ROCK AND LONEROCK CREEKS WATERSHED ASSESSMENT

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FOREST GROVE, OREGON

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FINAL REPORT

Prepared for

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ACRONYMS AND ABBBREVIATIONS

BLM	Bureau of Land Management
BOD	Biological Oxygen Demand
BOR	Bureau of Reclamation
cfs	Cubic feet per second
CHT	Channel Habitat Type
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Security Program
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DO	Dissolved Oxygen
DOGAMI	Department of Geology and Mining Industries
DPS	Distinct Population Segment
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
GCWD	Gilliam County Weed Department
GIS	Geographic Information Systems
gpm	Gallons per minute
GPS	Geographic Positioning System
HUC	Hydrologic Unit Code
IPM	Integrated Pest Management
LJDLAC	Lower John Day Local Advisory Committee
LWD	Large Woody Debris
MaSA	Major Spawning Area
MiSA	Minor Spawning Area
MPG	Major Population Grouping
NMFS	National Marine Fisheries Service
NRCS	Natural Resource Conservation Service
OAR	Oregon Administrative Rules
OCS	Oregon Climate Service
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board (Formerly GWEB)
OWRD	Oregon Water Resources Department
RCU	Riparian Condition Unit
REMAP	Regional Environmental Monitoring and Assessment Project
RM	River mile
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAB	Water Availability Basin
WARS	Water Availability Reporting System
WPN	Watershed Professionals Network
WQMP	Water Quality Management Plan

CHAPTER 1: WATERSHED CONDITION SUMMARY

This chapter summarizes the findings of the Rock and Lonerock creeks watershed assessment, including the major findings, identification of data gaps, and a listing of the recommendations that resulted from performing the assessment.

INTRODUCTION

The purpose of this watershed assessment is to characterize current and historic watershed conditions within the Rock and Lonerock creeks watershed with respect to land use; hydrology; aquatic, riparian, and upland habitats; water quality; and aquatic life. The assessment is intended to identify changes to watershed conditions and functions, and to understand how human activities in the watershed have likely contributed to these changes. Based on these inferences, the assessment identifies opportunities for improvement in watershed conditions using various land management practices and watershed enhancement projects. With these objectives in mind, this assessment was performed by gathering, synthesizing, analyzing, and interpreting existing data and gathering new data during the assessment. This assessment was performed following the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (WPN 1999). Existing data was supplemented with field surveys and other data collection efforts to fill information gaps and document the current status of the watershed. The assessment was funded by an OWEB grant.

CHANNEL HABITAT TYPES

Summary: Understanding the morphologic features of streams helps identify both their sensitivity to disturbance and their potential for recovery. In this assessment, stream reaches throughout the Rock and Lonerock creeks watershed were classified into Channel Habitat Types (CHTs), to characterize the overall sensitivity of Rock Creek, Lonerock Creek, and tributaries to disturbance. A total of 599.1 miles of streams were typed throughout the watershed. The Rock and Lonerock creeks watershed comprises a number of channel habitat types that range in sensitivity to disturbances such as altered hydrologic and sediment-input regimes. Watershed-wide, 12.4% of the total channel length (74.3 miles) is classified as highly sensitive to disturbance. These channels occur in the middle portion of the watershed, north and east of Condon, as well as in some of the upper reaches, particularly north and east of Lonerock and south of Hardman.

Channels classified as moderately sensitive to disturbance represented 65.2% of the total channel length in the watershed (390.6 miles). Moderately Steep Narrow Valley channels were the most common CHT type in the watershed and represented 29.4% of the total channel length. These moderately sensitive channels occur throughout the watershed and tend to represent the largest proportion of channel length in most of the headwaters throughout the watershed. Throughout the watershed, 22.4% of the channels are classified as CHTs that are least-sensitive to disturbances. Because these CHT types are confined and relatively stable, they tend to be poor candidates for instream restoration projects. However, these areas should not be overlooked for riparian and upland restoration opportunities, as steep slopes, commonly associated with these channel types, can deliver large amounts of sediment to receiving waters if native vegetative cover is compromised.

DATA GAPS

- Comprehensive ground-truthing and field verification of channel habitat types with those located on private property in particular.

RECOMMENDATIONS

- Although channel habitat typing provides one source of information used to identify potential restoration opportunities, we suggest a more intensive field-based survey be performed to further examine stream channel conditions. Rosgen stream typing and/or a detailed hydro geomorphic assessment would both improve baseline information and better quantify reach-specific channel conditions in the watershed for restoration opportunity identification and prioritization.

- Field work performed during this watershed assessment allowed for a more detailed examination of physical habitat characteristics in selected reaches throughout the watershed; similar reach-specific surveys should be performed in advance of implementing restoration projects in the basin.

RIPARIAN AND WETLANDS

Summary: This watershed-wide, screening-level assessment provides a foundation for understanding current riparian conditions in the watershed relative to what occurred historically. Agriculture, forestry, and settlement patterns have altered riparian zone conditions throughout the Rock and Lonerock creeks watershed. These changes have resulted in reductions in stream shading and riparian recruitment of large woody debris. Riparian zones occurring in upper reaches of stream networks in primarily forested areas are currently being limited by small tree sizes or a lack of trees altogether. Existing information suggests that riparian areas in the middle and lower portions of the watershed (by virtue of the ecoregions within which these areas occur) were not historically stocked with high densities of larger trees. However, riparian vegetation, primarily in the form of shrubs such as small willows, was still abundant in many of these areas and provided many of the same functions as did larger trees. Such functions include increased stream bank stability, abatement of the effects of high flows, and partial stream shading. The lack of this riparian vegetation has contributed to degraded channel conditions in parts of the lower and middle watershed.

Wetland types occurring within the watershed include freshwater emergent wetlands, freshwater forested/shrub wetlands, and freshwater ponds. Freshwater emergent wetlands were the most common type of wetland occurring in the watershed, comprising 86.5% of total wetland acres within the basin. Freshwater forested/shrub wetland and freshwater ponds accounted for 9.6 and 3.9% of the total wetland acres within the basin, respectively. Wetland areas are present in each of the subwatersheds; however, 66.0% of the total wetland area within the watershed occurs in the Juniper Creek subwatershed. Another 11.7% of the total area occurs in adjacent Chapin Creek subwatershed.

DATA GAPS

- Field data to quantify current riparian zone conditions, particularly in the areas of the watershed where conditions could be best improved by riparian restoration projects.

RECOMMENDATIONS

- This watershed-wide, screening-level assessment provides a starting point for characterizing riparian zone conditions in the watershed. We recommend collection of reach-specific field data to quantify current riparian zone conditions, particularly in areas of the watershed where conditions could be best improved by riparian restoration projects.
- Landowners should continue to be encouraged to create riparian buffers that aid in the establishment of vegetation appropriate to the ecoregion.
- Landowners should continue to utilize programs such as the Conservation Reserve Enhancement Program (CREP). Landowners who do not wish to participate in CREP can contact the Gilliam SWCD for information on other programs and potential funding mechanisms.
- Measures should be taken to reestablish trees, shrubs, and other vegetation in riparian zones. Riparian fencing can effectively control livestock access to riparian areas and allow vegetation to regenerate, while tree and shrub planting will further expedite and enhance recovery.

HYDROLOGY AND WATER USE

Summary: The purpose of this component of the assessment is to evaluate the potential impacts of land and water-use practices on the hydrology of the Rock and Lonerock creeks watershed. The Watershed Assessment Manual includes screening-level assessments of each of the major land-use types occurring in the Rock and Lonerock creeks watershed to determine which land-use types are potentially altering hydrologic processes. Results of the land-use effects assessment suggested that three subwatersheds are at moderate risk of peak flow enhancement due to agricultural land uses. These included Rood Canyon, Lonerock Creek and Wild Call Canyon, all occurring at higher elevations. While less cropland and more rangeland occurs in the higher country, higher rainfall in these areas increases the likelihood of amplified runoff events. The screening-level assessment for potential effects of land use and roads on increasing peak flows indicated that road densities were sufficiently low so as to present only a low risk of peak-flow enhancement throughout the watershed.

RECOMMENDATIONS

- Continued use of soil conservation practices, such as no-till seeding and placing agricultural land into the Conservation Reserve Program (CRP).
- Reestablishment of a stream gage station on lower Rock Creek to assist with further characterizing the hydrologic regime of the watershed and would allow a closer evaluation of the effects of land and water conservation techniques on the watershed's hydrologic condition.
- Additional water conservation measures should be considered in the watershed to help protect and improve stream flows necessary for maintaining natural aquatic communities. Based on the most up-to-date information, water conservation measures should include controlling the spread of juniper into areas historically dominated by native bunchgrasses and greater irrigation efficiency.

UPLANDS

Summary: Nearly half of the Rock Creek and Lonerock Creek watershed is rangeland which occurs primarily on privately owned land, with small BLM and State of Oregon holdings. Although sheep ranching historically occurred in the watershed, only cattle ranching is currently practiced. Rangelands in the watershed were historically dominated by bunchgrass communities comprising blue-bunch wheatgrass and Sandberg bluegrass on lower elevation slopes on all aspects and entire south- and west-facing slopes. Idaho fescue dominated the steep north- and east-facing slopes, while basin wild rye occurred primarily in the valley bottoms and hillslope swales (Hugh Barrett, personal communication). These bunch-grass communities co-exist with mixed sagebrush/bunch grass communities throughout the watershed. Euro-American settlement of the watershed and the accompanying introduction of unmanaged grazing, conversion of range to agricultural lands, alteration of hydrologic and fire regimes, and the invasion of noxious weeds and some native species have altered these communities. These changes, particularly the uncontrolled spread of noxious weeds and juniper, threaten both the rangel and biodiversity of the watershed as well as the potential for recovery of overall watershed health and function (NWPCC 2004).

