four-wing milkvetch | *Astragalus tetrapterus* | A | L4 |
| Hayden's cymopterus | *Cymopterus nivalis* | A | L2 |
| Hayden's sedge | *Carex haydeniana* | T | L4 |
| iodine bush | *Allenrolfea occidentalis* | A | L2 |
| large-flowered chaenactis | *Chaenactis macrantha* | T | L4 |
| long-flowered snowberry | *Symphoricarpos longiflorus* | A | L2 |
| lyrate malacothirx | *Malacothris sonchoides* | T | L3 |
| Malheur crypthantha | *Cryptantha propria* | T | L4 |
| moonwort | *Botrychium lunaria* | A | L2 |
| moss gentian | *Gentiana prostrata* | A | L2 |
| naked-stemmed phacelia | *Phacelia gymnoclada* | A | L2 |
| narrowleaf cottonwood | *Populus angustifolia* | T | L4 |
| nodding melic | *Melica stricta* | T | L4 |
| ochre-headed buckwheat | *Eriogonum ochrocephalum ssp. calcareum* | T | L4 |
| pinnate grapefern | *Botrychium pinnatum* | A | L2 |
| prickly poppy | *Argemone munita ssp. rotundata* | A | L2 |
| purple cymopterus | *Cymopterus purpurascens* | A | L2 |
| Raven's lomatium | *Lomatium revenii* | A | L2 |
| salt heliotrope | *Heliotropium curassavicum* | T | L3 |
| short-fruited willow | *Salix brachycarpa var brachycarpa* | T | L4 |
| Sierra willow | *Salix orestera* | T | L3 |
| sky pilot | *Polemonium viscosum* | T | L4 |
| slender gentian | *Gentianella tenella* | A | L2 |
| slender wild cabbage | *Caulanthus major var. nevadensis* | S | L2 |
| Steens Mountain paint brush | *Castilleja pilosa var. steenensis* | S | L4 |
| thick-stemmed wild cabbage | *Caulanthus crassicaulis* | T | L4 |
| Torrey's malacothrix | *Malacothrix torreyi* | T | L4 |
| two-stemmed onion | *Allium bisceptrum* | T | L4 |
| verrucose seapurslane | *Sesuvium verrucosum* | A | L2 |
| weak-stemmed stonecrop | *Sedum debile* | T | L4 |

BLM and ONHP Status (on next page)

*BLM Status*

S=Sensitive—species that could easily become endangered or extinct in a state, are restricted in range, and have natural or human-caused threats to survival.

A=Assessment—species not presently eligible for official federal or state status but are still of concern and need protection or mitigation in BLM activities.

T=Tracking—species that may become of concern in the future, but more information is needed to determine status for management purposes.

E=Endangered – federally listed under the Endangered Species Act.

*ONHP (Oregon Natural Heritage Program) Status*

L1—taxa threatened with extinction or presumed to be extinct throughout their range.

L2—taxa threatened with extirpation or presumed to be extirpated from the State of Oregon.

L3—taxa of conservation concern that need more information to determine status.

Source: BLM, 2005.

**Appendix 3 – Special Status Animal Species in the Alvord Lake Sub-basin.** See the Status information at the bottom of the table. The Sub-basin Occurrence column indicates if each species is Known to use the sub-basin or just Suspected to periodically use the sub-basin.