Recent estimates suggest that juniper has encroached on more than 30,000 acres of rangeland in the Rock Creek and Lonerock Creek watershed over the past century (Walter Powell, personal communication, June 2008). Encroachment of juniper onto grasslands is clearly evident to long-time residents of the watershed, as they have watched hillsides become crowded with stands of juniper. This is particularly evident in the upper areas of the watershed around the town of Lonerock. Efforts to control the spread of juniper are currently underway in the Rock Creek and Lonerock Creek watershed. The Gilliam SWCD has received funding through OWEB and NRCS EQIP for a juniper removal project near Lonerock totaling approximately 3,500 acres. The SWCD has applied for additional grant funding that could increase the total acreage of the project by 1,500 acres.

The uncontrolled spread of noxious weeds has been identified as one of the primary issues of concern for the Rock Creek and Lonerock Creek watershed. In the Rock Creek and Lonerock Creek watershed, common weed species include Dalmatian toadflax, medusa head, kowhai, and spotted, diffuse, and Russian knapweeds; Scotch

thistle; and poison hemlock, among others (Teri McElroy, personal communication, October 2008). Current efforts to control noxious weeds in the Rock Creek and Lonerock Creek watershed focus on land-owner-specific treatment of weeds in areas of high infestation. The Gilliam County Weed Department maintains a prioritized list of target species occurring in the county.

DATA GAPS:

- Comprehensive inventory of noxious weed locations and acreages. The current maps are not necessarily up-to-date or complete.
- Current forest stand size, structure, and deviation from expected historic conditions.

RECOMMENDATIONS:

- We recommend that land currently being protected through the Conservation Reserve Program (CRP) be reenrolled in the program in 2011.
- We recommend continued support of the CRP and the benefits this program provides to watershed function.
- We further encourage all landowners to take advantage of CRP in areas of shallow and highly erodible soils.
- We encourage the Gilliam SWCD to continue to work with local landowners to increase the use of minimum-tillage or direct-seeding methods that can improve soil health and productivity, reduce soil erosion, improve water quality, and increase crop residue.
- We encourage the Gilliam SWCD and local NRCS staff to continue to work with ranchers in preparing formal grazing plans.
- We recommend that all landowners acquaint themselves with noxious weeds known to be present in the watershed, learn to recognize them, take steps to prevent their spread, and treat infestations as they're identified.

SEDIMENT SOURCES

Summary: While the Rock and Lonerock creeks watershed has always received sediment from upland sources, human alteration of the landscape has increased these inputs with adverse effects to aquatic habitat and the life it supports. While current sediment loading levels are almost surely not as high as they were in the late 19th and early 20th centuries when land-clearing and overgrazing were commonplace in eastern Oregon, some land-use activities still contribute high sediment loads to Rock Creek, Lonerock Creek, and their tributaries. Land use is dominated by cattle grazing, small grain farming, and hay production. When not properly managed for erosion control, each of these land uses results in increased sediment loads into stream systems. While Best Management Practices (BMPs) can minimize adverse effects to streams (Waters 1995 and Turner 1997), these practices are only partially implemented in the watershed.

Much of the watershed area is used as rangeland for cattle. In some areas of the watershed, livestock are allowed to overgraze riparian areas, leading to degradation of channels and aquatic habitats. Some bottomland pastures are heavily overgrazed, or even completely denuded of vegetation in late fall, leaving no cover on the land for the entire winter. Some incised channels are not vegetated, leading to further erosion, incision and sediment delivery. Addressing land-use practices, such as overstocking bottomland pastures and allowing livestock unlimited access to riparian zones and stream channels, would also reduce the sediment load to Rock Creek.

Rural road runoff is also contributing sediment to Rock Creek, Lonerock Creek, and their tributaries, both through the physical action of washing of sediment off of the road, as well as from the channelization and concentration of runoff through culverts (WPN 1999). The OWEB Watershed Assessment manual uses a standard of all roads within 200ft of streams as potential sediment sources. Based on that criterion, 31% of the streams in the watershed are thus potentially affected by nearby roads.

While accelerated streambank erosion is occurring in sections of Rock Creek, severe bank erosion and active channel downcutting does not

appear to be pervasive in the watershed. Smaller channels were frequently observed to be connected to floodplains and supported gently sloping, well-vegetated banks. Sections of Rock Creek that showed significant signs of erosion largely occurred in the middle and lower sections of the creek. Much of this erosion is likely occurring as a result of the river attempting to re-establish meander bends to re-distribute energy expenditure more uniformly along the length of the channel. Rural and forest roads appear to be the other significant "hillslope" source of sediment to Rock Creek, Lonerock Creek, and their tributaries.

DATA GAPS

- The lack of a complete description of agricultural practices within the watershed precluded a quantitative assessment of risks of elevated sediment loading from croplands.

RECOMMENDATIONS

- Identify land parcels most in need of conservation measures to reduce soil erosion. Specifically, croplands that occur on steeper slopes and those that are tilled adjacent to streams with no riparian buffer should receive priority attention for such activities.
- Improve soil and water resource management in the uplands to increase retention of sediment and infiltration of rain water into the ground.
- Reduce sediment inputs from rural and forest roads; prioritize risks and develop mitigation strategies for areas identified as highest risk using a standard approach such as ODF's Forest Road Hazard Inventory Protocol.
- Those streams that are paralleled at a close distance by roads should be further assessed for the potential to improve run-off conditions with the use of sediment traps and water bars, and other runoff abatement and control measures.
- Use of grazing strategies that prevent overgrazing to reduce soil erosion from rangelands.
- Continued control of juniper expansion within the watershed will significantly reduce the contribution of sediment to streams from rangelands in the watershed

CHANNEL MODIFICATIONS

Summary: Channel modifications that have occurred in the watershed have resulted primarily from agricultural activities and construction of road infrastructure. Small agricultural impoundments and cattle ponds commonly observed within the watershed can create migration barriers to resident and anadromous salmonids. These impoundments also result in the loss of spawning and rearing habitat for native fish species and impact water quality. Furthermore, such areas often provide suitable habitat for non-native fish species, and it is not uncommon for non-native fish to be introduced into ponds and other impoundments. Channelization, including the straightening and relocation of channels, is often a result of agricultural activities. Impacts caused by such activities may include the reduction of key habitat features and altered hydrologic regimes.

Roads commonly occur in close proximity to stream channels within the watershed, both in low-gradient areas along mainstem streams and higher-gradient, steeper areas along tributaries. We limited our delineation of channel modifications caused by roads to areas where the stream channel is significantly constrained by a road grade. However, it is likely that negative impacts caused by roads, including the loss of side channels, lateral pools, and riparian function, occur throughout the watershed.

Small dams and irrigation ditches provide water necessary to support agricultural production on the Rock Creek floodplain. Their effects on hydrology and fish populations cannot be overlooked and can be minimized. Fish screens on diversion intakes, installed on a number of irrigation ditches in the watershed, prevent fish from entering and stranding in irrigation ditches. Small dams used for irrigation diversions can be built to allow fish passage with the inclusion of fish ladders and other features used to aid fish passage. Such measures are already being implemented in places within the Rock Creek and Lonerock Creek watershed owing largely to the cooperation between concerned land owners and the Gilliam SWCD.

DATA GAPS

- While a fairly extensive list of channel modifications was compiled from inspection of aerial photography and ground-truthing it should be noted that this list of modifications is by no means complete. Limited access to private lands, as well as difficulty in identifying smaller channel modifications on aerial photos, prevented a complete coverage of the watershed.

RECOMMENDATIONS

- The Gilliam SWCD should conduct site visits to channel modifications that have been identified to verify the extent of the channel modification; characterize changes to the channel shape and function; determine the impact of the modification on fish habitat and stream flow modification; and identify any potential fish passage issues.
- The Gilliam SWCD should continue to monitor and address channel modifications that present barriers to fish passage in the watershed.

WATER QUALITY

Summary: Water quality data have been collected only sporadically. No single program has been implemented to monitor water quality throughout the watershed, and data collection efforts vary extensively among the subwatersheds. In the last 40 years a handful of qualitative and quantitative water quality data have been collected in conjunction with the production of investigation reports, watershed work plans, and watershed improvement plans (Gilliam County SWCD et al. 1969, Gilliam County SWCD et al. 1975, Gilliam County SWCD et al. 1985, Bureau of Reclamation [BOR] 1993). Water quality data were collected in the summer of 2008 to begin to characterize current water quality conditions and patterns in the watershed. The water quality field assessment comprised three parts: continuous water temperature monitoring, regular (approximately bi-weekly) monitoring of temperature, conductivity, and dissolved oxygen, and a survey of macroinvertebrate communities. Four waterbodies in the Rock Creek and Lonerock Creek watershed are listed by the DEQ as water quality impaired (DEQ 2009). Of these four streams, three are listed for exceeding water temperature standards and one is listed for both exceeding water temperature standards and for violation of dissolved oxygen standards. Beneficial uses that are affected by these water quality violations include salmon and trout rearing and migration, salmonid fish rearing, salmonid fish spawning, anadromous fish passage, and cool-water aquatic life.

DATA GAPS

- Water quality data for the Rock and Lonerock creeks watershed are scant. No regular monitoring, aside from that performed in summer 2008 for this assessment, has occurred in the watershed.

RECOMMENDATIONS

- Data collected during this assessment suggest that the water quality parameters of temperature and biological integrity are most impaired in the middle reaches of Rock Creek. As efforts to improve upland, instream, and riparian conditions are undertaken, monitoring of chemical and biological endpoints that are responsive to these efforts is recommended to document improvement.
- To better characterize the water quality of the Rock and Lonerock creeks watershed, monitoring efforts should be initiated. We suggest developing a water quality monitoring plan for the watershed that would include establishment of permanent monitoring sites and regular monitoring of selected parameters, including water temperature, dissolved oxygen, and biological communities. Monitoring sites should be established that would allow determination of both overall trends in water quality as well as the effects of any restoration efforts. The Gilliam SWCD and the Gilliam-East John Day Watershed

Council are in the planning stages of initiating a long-term water quality monitoring program that will focus on deploying temperature loggers in four larger watersheds in the county (Hay Creek, Thirtymile Creek, Rock Creek, and Ferry Canyon Creek). We recommend that monitoring sites overlap with those used in previous assessments (DEQ and/or ABR) to the extent possible.

FISH AND FISH HABITAT

Summary: Steelhead in the Rock Creek and Lonerock Creek watershed belong to the Lower John Day River population within the John Day River Major Population Group (MPG) of the Middle Columbia River steelhead distinct population segment. The population is considered "very large" with a mean minimum abundance threshold of 2,250 spawners. Three of 11 Major Spawning Areas for this population occur with the Rock Creek and Lonerock Creek watershed, emphasizing the importance of the watershed to contributing to the maintenance of the lower John Day steelhead population. Data collected over the past six years suggest variability in the population size among years, but no significant overall upward or downward trends in abundance have occurred over this period.

Past land-management practices, intensive grazing management and logging, in particular, resulted in changes in Rock Creek and Lonerock Creeks' physical characteristics that persist to this day. These changes include increased sediment loads, increased water temperatures, lower summer flows, eroding streambanks, and loss of riparian vegetation, channel incision and other changes to the size and shape of stream channels within the watershed. Although these deleterious effects are evident in places throughout the watershed, little information currently exists that characterizes these conditions in the watershed or identifies areas where conditions are particularly good or poor. This assessment included field surveys of habitat conditions aimed at beginning to characterize the physical and biological conditions of Rock Creek and Lonerock Creek.

According to ODFW (2008a), primary limiting factors to steelhead in Rock Creek include degraded channel structure and complexity (habitat quantity and diversity), increased sediment loading, elevated water temperatures, and altered hydrology. Fish passage is also listed as a high-priority limiting factor in a number of creeks by ODFW, including Rock Creek; the Gilliam SWCD is working with ODFW to provide fish passage at all five diversion structures on the creek. Habitat strategies specific to areas within the Rock Creek and Lonerock Creek watershed as defined by ODFW (2008a) include the following:

- Restore passage and connectivity (Rock, Upper Rock, Middle Rock, and Lonerock)
- Restore degraded and maintain properly functioning channel structure and complexity (Rock, Middle Rock)
- Restore natural hydrograph to provide sufficient flow during critical periods (Rock)
- Restore riparian condition and LWD recruitment (Lonerock)

The primary threats to steelhead in the Lower John Day River include hatchery management that results in high rates of straying hatchery fish in natural spawning areas, current land use practices, water withdrawals, wetland draining and conversion, stream channelization and diking, and the Columbia River mainstem hydropower system (ODFW 2008a). Land-use practices include agricultural and grazing practices which result in the removal of canopy cover and bank vegetation from the riparian corridor.

The Gilliam SWCD is currently engaging in projects in the watershed aimed at addressing a number of these issues. In addition to the fish passage improvements being made at diversions on Rock Creek, the SWCD is seeking financial assistance to remove juniper from thousands of acres in the watershed, which should result in improved summertime hydrologic conditions in and below Lonerock Creek. Continued use of the CREP program will also benefit Rock and Lonerock creeks by improving riparian zone conditions, which will result in improved channel stability, decreased rates of bank erosion and lower summer water temperatures.

DATA GAPS

- Information describing fish community composition is limited for the Rock and Lonerock creeks watershed. Data is limited to incidental data collected by ODFW and surveys conducted in conjunction with this assessment.
- Relative abundance, distribution, and extent of *O. mykiss* within the watershed.
- The extent to which stray hatchery fish are present in natural spawning areas.
- Quantitative and current data describing physical habitat conditions for native fish in the watershed.

RECOMMENDATIONS

- The Gilliam SWCD, NRCS, landowners, and others should address the primary limiting factors to steelhead in Rock Creek which include degraded channel structure and complexity (habitat quantity and diversity), increased sediment loading, elevated water temperatures, and altered hydrology.
- The Gilliam SWCD, NRCS, landowners, and others should implement habitat strategies specific to areas within the Rock and Lonerock creeks watershed as determined by ODFW.

CHAPTER 2: INTRODUCTION

PURPOSE AND SCOPE

The purpose of this watershed assessment is to characterize current and historic watershed conditions within the Rock and Lonerock creeks watershed with respect to land use; hydrology; aquatic, riparian, and upland habitats; water quality; and aquatic life. The assessment is intended to identify changes to watershed conditions and functions and to understand how human activities in the watershed have likely contributed to these changes. Based on these inferences, the assessment identifies opportunities for improvements in watershed conditions using various land management practices and watershed enhancement projects. With these objectives in mind, this assessment was performed by gathering, synthesizing, analyzing, and interpreting existing data and gathering new data during the assessment. This assessment was performed following the guidelines of the Oregon Watershed Enhancement Board (OWEB) watershed assessment manual (Watershed Professionals Network [WPN] 1999) with supplemental field surveys and data collection to fill in the gaps needed to understand the current status of the watershed. The assessment was funded by an OWEB grant awarded to the Gilliam Soil and Water Conservation District (SWCD).

METHODS

ASSESMENT GUIDELINES

Protocols used in this assessment are from the Oregon Watershed Assessment Manual (WPN 1999). The manual provides background information, a framework and methodology, and resources for conducting watershed assessments in Oregon. When sufficient data existed, analyses of watershed conditions and functions were performed using the methods described in the manual. When data were insufficient to perform recommended analyses, these informational deficiencies were noted as information gaps and included in the lists of recommendations for future tasks at the end of each chapter.

MAPPING

Maps for this assessment were produced using ArcView 3.2a and ArcMap 9.2 (ESRI, Redlands, CA). This software is used to view, create, and analyze Geographic Information Systems (GIS) data. GIS data and maps used in the assessment are available from ABR, Inc. and the Gilliam Soil and Water Conservation District.

WATERSHED ISSUES

In January 2008, the Gilliam SWCD, the Gilliam-East John Day Watershed Council, ABR, Inc. assessment staff, and other partners met in Condon to plan the assessment and identify watershed issues. On 19-20 February 2008, two public forum meetings were held to gather additional input from landowners within the basins. Identifying watershed issues in such group settings helps focus the assessment on issues that are collectively thought to be contributing most to impaired conditions and functions in the watershed. During this initial phase of the assessment, the following issues were identified as areas of concern and as those most likely affecting the current condition of the watershed.

1. Steelhead distribution and abundance
2. Fish passage
3. Water quality
4. Riparian conditions
5. Uplands management/Sediment loading
6. Flow regime
7. Channel stability/incision
8. Noxious weeds/Juniper encroachment

WATERSHED OVERVIEW

LOCATION AND SETTING

Rock Creek and Lonerock Creek are located in north central Oregon, flowing to the northwest, and emptying into the John Day River at river mile (RM) 21.6. Two fifth-field watersheds comprise the assessment area: the Upper Rock Creek Watershed (Hydrologic Unit Code [HUC]1707020411) and the Lower Rock Creek Watershed (HUC 1707020412) occurring within Gilliam, Morrow, and Wheeler Counties. This assessment area includes the mainstem Rock Creek, mainstem Lonerock Creek, and all of their associated tributaries. The Rock and Lonerock creeks watershed encompasses 322,298 acres, draining directly into the John Day River. Thirteen subwatersheds occur within the assessment area: French Charlie Canyon, Juniper Canyon, South Fork Rock Creek, Dry Creek-Rock Creek, Sixmile Canyon, Lonerock Creek, Rood Canyon, Juniper Creek, Middle Fork Rock Creek, Wild Call Canyon, Buckhorn Creek, Brown Creek, and Chapin Creek (Figure 2.1; Table 2.1). Elevation ranges from 403 feet at the confluence with the John Day River to 5,364 feet in the eastern portion of the crest of the Chapin Creek subwatershed.

ECOREGIONS AND VEGETATION

The Rock and Lonerock creeks watershed occurs within Oregon's Blue Mountain physiographic province. This large geographic area is subdivided into ecoregions based on uniform climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Each ecoregion has characteristic disturbance regimes that shape the form and function of the watersheds in the region. Therefore, the identification of ecoregions within a watershed context can assist in determining how the watershed responds to physical alterations. The Rock and Lonerock creeks watershed includes portions of five ecoregions: Pleistocene Lake Basin (10e), Deschutes/John Day Canyons (10k), Umatilla Plateau (10c), John Day/Clarno Highlands, and the Maritime-Influenced Zone (11c; Appendix A–Ecoregion Descriptions [WPN 1999]; Figure 2.2). Topography, climate, and geography vary among these ecoregions, contributing to a range of stream channel and riparian conditions within the watershed.

The Pleistocene Lake Basin Ecoregion occurs in the lowlands of the John Day River immediately south of the Columbia River. The topography in this ecoregion is comprised of low gradient slopes with streams and rivers of low to moderate gradient; the geology is comprised of lake deposits from the Missoula Floods. Potential streamside vegetation in this ecoregion comprises black cottonwood in areas of perennial streamflow, with mountain alder, red osier dogwood and willow shrubs common (WPN 1999). Within the Rock and Lonerock creeks watershed, this ecoregion occurs in the lower part of French Charlie Canyon at the confluence with the John Day River.