| Common Name | Scientific Name | Status | | | | Sub-basin Occurrence |
|---|---|---|---|---|---|---|
| | | Fed | BLM | OR | ONHP | |
| | | | | | | |
| **BIRDS** | | | | | | |
| American white pelican | *Pelecanus erythrorhynchos* | | BA | | L2 | Known |
| bank swallow | *Riparia riparia* | | BT | | L4 | Suspected |
| black-throated sparrow | *Amphispiza bilineata* | | BT | | L2 | Known |
| Bobolink | *Dolichonyx oryzivorus* | | BT | | L4 | Suspected |
| broad-tailed hummingbird | *Selasphorus platycercus* | | BT | | L4 | Known |
| great egret | *Casmerodius albus* | | BT | | L3 | Suspected |
| Greater sage-grouse | *Centrocercus urophasianus* | SoC | BS | | L2 | Known |
| greater sandhill crane | *Grus canadensis ssp.* | | BT | | L4 | Known |
| loggerhead shrike | *Lanius ludovicianus* | | BT | | L4 | Known |
| northern bald eagle | *Haliaeetus leucocephalus* | FT | | ST | L1 | Known |
| northern goshawk | *Accipiter gentilis* | SoC | BS | | L3 | Suspected |
| olive-sided flycatcher | *Contopus cooperi* | | BT | | L3 | Known |
| peregrine falcon | *Falco peregrinus ssp.* | | BS | SE | L1 | Known |
| sage sparrow | *Amphispiza belli* | | BS | | L4 | Known |
| snowy egret | *Egretta thula* | | BA | | L4 | Suspected |
| Swainson=s hawk | *Buteo swainsoni* | | BT | | L4 | Known |
| western burrowing owl | *Athene cunicularia* | SoC | BS | | L2 | Known |
| western snowy plover (inland) | *Charadrius alexandrinus* | | | ST | L2 | Known |
| white-faced ibis | *Plegadis chihi* | SoC | BT | | L4 | Known |
| willow flycatcher | *Empidonax traillii adastus* | SoC | BT | | L4 | Suspected |
| **FISH** | | | | | | |
| Alvord chub | *Gila alvordensis* | SoC | BA | | L2 | Known |
| Borax Lake chub | *Gila boraxobius* | FE | | SE | L1 | Known |
| Lahontan cutthroat trout | *Oncorhynchus clarki* | FT | | ST | L1 | Known |
| **MAMMALS** | | | | | | |
| California bighorn sheep | *Ovis canadensis ssp.* | SoC | BT | | L4 | Known |
| fringed myotis | *Myotis thysanodes* | SoC | BT | | L3 | Suspected |
| kit fox | *Vulpes velox* | | | ST | L2 | Known |
| long-eared myotis | *Myotis evotis* | SoC | BT | | L4 | Known |
| long-legged myotis | *Myotis volans* | SoC | BT | | L3 | Known |
| pallid bat | *Antrozous pallidus* | SoC | BT | | L3 | Known |
| Preble=s shrew | *Sorex preblei* | SoC | BT | | L3 | Known |
| pygmy rabbit | *Brachylagus idahoensis* | SoC | BA | | L2 | Known |
| silver-haired bat | *Lasionycteris noctivagans* | SoC | BT | | L3 | Known |
| spotted bat | *Euderma maculatum* | SoC | BA | | L2 | Known |
| Townsend=s big-eared bat | *Corynorhinus townsendii* | SoC | BS | | L2 | Known |
| western small-footed myotis | *Myotis ciliolabrum* | SoC | BT | | L3 | Known |
| white-tailed antelope ground squirrel | *Ammospermophilus leucurus* | | BT | | L3 | Known |
| Yuma myotis | *Myotis yumanensis* | SoC | BT | | L4 | Known |

| REPTILES | | | | | | |
|---|---|---|---|---|---|---|
| desert horned lizard | *Phrynosoma platyrhinos* | | BT | | L3 | Known |
| long-nosed leopard lizard | *Gambelia wislizenii* | | BT | | L4 | Known |
| Mojave black-collared lizard | *Crotophytus bicinctores* | | BT | | L3 | Known |
| northern sagebrush lizard | *Sceloporus graciosus* | SoC | BT | | L4 | Known |

Status:
*Federal*
FE=Federal Endangered — A species which is in danger of becoming extinct within the foreseeable future throughout all or a significant portion of its range.
FT=Federal Threatened — A species that is likely to become endangered within the foreseeable future.
FC=Federal Candidate: — A species for which the USFWS or NMFS have sufficient information to support a proposal for listing as Threatened or Endangered under the ESA.
SoC=Species of Concern — A former C2 candidate species which needs additional information in order to propose as Threatened or Endangered under the ESA. The USFWS is reviewing species information for consideration as Candidates for listing under the ESA.
*BLM*
BS=Bureau Sensitive: — Species that could easily become endangered or extinct in a state, are restricted in range, and have natural or human-caused threats to survival.
BA=Bureau Assessment: — Species not presently eligible for official federal or state status but are still of concern and need protection of mitigation win BLM activities.
BT=Bureau Tracking: — Species that may become of concern in the future, but more information is needed to determine status for management purposes.

*State of Oregon*
SE=State Endangered — A species which is in danger of becoming extinct within the foreseeable future throughout all or a significant portion of its range. This species may be extirpated from its range within the state.
ST=State Threatened: — An animal that could become endangered within the foreseeable future within all or a portion of its range.

*ONHP (Oregon Natural Heritage Program)*
L1=List 1: Taxa that are threatened with extinction or presumed to be extinct throughout their entire range.
L2=List 2: Taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon.
L3=List 3: Species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
L4=List 4: Taxa which are of concern, but are not currently threatened or endangered.