The Deschutes/John Day Canyons Ecoregion occurs in the deep canyons of the Deschutes and John Day Rivers. Rivers within this ecoregion are moderate to steep-gradient and confined by steep-sided canyons cutting through plateaus; the geology is dominated by basalt lava flows (WPN 1999). Upland vegetation in the Deschutes/John Day Canyons Ecoregion includes juniper, Idaho fescue and bluebunch wheatgrass, although much of the uplands are used for wheat production. Potential streamside vegetation in this ecoregion includes hardwoods such as cottonwood, white alder and willow, with red osier dogwood and willow shrubs common (WPN 1999). Within the Rock and Lonerock creeks watershed, this ecoregion primarily occurs along the lower elevation portions of the mainstem streams, including Rock Creek and Lonerock Creek as well as the South and Middle Forks of Rock Creek, Sixmile Canyon, Rood Canyon and Juniper Creek (Figure 2.2).

The high plateau south of the Columbia River and north of the Blue Mountains encompasses the Umatilla Plateau Ecoregion which is the major ecoregion in the Rock and Lonerock creeks watershed. The geology in this ecoregion is wind-deposited soil atop basalt flows. Upland native vegetation includes bluebunch wheatgrass, Idaho fescue, rose, hawthorn, and snowberry (WPN 1999). Shrubs such as Douglas spirea, red osier dogwood, water birch, willows and mountain alder comprise the streamside vegetation in this ecoregion. This ecoregion primarily occurs along the higher-elevation portions of the mainstem streams including both Rock and Lonerock creeks as well as the South Fork of Rock Creek, Sixmile Canyon, and Rood Canyon. This ecoregion also occurs in the lower portions of Juniper Creek, the Middle Fork of Rock Creek, Buckhorn Creek, and Brown Creek (Figure 2.2).

The John Day/Clarno Highlands Ecoregion is comprised of the high-elevation slopes that form the western perimeter of the Blue Mountains and separate the north-central Blue Mountains from the southern Blue and Ochoco Mountains (WPN

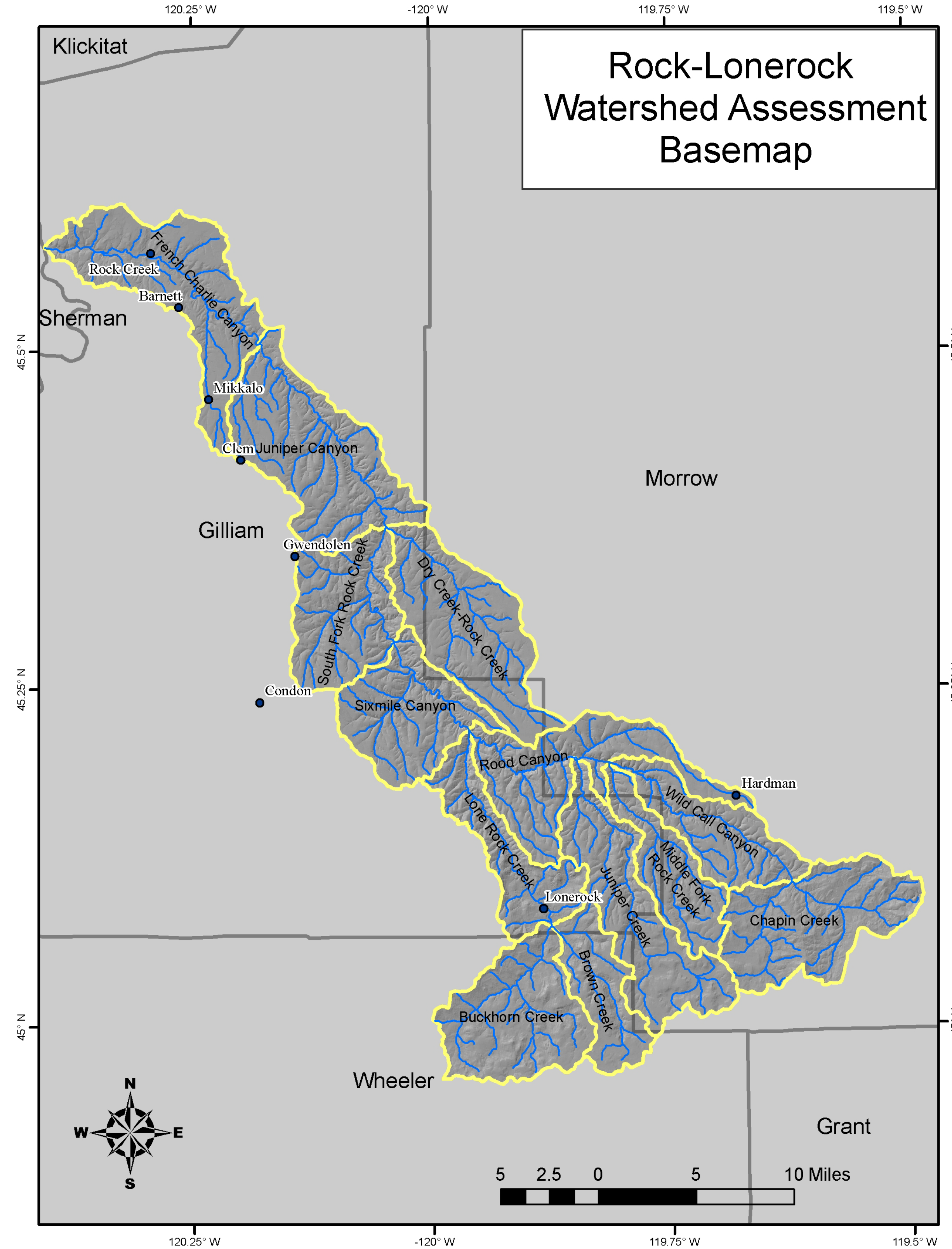

Figure 2.1. Subwatersheds occurring within the Rock and Lonerock creeks watershed assessment study area.

Table 2.1. Acreage and Hydrologic Unit Codes (HUC) of the 13 subwatersheds in the Rock and Lonerock creeks watershed, Oregon.

Subwatershed	HUC	Acres
French Charlie Canyon	170702041205	32,994
Juniper Canyon	170702041204	35,867
South Fork Rock Creek	170702041202	23,199
Dry Creek-Rock Creek	170702041203	30,129
Sixmile Canyon	170702041201	23,033
Lonerock Creek	170702041107	17,783
Rood Canyon	170702041108	26,576
Juniper Creek	170702041104	28,722
Middle Fork Rock Creek	170702041102	15,337
Wild Call Canyon	170702041103	17,791
Buckhorn Creek	170702041105	26,999
Brown Creek	170702041106	14,260
Chapin Creek	170702041101	29,607
Total		322,298

1999). Underlying geology in this ecoregion varies and includes basalt flows and eroded remnants of a mountain chain. In the uplands, native vegetation includes grasses, ponderosa pine and true fir. Streamside vegetation in this ecoregion includes dense alder and cottonwood trees, willows, Sitka alder, mountain alder, and common snowberry shrubs (WPN 1999). Within the Rock and Lonerock creeks watershed, the John Day/Clarno Highlands Ecoregion occurs in the upper portions of Buckhorn Creek, Brown Creek, Juniper Creek, the Middle Fork of Rock Creek, Wild Call Canyon, and the majority of the Chapin Creek subwatershed (Figure 2.2).

A small area within the Chapin Creek subwatershed is within the Maritime-Influenced Zone Ecoregion. This area is potentially influenced by marine weather systems that are moving eastward through the Columbia River Gorge. The topography of this area is typically rolling hills or, less frequently, steep-sided canyons with Columbia River basalt geology. Potential streamside vegetation includes hardwoods such as cottonwoods, willows, and alder with willow and mountain alder shrubs. Conifers include Douglas-fir with ponderosa pine occurring at lower elevations (WPN 1999).

Vegetation types commonly found throughout the lower and middle portions of the watershed include agricultural cropland and range land, bluebunch wheatgrass, sagebrush, and Idaho fescue. Upper portions of the watershed including the Buckhorn Creek, Brown Creek, Juniper Creek, Middle Fork of Rock Creek, and Chapin Creek have forested vegetation types including Western juniper, Ponderosa pine, Douglas fir, Western larch, and lodgepole pine forests (Figure 2.3).

LAND USE AND OWNERSHIP

The Rock and Lonerock creeks watershed primarily supports land uses for production of livestock and livestock feed, agriculture including dryland cereal crop production on plateaus, and irrigated crops on the valley bottoms (Figure 2.4), and areas within the upper watershed that support forestry. The rural community of Lonerock (population of 20 as of 2006; Center for Population Research and Census, Portland State University) in the upper watershed represents the only concentrated settlement within the assessment area; there are no larger urban areas occurring within the watershed.

Most of the Rock and Lonerock creeks watershed is privately owned, accounting for 94.0 percent of the watershed area. Approximately 14,022-acres (4.4 percent) of the watershed are managed by the United States Forest Service (USFS) as part of the Umatilla National Forest, including portions of Buckhorn Creek, Brown Creek, Juniper Creek, and Chapin Creek subwatersheds. Bureau of Land Management (BLM) inholdings are dispersed throughout the watershed totaling 4,767-acres of land (1.5 percent) while state-owned lands total 438-acres (0.1 percent).