Extirpated—no longer within the original range of the species in Oregon

Source: BLM, 2005.

## Appendix 4 – Glossary and Acronym List.

**ACEC:** Area of Critical Environmental Concern

**AMP:** Allotment Management Plan

**APHIS:** Agricultural Plant and Animal Health Inspection Service

**AUM:** Animal Unit Month

**Allotment:** Specific portion of public land allocated for livestock grazing, typically with identifiable or fenced boundaries and permitted for a specified number of livestock for a prescribed period of time.

**Allotment Management Plan (AMP):** A plan for managing livestock grazing on specified public land.

**Alluvial/Alluvium:** Sand, clay, etc. deposited by flowing water, especially in a stream bed.

**Andesite:** A fine-grained igneous rock of intermediate composition composed of about equal amounts of iron and magnesium minerals and plagioclase feldspars.

**Andrews FEIS:** Andrews Management Unit/Steens Mountain Cooperative Management and Protection Area Proposed Resource Management Plan and Final Environmental Impact Statement, Burns District BLM, 2004.

**Animal Unit:** One cow, one cow/calf pair, one horse, or five sheep.

**Animal Unit Month (AUM):** The forage needed to support one cow, one cow/calf pair, one horse, or five sheep for one month. Approximately 800 pounds of forage.

**Aquifer:** Rock or rock formations (often sand, gravel, sandstone, or limestone) that contain or carry groundwater and act as water reservoirs.

**Area of Critical Environmental Concern (ACEC):** Area where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect humans from natural hazards.

**BLM:** Bureau of Land Management

**Basalt:** A dark, heavy, fine-grained silica-poor igneous rock composed largely of iron and magnesium minerals and calcium-rich plagioclase feldspars.

**Basin (River):** In general, the area of land that drains water, sediment, and dissolved materials to a common point along a stream channel. River basins are composed of large river systems.

**Best Management Practices (BMPs):** A set of practices which, when applied during implementation of management actions, ensures that negative impacts to natural resources are minimized. BMPs are applied based on site-specific evaluation and represent the most effective and practical means to achieve management goals for a given site.

**Bureau of Land Management (BLM):** Government agency with the mandate to manage federal lands under its jurisdiction for multiple uses.

**BLM Assessment Species:** Plant and animal species on List 2 of the Oregon Natural Heritage Data Base, or those species on the Oregon List of Sensitive Wildlife Species (OAR 635-100-040) that are identified in BLM Instruction Memo OR-91-57 and are not included as federal candidate, state listed, or BLM sensitive species.

**BLM Sensitive Species:** Plant or animal species eligible for federal listed, federal candidate, state listed, or state candidate (plant) status, or on List 1 in the Oregon Natural Heritage Data Base, or approved for this category by the BLM State Director.

**BLM Tracking Species:** Plant and animal species on List 3 and 4 of the Oregon Natural Heritage Data Base, or those species on the Oregon List of Sensitive Wildlife Species (OAR 635-100-040) that are identified in BLM Instruction Memo OR-91-57 and are not included as federal candidate, state Listed, BLM sensitive, or BLM assessment species.

**Borax:** An evaporite mineral ($Na_2B_4O_7\ 10H_2O$). It is the major source of boron and is generally found in alkali lake deposits. It has a variety of uses (e.g., glass and ceramics manufacturing, agricultural chemicals, chemical fluxes, fire retardant and preservative).

**CFR:** Code of Federal Regulations

**cfs:** cubic feet per second—a measure of the amount of flowing water

**CMPA:** Cooperative Management and Protection Area

**CWA:** Clean Water Act

**Candidate Species:** Any species included in the Federal Register Notice of Review that are being considered for listing as threatened or endangered by the US Fish and Wildlife Service.

**Chalcedony:** A cryptocrystalline variety of quartz ($SiO_2$) consisting of microscopic fibers. It exhibits a myriad of colors and patterns and is used primarily as an ornamental or gemstone. Agate, jasper and thunder eggs are varieties.

**Clay:** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40% or more clay, less than 45% sand, and less than 40% silt.

**Clay (Geology):** A rock or mineral fragment of any composition finer than 0.00016 inches in diameter. Mineral = a hydrous aluminum-silicate that occurs as microscopic plates, and commonly has the ability to absorb substantial quantities of water on the surface of the plates.

**Climax Vegetation:** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change as long as the environment remains the same.

**Colluvium:** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Community:** A group of species of plants and/or animals living and interacting at a particular time and place; a group of people residing in the same place and under the same government.

**Corridor (Landscape**): Landscape elements that connect similar patches of habitat through an area with different characteristics. For example, streamside vegetation may create a corridor of willows and hardwoods between meadows or through a forest.

**DEQ:** Oregon Department of Environmental Quality

**DO:** Dissolved oxygen, oxygen dissolved in water.

**Deep Soil**: A soil that is 40 to 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Developed Recreation:** Recreation that requires facilities which in turn result in concentrated use of an area; for example, a campground.

**Diatomite:** A soft, crumbly, lightweight, highly porous sedimentary rock consisting mainly of microscopic siliceous skeletons of diatoms (single-celled aquatic plants related to algae). It is used for filter aids, paint filler, abrasives, anti-caking agents, insecticide carriers, and insulation.

**Dispersed Recreation:** Recreation that does not occur in a developed recreation life; for example, hunting or backpacking.

**Disturbance:** Refers to events that alter the structure, composition, or function of terrestrial or aquatic habitats. Natural disturbances include, among others, drought, floods, wind, fires, wildlife grazing, insects, and pathogens. Human-caused disturbances include actions such as timber harvest, livestock grazing, roads, and the introduction of exotic species.

**Drainage Surface:** Runoff, or surface flow of water, from an area.

**Duff:** A generally firm organic layer on the surface of mineral soils consisting of fallen decaying plant material including everything from the litter on the surface to underlying pure humus.

**EIS:** Environmental Impact Statement

**EPA:** Environmental Protection Agency

**ESA:** Endangered Species Act

**ESI:** Ecological Site Inventory

**Ecological Site Inventory (ESI**): The basic inventory of present and potential vegetation on BLM rangelands. Ecological sites are differentiated on the basis of the kind, proportion, or amount of plant species.

**Ecological Status:** The present state of vegetation of a range site in relation to the potential natural community for that site. Four classes are used to express the degree to which the production or composition of the present plant community reflects that of the potential natural community (climax):

| Ecological Status (Seral stage) | Percent of Community in Climax Condition |
|---|---|
| Potential natural community | 76-100 |
| Late seral | 51-75 |
| Mid-seral | 26-50 |
| Early seral | 0-25 |

**Ecosystem:** A complete, interacting system of living organisms and the land and water that make up their environment; the home places of all living things, including humans.

**Endangered Species:** Any species defined under the ESA as being in danger of extinction throughout all or a significant portion of its range. Listings are published in the Federal Register.

**Environmental Assessment (EA):** One type of document prepared by federal agencies in compliance with the National Environmental Policy Act (NEPA) which portrays the environmental consequences of proposed federal actions which are not expected to have significant impacts on the human environment.

**Environmental Impact Statement (EIS):** One type of document prepared by federal agencies in compliance with the National Environmental Policy Act (NEPA) which portrays the environmental consequences of proposed major federal actions expected to have significant impacts on the human environment.

**Ephemeral Stream:** A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no continuous supply from melting snow or other source, and its channel is above the water table at all times.

**Erosion:** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

**Erosion (Accelerated):** Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, e.g., fire that exposes the surface.

**Erosion (Geologic):** Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the buildup of such landscape features as flood plains and coastal plains. Erosion is synonymous with natural erosion.

**Evapotranspiration:** The release and movement of moisture through evaporation from water and soil surfaces, and loss from living vegetation.

**F—AR:** Functional—At Risk

**FEIS:** Final Environmental Impact Statement

**FLPMA:** Federal Land Policy and Management Act

**Fauna:** The vertebrate and invertebrate animals of an area or region.

**Federal Land Policy Management Act of 1976 (FLPMA):** Law mandating that the BLM manage lands under its jurisdiction for multiple uses. Establishes guidelines for its administration; and provides for the management, protection, development, and enhancement of the public lands, among other provisions.

**Feldspar:** Common rock-forming minerals composed of silicate of aluminum, combined with sodium and either potassium or calcium.

**Fine Textured Soil:** Sandy clay, silty clay, or clay.

**Fire Effects:** The physical, biological, and ecological impact of fire on the environment.

**Fire Intensity:** The product of the available heat of combustion per unit area of ground and the rate of spread of the fire.

**Fire Management Plan (FMP):** A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

**Fire Regime:** The characteristics of fire in a given ecosystem, such as the frequency, predictability, intensity, and seasonality of fire.

**Fire Return Interval:** The number of years between two successive fires documented in a designated area (i.e., the interval between two successive fire occurrences).

**Fire Suppression:** All the work activities connected with fire-extinguishing operations, beginning with the discovery and continuing until the fire is completely extinguished.

**Flood Plain:** A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform build of sediment deposited during overflow and lateral migration of the stream.