GEOLOGY

The John Day River basin has a rich and complicated geologic history. Geologic formations underlying the John Day basin are a combination of sedimentary and igneous rocks. Geologic

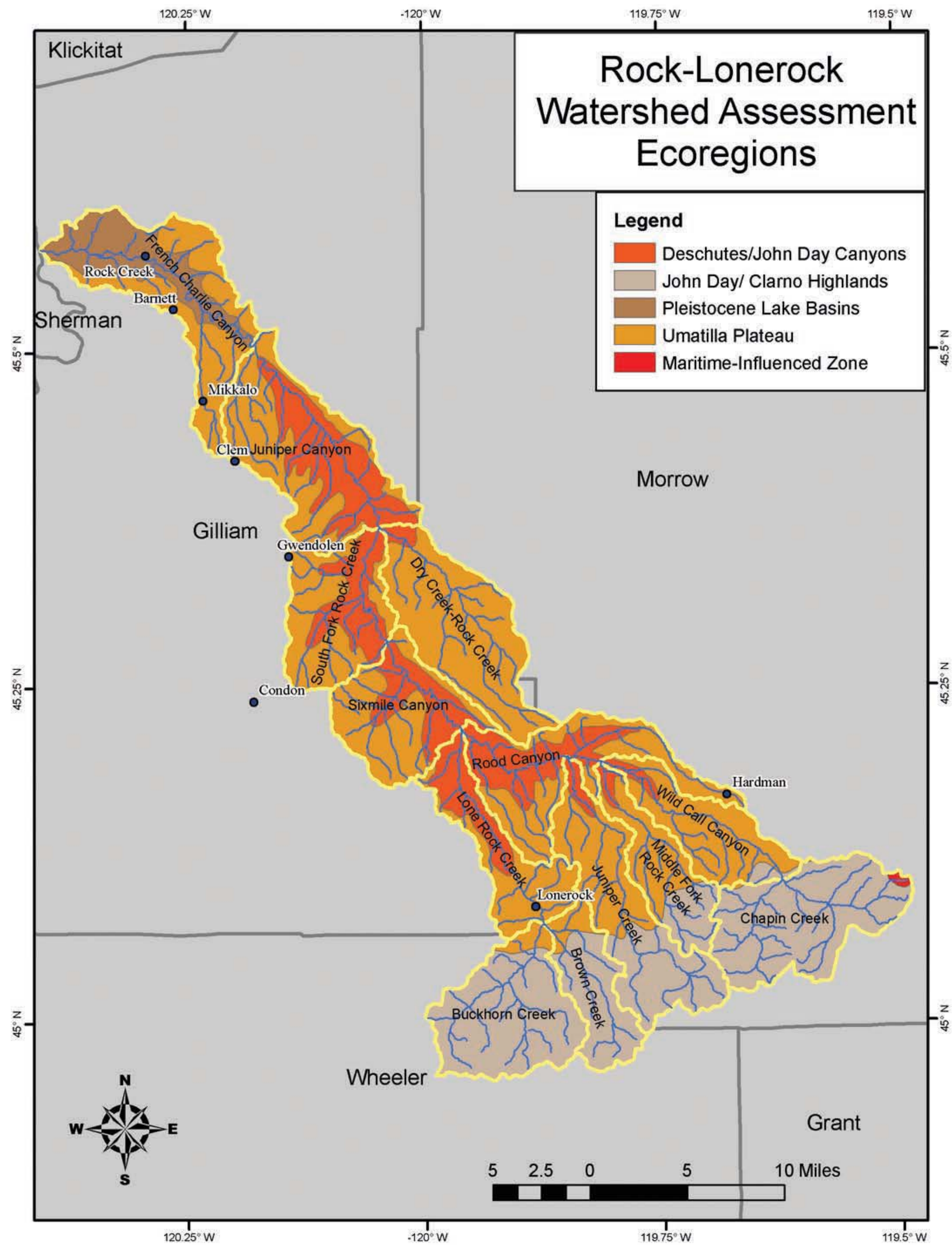

Figure 2.2. Ecoregions occurring within the Rock and Lonerock creeks watershed assessment study area.

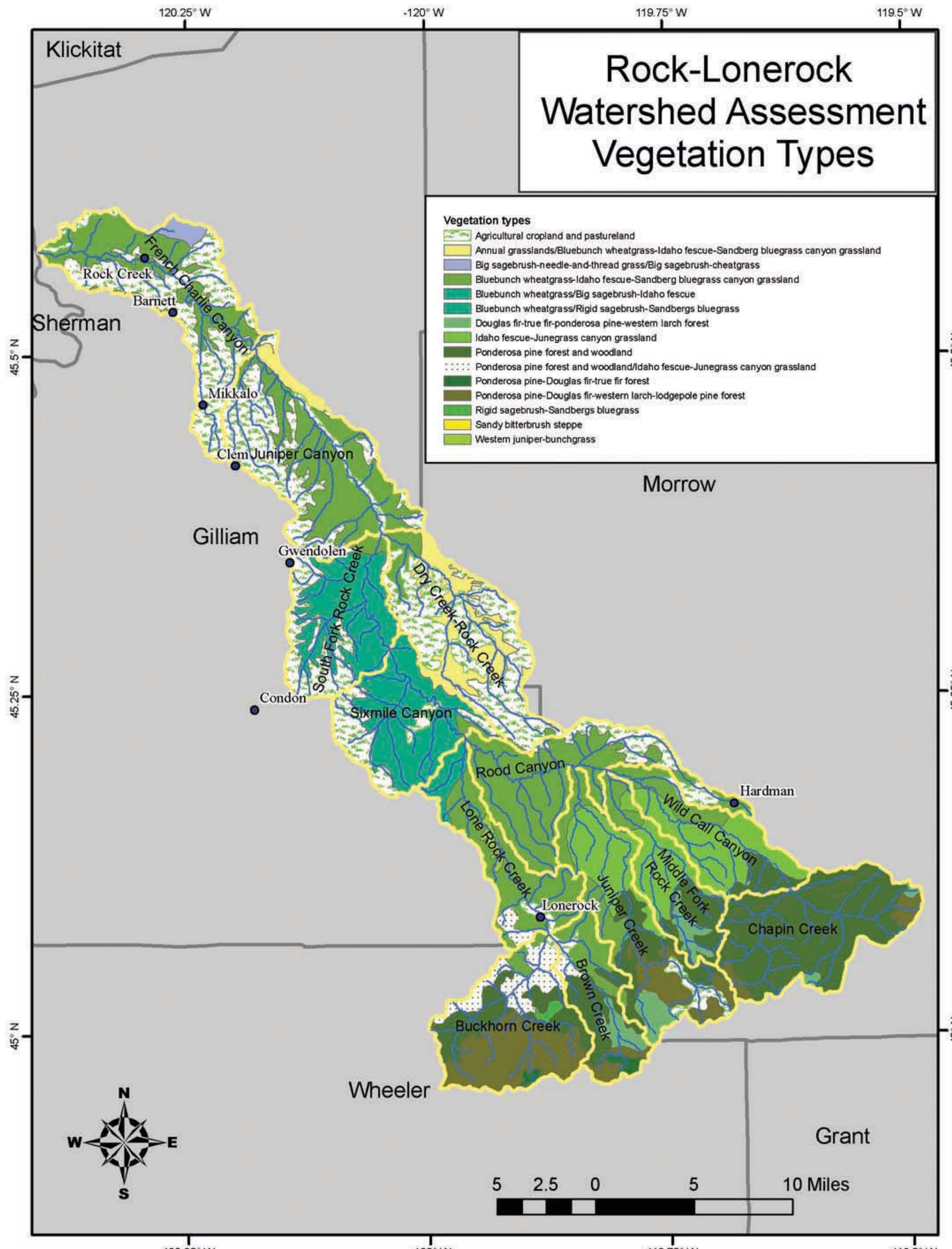

Figure 2.3 Vegetation zones occurring within the Rock and Lonerock creeks watershed assessment study area.