**Forage:** Vegetation (both woody and non-woody) eaten by animals, especially grazing and browsing animals.

**Forb:** Any herbaceous plant not a grass or a grass-like species. Broad-leafed plants; includes plants that commonly are called weeds or wildflowers.

**Fuel (Fire):** Dry, dead parts of trees, shrubs, and other vegetation that can burn readily.

**Functional—At Risk (FAR):** Riparian/wetland areas that are in functioning condition but an existing soil, water, or vegetation attribute makes them susceptible to degradation.

**GIS:** Geographic Information System

**Geographic Information System (GIS):** An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

**Graben:** A fault-bounded down-dropped portion of the earth’s crust.

**Gravel:** Unconsolidated, rounded or angular fragments of rock. Usually defined as being larger than sands and smaller than cobbles, so about two millimeters to 2.5 inches.

**Ground Water:** Water that sinks into the soil and is stored in slowly flowing and slowly renewed underground reservoirs called aquifers.

**Gully:** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**HCCWMA:** Harney County Cooperative Weed Management Area

**HCWC:** Harney County Watershed Council

**HMA:** Herd Management Area

**HSWCD:** Harney Soil and Water Conservation District.

**HUC:** Hydrologic Unit Code

**Habitat:** A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

**Herd:** One or more wild horse bands using the same general area.

**Herd Management Area (HMA):** A geographic area identified in a Management Framework Plan or Resource Management Plan for the long-term management of a wild horse herd.

**Herd Management Area Plan:** A plan that prescribes measures for the protection, management, and control of wild horses and their habitat on one or more HMAs, in conformance with decisions made in approved Management Framework or Resource Management Plans.

**Horizon (Soil):** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes.

**Hydrologic:** Refers to the properties, distribution, and effects of water. “Hydrology” refers to the broad science of the waters of the earth; their occurrence, circulation, distribution, chemical and physical properties, and their reaction with the environment.

**Hydrologic Unit Code (HUC):** A coding system developed by the U.S. Geological Service to map geographic boundaries of watersheds of various sizes.

**Hydrothermal Deposit:** A mineral deposit formed by hot mineral-laden fluids.

**Igneous Rock:** Rock that solidified from a molten or semi-molten state. The major varieties include intrusive (solidified beneath the surface of the earth) and volcanic (solidified on or very near the surface of the earth).

**Intermittent Stream:** A stream, or reach of a stream, that flows for prolonged periods only when it receives groundwater discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

**Interior Drainage:** Streams with no outlet to the sea.

**Lacustrine:** Of or found in or on lakes.

**Leasable Minerals:** Minerals that may be leased to private interests by the federal government including oil, gas, geothermal, coal, and sodium compounds.

**Limestone:** A sedimentary rock consisting chiefly of calcium carbonate.

**Loam:** Soil material that is seven to 27% clay particles, 28 to 50% silt particles, and less than 52% sand particles.

**Locatable Minerals:** Minerals subject to exploration, development, and disposal by staking mining claims as authorized by the Mining Law of 1872, as amended. This includes deposits of gold, silver, and other uncommon minerals not subject to lease or sale.

**Map Unit:** The basic system of description in a soil survey and delineation on a soil map. Can vary in level of detail.

**Mechanical Treatment:** Use of mechanical equipment for seeding, brush management, and other management practices.

**Microbiotic Crust:** Lichens, mosses, green algae, fungi, cyanobacteria, and bacteria growing on or just below the surface of soils.

**Mineral Estate:** Refers to the ownership of minerals at or beneath the surface of the land.

**Mitigation:** Measures designed to counteract environmental impacts or to make impacts less severe.

**Monitoring:** The periodic and systematic collection of resource data to measure progress toward achieving objectives.

**Monitoring and Evaluation:** The collection and analysis of data to evaluate the progress and effectiveness of on-the-ground actions in meeting resource management goals and objectives.

**Multiple Use:** Management of public land and its resources to best meet various present and future needs of the American people. This means coordinated management of resources and uses to assure the long-term health of the ecosystem.

**NEPA:** National Environmental Policy Act

**NF:** Nonfunctioning

**NOAA:** National Oceanographic and Atmospheric Administration

**NRCS:** Natural Resource Conservation Service

**National Environmental Policy Act of 1969 (NEPA):** Law requiring all federal agencies to evaluate the impacts of proposed major federal actions with respect to their significance on the human environment.

**National Wildlife Refuge (NWR):** An area administered by the U.S. Fish and Wildlife Service for the purpose of managing certain fish or wildlife species.

**Naturalness (a primary wilderness value):** An area that generally appears to have been affected primarily by the forces of nature with the imprint of people's work substantially unnoticeable.

**Nonfunctioning:** PFC classification of riparian-wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc.

**Noxious Weed:** A plant specified by law as being especially undesirable, troublesome, and difficult to control. A plant species designated by federal or state law as generally possessing one or more of the following characteristics: aggressive and difficult to manage; parasitic; a carrier or host of serious insects or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

**Nutrient (Plant):** Any element taken in by a plant that is essential to its growth. Plant nutrients are mainly nitrogen, phosphorous, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil, and carbon, hydrogen, and oxygen obtained from the air and water.

**ODEQ:** Oregon Department of Environmental Quality

**ODFW:** Oregon Department of Fish and Wildlife

**OHV:** Off-highway vehicle

**ONHP:** Oregon Natural Heritage Program

**OWEB:** Oregon Watershed Enhancement Board

**OWRD:** Oregon Water Resources Department

**Oregon TMDL:** Alvord Lake Sub-basin Total Maximum Daily Load & Water Quality Management Plan, Oregon DEQ, 2003.

**Organic Matter:** Plant and animal residue in the soil in various stages of decomposition.

**Overstory:** The plants in a plant community which form the upper canopy.

**PFC:** Proper functioning condition

**pH Value:** A numerical designation of acidity and alkalinity. (See Reaction, soil)

**PILT:** Payments In Lieu of Taxes

**PL:** Public Law

**PNC**: Potential Natural Community

**PRIA:** Public Rangelands Improvement Act of 1978

**Perennial:** A plant that lives for three or more years.

**Perennial Stream:** A stream in which water is present during all seasons of the year.

**Permeability:** The quality of the soil that enables water to move downward through the profile, measured as the number of inches per hour that water moves downward through the saturated soil.

**Playa Lake:** A shallow lake that is seasonally dry. Soils on the lake bottom are usually quite alkaline.

**Pleistocene:** Geologic time period characterized by the rise and receding of continental ice sheets; appearance of early man, epoch of time is 50,000 to 1,000,000 years ago.

**Pluvial:** Referring to a period of greater rainfall.

**Pluvial Lake:** A lake formed during a period of exceptionally high rainfall (e.g., a time of glacial advance during the Pleistocene epoch) and now either extinct or existing as a remnant, such as Lake Bonneville.

**Point Source Pollution:** Pollution that comes from a single identifiable source such as a smokestack, a sewer, or a pipe.

**Prescribed Burning:** Controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time to produce the fire line intensity and rate of spread required to attain planned resource management objectives.

**Prescribed Fire:** Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met prior to ignition. The introduction of fire to an area under regulated conditions for specific management purposes (usually vegetation manipulation).

**Primary Wilderness Values:** The primary or key wilderness values described in the Wilderness Act by which WSAs and wildernesses are managed to protect and enhance the wilderness resource. Values include roadlessness, naturalness, solitude, primitive and unconfined recreation, and size.

**Productivity:** 1) *Soil productivity*: the capacity of a soil to produce plant growth, due to the soil's chemical, physical, and biological properties (such as depth, temperature, water-holding capacity, and mineral, nutrient, and organic matter content). 2) *Vegetative productivity*: the rate of production of vegetation within a given period. 3) *General*: the innate capacity of an environment to support plant and animal life over time.

**Proper Functioning Condition (PFC):** Riparian-wetland areas achieve Proper Functioning Condition when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows. This thereby reduces erosion and improves water quality; filters sediment, captures bedload, and aids floodplain development; improves floodwater retention and groundwater recharge; develops root masses that stabilize streambanks again cutting action; develops diverse ponding and channel characteristics to provide habitat and water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and supports greater biodiversity. The functioning condition of riparian-wetland areas is a result of the interaction among geology, soil, water, and vegetation.

**Public Land:** Any land or interest in land owned by city, county, state or federal government.

**Pumice:** A glassy, rhyolitic rock exhibiting a vesicular, or frothy texture. It is generally used as a light weight aggregate and an abrasive.

**RAC**: Resource Advisory Council

**RMP**: Resource Management Plan

**RNA:** Research Natural Area

**ROW:** Right-of-way

**Rangeland:** Land on which the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range Site:** An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

**Reaction, Soil:** A measure of acidity or alkalinity of a soil, expressed in pH values. Soils with pH values less than 7 are acidic and those with pH greater than 7 are alkaline.