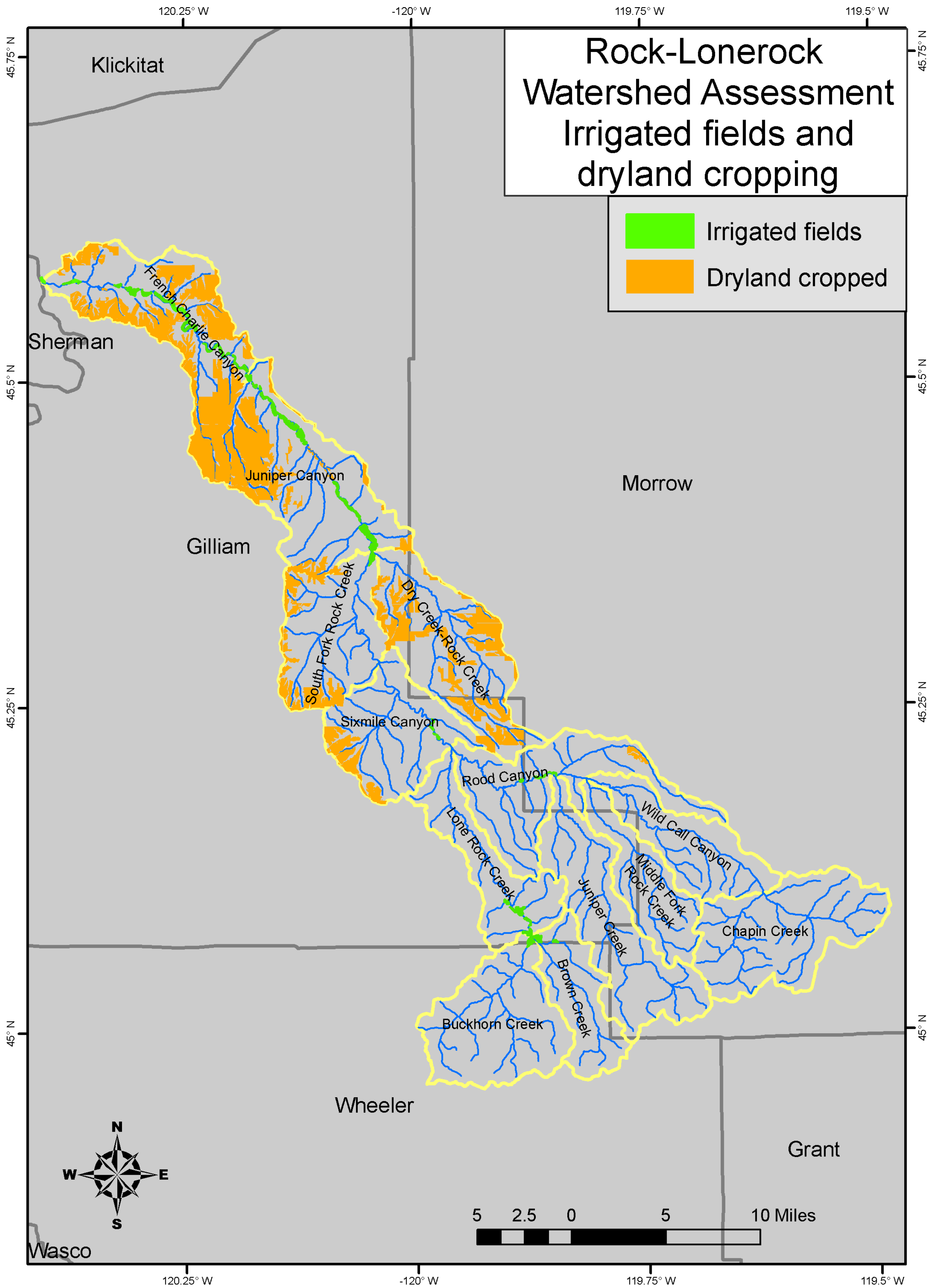

Figure 2.4 Agricultural land use occurring within the Rock and Lonerock creeks watershed assessment study area.

formations in the region range from 10 to 250 million years old. The earliest rock formations occurring in the region are lava flows and volcanic ash, sandstone, and shale deposits from at least 250 million years ago (BLM 1999). Between 54 and 37 million years ago, lava, mudflows, and tuffs of the Clarno Formation were produced by a series of widespread volcanic eruptions. Eruptions that followed in the vicinity of the present-day Cascade Range deposited thick layers of volcanic ash in the region, which have become called the John Day Formation. Widespread volcanic activity later occurred between 19 and 12 million years ago and produced flood basalts known as the Columbia River Basalt Group. Following cessation of volcanic eruptions about 10 million years ago, erosion and faulting have since continued altering the landscape (BLM 1999) to produce the present-day physical setting. The dominant geologic formation in the Rock and Lonerock creeks watershed is Grande Ronde Basalt which occupies the majority of the watershed from the Juniper Canyon subwatershed upstream through the basin (Figure 2.5). Other geologic formations include Wanapum Basalt, occurring primarily along the mainstem Rock Creek in the French Charlie Canyon and the lower portion of the Juniper Canyon subwatershed; tuffaceous sedimentary rocks and tuff along the perimeter of French Charlie Canyon; as well as the John Day Formation, Picture Gorge Basalt, and landslide/ debris flow deposits occurring in the upper portion of the watershed (Figure 2.5).

Basalt is the most common volcanic rock and the most abundant rock in Oregon. Basalt is fine-grained, has a smooth texture, and is usually black in color when first formed. Weathered or otherwise altered basalt can be greenish, black, rusty brown, or even brick red. Andesite is another common volcanic rock with properties intermediate of basalt and rhyolite. Andesite may be grey, brown, or green. Andesite most often occurs as lava flows, ash deposits, or accumulations of angular debris (Alt and Hyndman 1989).

CLIMATE

Oregon is divided into nine climate zones with similar climatic conditions based primarily on temperature and precipitation. The Rock and Lonerock creeks watershed occurs wholly within Zone 6, the North Central Oregon climate zone as designated by the Oregon Climate Service (OCS). The region is characterized by cool, wet winters and warm, dry summers, with mild temperatures predominating throughout the year. Temperatures range with elevation, with higher areas cooler than lower elevation areas throughout the year. Winter and summer temperatures in the North Central zone are moderated by the Columbia River Gorge. Precipitation primarily occurs as winter rainfall, and the amount of precipitation increases with elevation (OCS 2005).

The City of Condon (Station 351765), just outside of the Rock and Lonerock creeks watershed receives an average of 13.3 inches of rainfall per year (maximum between 1928 and 2007: 20.5 inches in 1995; minimum between 1928 and 2007: 6.6 inches in 1939), with most precipitation occurring in November through January (Western Regional Climate Center 2005). The Larson Ranch at Mikkalo (Station 355545) in the northwestern portion of the watershed receives an average of 10.5 inches of rainfall per year (maximum between 1948 and 1994: 15.1 inches in 1983; minimum between 1948 and 1994: 6.4 inches in 1967; Western Regional Climate Center 2005). Monthly temperatures are highest in July with an average of 83.2 °F in Condon and 86.3 °F in Mikkalo for the time period on record. Snowfall can occur in the Mikkalo area between October and April, but December averages the highest snowfall (3.6 inches; Western Regional Climate Center, 2005).

HYDROLOGIC REGIME

Based on limited data, monthly mean discharge in Rock Creek (United States Geological Survey [USGS] Station 14047390; N 45° 15’53”, 120° 01’15”) and Lonerock Creek (USGS Station 14047380; N 45° 05’30”, 119° 53’10) is highest in March (216 cfs and 75 cfs in Rock Creek and Lonerock Creek respectively). As summer progresses, flows recede, often reaching their lowest in August (Monthly mean discharge in Rock Creek: 2.1 cfs; Lonerock Creek: 0.13 cfs). Flow rates increase substantially with the onset of the rainy season in October and November and are

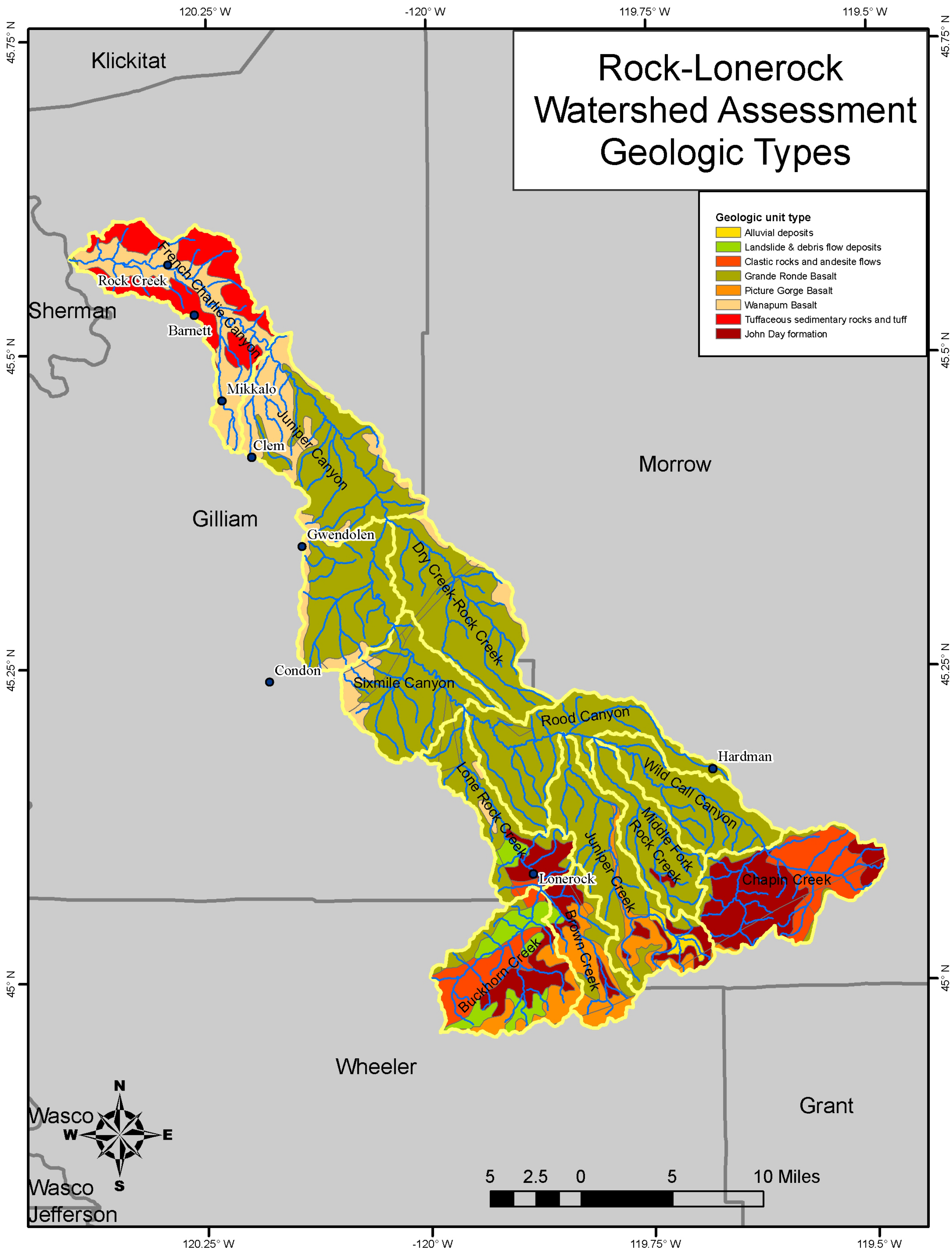

Figure 2.5 Dominant geologic formations occurring within the Rock and Lonerock creeks watershed assessment study area.

generally higher through April. Maximum peak streamflow events on record in Rock Creek include 3,360 cfs on 5 May 1983 and 2,400 cfs on 23 February 1986 (period of record 1976–1989; USGS).

SUMMARY OF PAST ASSESSMENTS OF WATERSHED CONDITIONS

A number of existing assessments have been conducted on Rock Creek and its tributaries. These documents each provide a brief narrative of watershed conditions as they existed when the document was written as well as an identification of problems, concerns, and opportunities for improvements within the watershed. While the specific goals and objectives of each plan or report differ, the general emphasis was to promote land-use practices that would benefit watershed conditions and functions, particularly through soil and water conservation measures.

Past assessments performed on the Rock and Lonerock creeks watershed or portions thereof include:

- Preliminary Investigation Report, Rock Creek Watershed, Gilliam and Morrow Counties, Oregon, Sponsored by Gilliam County SWCD, Heppner SWCD, and the Rock Creek Water Control District, April 1969
- Watershed Work Plan, Rock Creek Watershed, Gilliam and Morrow Counties, Oregon, Prepared by Gilliam County SWCD, Morrow SWCD, and the Rock Creek Water Control District, April 1975
- Dry Fork Watershed, Gilliam and Morrow Counties, Oregon, Watershed Plan and Environmental Assessment, Prepared by Gilliam County SWCD, Morrow SWCD, Rock Creek Water Control District, Gilliam County Court, and Morrow County Court, September 1985
- Rock Creek Watershed Improvement Plan, Oregon Department of Agriculture, May 1991
- Stream Restoration Program for the Rock Creek Tributary of the John Day River, Bureau of Reclamation, January 1993

GILLIAM SOIL & WATER CONSERVATION DISTRICT

The Gilliam SWCD encourages and promotes the stewardship of natural resources in the county by coordinating local, state, and federal programs with local land owners, as well as through local conservation projects and activities. The SWCD serves as a link between federal and state agencies and local landowners. Through agricultural assistance programs such as the Farm Bill's Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), and the Environmental Quality Incentives Program (EQIP), the SWCD works with local landowners to implement soil and water conservation projects that benefit both the long-term economic viability of agri-business as well as natural resource conditions of the watershed.

GILLIAM-EAST JOHN DAY WATERSHED COUNCIL

The Gilliam-East John Day Watershed Council covers five major watersheds in the lower basin: Rock Creek, Lonerock Creek, Thirtymile Creek, Hay Creek, and Ferry Canyon. The health of these watersheds is essential to the long term survival of Middle Columbia River steelhead. In 1996, the Oregon legislature authorized the creation of watershed councils as non-regulatory entities to assist local landowners in voluntary restoration activities. Councils are based on the theory that successful restoration is supported at the local level, where people care most about the health of the watershed. Watershed councils offer local residents the opportunity to evaluate local conditions and coordinate with government agencies. Through this bottom-up approach, partnerships between landowners, governments, and non-profit organizations are formed. The council fosters education and cooperation among all parties, which ultimately leads to improvement in the watershed for fish, invertebrates, plants, and people.

The Gilliam-East John Day Watershed Council was established on June 11, 1997 by the Gilliam County Court. The Council has two primary purposes:

1. Develop projects to implement the steelhead recovery plan, and
2. Design projects to get more of the community involved in watershed health.

CHAPTER 3: HISTORICAL CONDITIONS

NATIVE AMERICAN PRESENCE

The evidence of humans on the Columbia Plateau dates back approximately 15,000 years (Aikens 1993). However, evidence of human occupation on the Plateau is most abundant in the past 10,000 years corresponding with the last of the Missoula flood events. The Rock and Lonerock creeks watershed falls within the home range of the Western Columbia Sahaptins, more commonly known as the Tenino and Warm Springs Indians. The Sahaptin people occupied both sides of the Columbia River (Hunn and French 1988).

The cultural area known as the Plateau is generally considered to be the vast region that straddles the Columbia River and follows its tributaries. Plateau culture spanned portions of what is now north-central and northeastern Oregon, Washington, Idaho, Montana, and British Columbia. Areas near the Klamath Lake basin, which is adjacent to, but not part of, the Columbia River drainage are sometimes included. The Cascade Mountains isolate the Plateau from the moderating influence of marine air creating a semi-arid desert environment with forested uplands. The Plateau is comprised of a number of zones, each characterized by dominant vegetation types. These zones gradually transition from the lower elevations along the Columbia River to the volcanic summits of the Cascade Mountains. Seasonal temperatures in this area vary greatly (Berg 2007).

Archaeological evidence suggests that key food resources included salmon, deer, elk, roots, and berries. The proportions of such food items within the Sahaptin diet varied as climate and technologies changed. Tribal members took advantage of the long harvest season by following the highly mobile “seasonal round,” whereby movements were tied to seasonal changes in food resource availability (Berg 2007). In early May, when spring Chinook salmon runs peaked, fishing intensified at strategic locations throughout the Columbia Basin, including at the “Long Narrows” downstream of Celilo Falls on the mainstream Columbia River. Later, as summer Chinook, fall Chinook and other salmon runs arrived, the preferred harvest location moved upstream to Celilo Falls. Families with traditional fishing sites near Celilo Falls often remained at these locations for the duration of the salmon migration. After fishing the runs, families would dismantle their lodges and begin a series of moves southward, camping successively at Rock Creek, Olex, Condon and eventually John Day. Strong seasonal contrasts on the Plateau required substantial food supplies to be dried for winter use. Caches of food items were stored in special pits at the winter village sites (Berg 2007). A great emphasis was placed on hunting both deer and elk, but edible roots were also a primary food resource.

Pioneers in Gilliam County remember tribal members traveling through the area on the way to hunt or gather food. In the early days they traversed the county in great numbers, traveling single file on well-worn paths, in groups of up to 200 with as many as 150 head of horses (Thouvenel 1952). The Sahaptin people continued to travel through the Rock and Lonerock creeks watershed well into the 1900s. Alma Campbell of Lonerock recalled her father allowing them to leave injured or lame horses in the pasture until their return later in the year (Alma Campbell, personal communication). Her mother would bake pies to share and would have George Willy in to eat dinner with the family. She also remembers the gathering of wool and digging for camas roots. This continued until there were just a few that would come each year. The last time Tim Campbell remembers Sahaptins coming to Lonerock was in the late 1990s; a very old woman with at least three generations of family with her came. They were of the Roosevelt tribe which inhabited the area across the Columbia River from Biggs, Oregon (Tim Campbell, personal communication).

EARLY SETTLEMENT

Settlement of the Willamette Valley took place by wagon train between 1843 and 1852. This early influx of settlers participated in the United States Congressional Homestead Act of 1862, a land program providing for the transfer of 160 acres of unoccupied public land to each homesteader on payment of a nominal fee. The homesteader had to live on his or her land, build a house, and make improvements and farm for five years. Land could also be acquired after six months of residence for $1.25 an acre. In the years following the early settlement within the Willamette Valley, some homesteaders began moving back to the area of the state that would eventually become Gilliam County. The earliest settlers in Gilliam County filed claims along creeks and bottom lands (Gilliam County Historical Society [GCHS] Undated).

OLEX AND CENTRAL ROCK CREEK SETTLEMENT

In 1862, the first settlers began to graze cattle along Rock Creek. These settlers included Thomas Richmond and J.W. Whitely. By 1865 there were five additional settlers in the area, Josephus Martin, Charles Pincense (French Charlie), Conrad Schott, John Shalliday, and D.F. Strickland. In 1866, James Richardson and a Mr. Staggs also settled on Rock Creek.

Tip Mobley settled at Olex in 1872, near his sister, Mrs. Conrad Schott. Mr. Mobley recalled that bunch grass on the good land was "belly high to a saddle horse," and the only place there was any sagebrush and rye grass was on the creek bottom land. He recalled that so many salmon came up Rock Creek in the spring of each year that he would use a pitchfork to throw them out of the creek and use them for fertilizer on the garden. Deer were also plentiful in the fall near Olex with some antelope present as well.

At one time, Olex had two general stores, two blacksmith shops, one drug store, a meat market, a school, a church, a saloon, and a hotel (Figure 3.1). One of the stores had an upstairs room that served as a combination community hall/dance hall. An important commercial enterprise in Olex was the J.A. Crum gristmill, built in 1883 (GCHS Undated; Figure 3.2). This was the first gristmill in Gilliam County and was used by settlers to grind wheat crops now being grown in the area.

Figure 3.1. Historical photo of Olex, Oregon taken in 1979 (Gilliam County Historical Society). Olex is located in the Juniper Canyon subwatershed within the Rock and Lonerock creeks watershed, Oregon.

Figure 3.2. The J.A. Crum gristmill, built in 1883, was located in Olex, Oregon.

In March of 1876 the county surveyor of Wasco County was directed to survey a line for a county road through the eastern portion of the county, and he reported to the Wasco County court as follows: "The proposed county road passes through one of the richest valleys in Eastern Oregon and is in direct line with the southern portion of Umatilla County. We consider the road to be of great importance to The Dalles, as it will secure a large amount of trade for said town. We further advise that Rock Creek is fast settling up; many new settlers having located along the creek in the last year. We would, therefore, recommend that said road be adopted at the next term of the County court and the same be ordered by the supervisor as soon as practicable." This road was later called Gilliam County No. 1 and followed the course of Rock Creek to a point near where the Oregon Trail crossed the John Day River at McDonald Ferry or Leonards Bridge. This road originated in what is now Morrow County (GCHS Undated).

LONEROCK SETTLEMENT

In 1871, George Boone and his family settled in the Lonerock Valley, becoming the first settlers in the area. Madora Boone, her husband John Madden, and their family also settled in Lonerock about this time. George Madden, born in 1872, was the first child born to settlers in the Lonerock Valley (GCHS Undated). Both the Boones and the Maddens raised horses and built rock fences to keep them from going down to the creek. Some of those fences are still standing today (GCHS Undated). Over the years, ranchers in the Lonerock Valley shifted from raising primarily horses, to sheep, and finally cattle.