**Regeneration:** The new growth of a natural plant community, developing from seed.

**Research Natural Area (RNA):** An area where natural processes predominate and which is preserved for research and education. Under current BLM policy, these areas must meet the relevance and importance criteria of ACECs and are designated as ACECs. An area of significant scientific interest that is designated to protect its resource values for scientific research and study.

**Resource Area:** The “on-the-ground” management unit of the BLM comprised of BLM administered land within a specific geographic area.

**Resource Management Plan (RMP):** Current generation of land use plans developed by the BLM under the Federal Land Policy and Management Act. Replaces the older generation Management Framework Plans. Provides long-term (up to 20 years) direction for the management of a particular area of land and its resources, usually corresponding to a BLM resource area.

**Revegetation:** Establishing or re-establishing desirable plants on areas where desirable plants are absent or of inadequate density, by management alone (natural revegetation) or by seeding or transplanting (artificial revegetation).

**Rhyolite:** A fine-grained light-colored silica-rich igneous rock composed largely of potash feldspars and quartz.

**Right-of-Way (ROW):** A permit or an easement which authorizes the use of public land for certain specified purposes, commonly for pipelines, roads, telephone lines, electric lines, reservoirs, etc; also, the reference to the land covered by such an easement or permit.

**Rill:** A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Riparian Area:** Area with distinctive soil and vegetation between a stream or other body of water and the adjacent upland; includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

**Rock Fragments:** Rock or mineral fragments having a diameter of two millimeters or more, e.g., pebbles, cobbles, stones, and boulders.

**Runoff:** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground water runoff or seepage flow from ground water.

**S&Gs:** Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington

**SEORMP:** Southeastern Oregon Resource Management Plan

**SMAC:** Steens Mountain Advisory Council

**SRMA:** Special Recreation Management Area

**SRP:** Special Recreation Permit

**Saleable Minerals:** High volume, low value mineral resources including common varieties of rock, clay, decorative stone, sand, gravel, and cinder.

**Sand (Geology):** A rock fragment or detrital particle between 0.0025 and 0.08 inches in diameter.

**Scenic River:** A river or section of a river that is free of impoundments and whose shorelines are largely undeveloped but accessible in places by roads.

**Sediment:** Soil, rock particles and organic or other debris carried from one place to another by wind, water or gravity.

**Sedimentary:** Any rock or mass deposited by wind or water.

**Sensitive Species:** Species identified by a Forest Service regional forester or BLM state director for which population viability is a concern either (a) because of significant current or predicted downward trends in population numbers or density, or (b) because of significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

**Seral:** Refers to the sequence of transitional plant communities during succession. Early-seral refers to plants that are present soon after a disturbance or at the beginning of a new successional process (such as seedling or sapling growth stages in a forest); mid-seral in a forest would refer to pole or medium saw timber growth stages; late- or old-seral refers to plants present during a later stage of plant community succession (such as mature and old forest stages).

**Seral Stage:** The developmental phase of a forest stand or rangeland with characteristic structure and plant species composition. The rated departure of a plant community from a described potential natural community (PNC) for a specific ecological site. Low-seral stage is an existing plant community which is defined as 0-25% comparability to the defined PNC; Mid-seral stage is an existing plant community which has 26-50% comparability to the PNC; Late seral stage is 51-75% comparable to the PNC; PNC is an existing plant community with 76-100% comparability to the defined PNC.

**Shallow Soil:** A soil that is 10 to 20 inches deep over bedrock or to other material that restricts the penetration of plant roots.

**Slope:** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, and then multiplied by 100. Thus, a slope of 20% is a drop of 20 feet in 100 feet of horizontal distance.

**Soil:** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil Association:** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single soil map unit.

**Soil Classification:** The systematic arrangement of soils into groups or categories on the basis of their characteristics.

**Soil Compaction:** An increase in soil bulk density of 15% or more from the undisturbed level.

**Soil Productivity:** The capacity of a soil to produce a specified plant or sequence of plants under specific management.

**Soil Profile:** A vertical section of the soil extending through all its horizons and into the parent material.

**Soil Survey:** A field investigation resulting in a soil map showing the geographic distribution of various kinds of soil and an accompanying report that describes the soil types and interprets the findings.

**Soil Texture:** The relative proportions of sand, silt, and clay particles in a mass of soil.

**Special Recreation Management Area (SRMA):** An area where recreation is the principal management objective, where intensive recreation management is needed, and where more than minimal recreation-related investments are required.

**Special Status Species:** Plant or animal species known or suspected to be limited in distribution, rare or uncommon within a specific area, and/or vulnerable to activities which may affect their survival.

**Stand:** A community of trees occupying a specific area and sufficiently uniform in species, age, spatial arrangement and condition as to be distinguishable from trees on surrounding lands.

**State Listed Species:** Any plant or animal species listed by the State of Oregon as threatened or endangered within the state under ORS 496.004, ORS 498.026, or ORS 564.040.

**Steens Act:** Steens Mountain Cooperative Management and Protection Act (2000)

**Stream Channel:** The hollow bed where a natural stream of surface water flows or may flow; the deepest or central part of the bed, formed by the main current and covered more or less continuously by water.

**Structure (Soil):** The arrangement of primary soil particles into compound particles or aggregates.

**Subwatershed:** A drainage area of approximately 20,000 acres, equivalent to a 6$^{th}$-field Hydrologic Unit Code (HUC). Hierarchically, subwatersheds (6$^{th}$-field HUC) are contained within a watershed (5$^{th}$-field HUC), which in turn is contained within a sub-basin (4th-field HUC).

**Succession:** A predictable process of changes in structure and composition of plant and animal communities over time. Conditions of the prior plant community or successional stage create conditions that are favorable for the establishment of the next stage. The different stages in succession are often referred to as "seral stages." (See Seral.)

**Sunstone:** A calcium-rich variety of plagioclase feldspar that exhibits a pink to red metallic shimmer when viewed perpendicular to the surface. The shimmer is caused by light reflecting off the surface of minute parallel platelets of native copper suspended in the stone.

**Sustained Yield:** Maintenance of an annual or regular periodic output of a renewable resource from public land consistent with the principles of multiple use.

**TMDL:** Total Maximum Daily Load

**TNC:** The Nature Conservancy

**TNR:** Temporary Nonrenewable

**Talus:** Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

**Terrace (Geologic):** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Terrestrial:** Of the land, in comparison to ‘aquatic’ which refers to objects or species which are found in water. In zoology, terrestrial is also often used to describe species that live on or in the ground, in comparison to those that fly or live in trees.

**Threatened Species:** Any plant or animal species defined under the ESA as likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

**Thunderegg:** An agate, opal, or chalcedony-filled nodule deposit formed in rhyolitic lavas or tuffs.

**Trend:** The direction of change in ecological status observed over time. Trend is described as toward or away from the potential natural community, or as not apparent.

**Tuff:** Volcanic ash or rock composed of compacted ash.

**USDA:** United States Department of Agriculture

**USDI:** United States Department of the Interior

**USFS:** United States Forest Service

**USFWS:** United States Fish and Wildlife Service

**USGS:** United States Geological Survey

**Upland:** Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Vale FEIS:** Proposed Southeastern Oregon Resource Management Plan and Final Environmental Impact Statement, Vale District BLM, 2001.

**Visual Resource Management Classifications (VRM) Class I:** The objective of this classification is to preserve the existing character of the landscape. This class provides for natural ecological changes and limited management activity. The level of change should be very low and must not attract attention. Class I is assigned to those areas where a management decision has been made to preserve a natural landscape.

**VRM Class II:** The objective of this classification is to retain the existing character of the landscape. The level of change to landscape characteristics should be low. Management activities may be seen but should not attract the attention of a casual observer. Any changes must conform to the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. This class represents the minimum level of VRM for WSAs.

**VRM Class III:** The objective of Class III is to partially retain the existing character of the landscape. Moderate levels of change are acceptable. Management activities may attract attention but should not dominate the view of a casual observer. Changes should conform to the basic elements of the predominant natural features of the characteristic landscape.

**VRM Class IV:** The objective of Class IV is to provide for management activities that require major modification of the landscape. These management activities may dominate the view and become the focus of viewer attention; however, every effort should be made to minimize the impact of these projects by carefully locating activities, minimizing disturbance, and designing the projects to conform to the characteristic landscape.

**WJMA:** Wildlands Juniper Management Area

**WMU:** Wildlife Management Unit

**WQMP:** Water Quality Management Plan

**WSA:** Wilderness Study Area

**WSR:** Wild and Scenic River

**Welded Tuff:** A glass-rich volcanic rock that has been solidified by the welding of its glass shards through an action of heat and hot gas.

**Wild River:** A river or section of a river that is free of impoundments and generally inaccessible except by trail, with watersheds and shorelines essentially primitive and waters unpolluted.

**Withdrawal:** Withholding an area of federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program; or transferring jurisdiction over an area of federal land, other than "property" governed by the Federal Property and Administrative Services Act, as amended (40U.S.C.472) from one department, bureau, or agency to another department, bureau, or agency.