Gilliam County was established February 25, 1885 from a portion of Wasco County and was named after Colonel Cornelius Gilliam, who commanded the Oregon Volunteers during the Cayuse War of 1847. Lone Rock was the first town in Gilliam County (part of Wasco County at the time), established as a town in 1882. Lonerock was named for an unusual, large, lone rock near the town which is still present (Figure 3.3). The first mail was delivered by horseback and supplies

Figure 3.3. An unusual, lone rock that the town of Lonerock is named after.

brought in by team and wagon from The Dalles or Pendleton. The town population around 1900 was 100. The businesses at that time were a general merchandise store, a blacksmith, a shop, a livery stable, one lawyer, a hotel, a boarding house and two saloons (Figure 3.4).

POPULATION PATTERN

The population has decreased in Gilliam County; census reports for Gilliam County in 1920 list the population as 3960, but by 2006 the population was 1775. Rock Creek, Olex, and Lonerock were once small towns with schools, post offices, and businesses. All of the small communities which once had schools no longer do. Nick Welp remembers that there were 24 students at the Rock Creek School when he attended, but this school is now closed.

In the early twenties economic hardship caused many landholders to move on. Being of less value than the cost of moving them, herds of horses were turned loose. By 1928 their number had severely depleted grazing lands. Over a five month period, Pat Campbell and his brother Mike gathered the horses from the range. Due to severe weather, they wintered the horses in Lonerock. Damage caused by the horses to the area is still visible today. Mike helped trail 400 head of horses from Lonerock to Oregon City where the horses were sold for $5 a head (GCHS Undated).

SIGNIFICANT NATURAL EVENTS

The winter of 1881–1882 was the most severe winter ever experienced in the county. Thousands of horses, sheep, and cattle were frozen or starved to death. During the spring of 1882 stockmen gathered pelts of the dead animals and by selling these, they managed to live through the following summer (GCHS Undated). Serious droughts occurred in 1934 and 1935. Dust storms were also

Figure 3.4. Lonerock, located in the Lonerock Creek subwatershed, prior to 1918.

documented with a storm in 1936 being noted as the most severe. In 1938–1939, water erosion caused serious damage, according to OSU extension office annual reports. By this time, according to SCS reports from 1938, twenty five percent of Gilliam County croplands had lost seventy five percent of the topsoil. There have also been several floods in the watershed over the years. Notable years were, 1914, 1936–1937, 1954, 1956, 1964–1965 and 1996.

1964–1965 STORM EVENTS AND FLOODING

In 1964 there was a storm event that caused extensive damage in the watershed. Rain on frozen snow caused severe flooding during the period of 21–24 December 1964. The run-off started at the higher elevations in southern Gilliam County on 21 December, when Chinook winds and rain started six inches of snow melting. On the morning of 22 December, more than an inch of rain fell causing severe flooding in the Condon area. The flooding in Condon began at approximately 8:30 A.M. with most of the flooding over by 11:00 A.M. Main Street and all of the canyons leading to Thirtymile Creek and Rock Creek were flooded. In the Shutler Flat area, the snows began to melt in the afternoon and the major flood hit the town of Arlington at approximately 5:00 P.M. The Condon weather station reported a total of 6.11 inches of precipitation from 21–24 December, with 2.55 inches occurring on 22 December alone. Farm weather stations reported 7 to 8 inches of precipitation to the OSU Extension agent for the month of December. Most of this precipitation occurred during the Christmas week (Oregon State University Extension Service [OSU Extension] Undated).

Floods brought disaster to some farms located in canyons and to all farms along Rock Creek and other creeks in the watershed (Figures 3.5, 3.6, and 3.7). The most significant loss was from soil

Figure 3.5. Boulders washed onto Highway 19 one mile south of Olex, Oregon, during the 1964 flood.

Figure 3.6. Ernie Kirsch, OSU Extension Agent, ASC Committee Chairman Lloyd Smith, and SCS Conservationist Lou Gilliam on Rock Creek at the Bob Patching farm after the 1964 flood.

Figure 3.7. Conditions after flood waters had receded in the Rock and Lonerock creeks watershed, Oregon.

erosion on wheat lands (OSU Extension Undated). In the Lonerock Creek watershed, Alma Campbell's family lost their home while the homes of Charles Welp and Bill West on Rock Creek suffered damage. The Olex Store was the hardest hit business in Gilliam County. Debris backed up behind the bridge across Rock Creek, diverting the stream through the store. Water rose almost to the top of the gas pumps outside while water rose five- to six feet high inside the building (OSU Extension Undated).

On 28–30 January 1965 the county was hit by a second flood due to rain falling on rapidly melting snow. Severe damage occurred along Rock Creek, but this flood was not as severe as the December flood in most areas. The Army Corp of Engineers arranged to do five small projects on Rock Creek where county roads were threatened. The Corps felt that these sites threatened public property and this made them eligible for assistance (OSU Extension Undated).

1996 FLOOD

Another major flood occurred within the Rock and Lonerock creeks watershed in 1996. Residents of Lonerock noted that more damage occurred as a result of the 1996 flood in comparison to the 1964 flood. Tim Campbell noted that the stream channel was twice as wide after the Christmas flood of 1964 but after the 1996 flood, the stream channel became deeper not wider, scouring the channel down to the bedrock in some reaches (Tim Campbell, personal communication). Some of this damage has been anecdotally attributed to the intensive logging that occurred in the upper part of the watershed during the early 1990s.

The lower and middle reaches of Rock Creek did not suffer as much damage as during the 1964 flood. Nick Welp of lower Rock Creek noted that it did not flood at their end of the creek as was predicted. He believes this was due to the stream channel being wider in 1996 than it was in 1964 and also due to much of the Dry Fork area being enrolled into the Conservation Reserve Program

(CRP) in 1986. Mr. Welp noted that the CRP has had a significant impact on water infiltration, flow regulation, and sediment loads within the stream. Mr. Welp noted that sediment loads within Rock Creek have diminished significantly; Rock Creek use to look like a "chocolate creek," but this no longer occurs. He also believes that the reduction of sediment loading has increased the steelhead populations within Rock Creek. Nick said, "As far as I am concerned the greatest thing that happened for the watershed was CRP. It removed a lot of ground that should never have been farmed to begin with (Nick Welp, personal communication)." Approximately 65,000 acres are currently enrolled in CRP in Gilliam County with approximately 9,000 acres occurring in the Rock Creek watershed. Additional acres are enrolled in the Morrow portion of the watershed.

CHAPTER 4: CHANNEL HABITAT TYPES

INTRODUCTION

Rivers and streams are dynamic systems that are shaped by a number of physical, hydrologic, and biological factors. Rivers and streams are continuously adjusting to changes in the amount of water or sediment they receive. These changes of water and sediment supplies occur both naturally and as a result of human activity in the watershed. A river or stream is considered stable when it is able to consistently transport its sediment load associated with local scour and deposition (Rosgen 1996). In other words, when a river is stable, erosion and deposition occurs at the same rate (Leopold 1994). When scouring processes produce degradation (decrease in streambed elevation by scouring of sediments), or when excessive sediment deposition results in aggradation (increase in streambed elevation by accumulation of sediments), the river channel is said to be unstable. While naturally occurring events such as large floods can produce channel scouring, land uses such as intensive grazing and forest harvest can cause channel instability by increasing sediment loads and altering local hydrology, which, in turn, can alter channel form through degradation or aggradation of the streambed. In the Rock and Lonerock creeks watershed, some land-use activities, such as building roads close to stream channels, have likely increased stream sediment loading and altered local runoff and discharge patterns, resulting in channel instability in places within the watershed. Such effects are examined more closely in subsequent assessment chapters.

Stream channels in the watershed vary in their sensitivity to these land use impacts, depending in part on their geomorphic characteristics, including channel gradient, channel size, and channel confinement or constraint. Classification of river segments according to these geomorphic characteristics can help determine the relative sensitivity of channels to disturbance and their responsiveness to restoration efforts and can therefore help focus restoration efforts on stream reaches or segments that will most likely respond to restoration efforts. Several frameworks currently exist for classifying streams according to geomorphic characteristics currently exist (e.g., Rosgen 1993, Montgomery & Buffington 1996). The Oregon Watershed Assessment Manual presents a classification scheme developed from these existing systems; this scheme is designed specifically for classifying Oregon rivers and streams according to their sensitivity to disturbance and therefore their responsiveness to restoration efforts. This stream classification system, using Channel Habitat Types (CHT), allows streams throughout the state to be classified according to geomorphologic characteristics, including stream size, channel gradient, and channel side-slope constraint. Appendix B lists the characteristics of each CHT included in this classification framework.

METHODS

Digital elevation models were used in conjunction with a 1:24000 base streams layer from the Oregon Department of Forestry (ODF) to map channel habitat types. Both perennial and seasonal streams in the watershed were included in this exercise. Channel typing was performed following OWEB protocols (WPN 1999). Channel gradient for all stream reaches was calculated using ArcMap 9.2 with 3D Analyst. Streams were divided into segments of uniform channel gradient class. These stream segments were typically at least 1,000 feet in length. Channel gradient classes were broken out at <1%, 1–2%, 2–4%, 4–8%, 8–16%, and >16%. CHTs were initially assigned to channel reaches with the aid of aerial photos, and questionable or uncertain areas were flagged for ground truthing. Because channel confinement is difficult to assess using only topographic maps or digital data, field validation of channel habitat typing occurred in February and April of 2008. Using field validation and digital photo assessments, channel types were verified at approximately 75 locations throughout the watershed. Table 4.1 summarizes CHT coding, nomenclature, and attributes of the various CHTs in the OWEB protocol. The data were then compiled and summarized to identify stream reaches that are most sensitive to disturbance and therefore most responsive to restoration measures (WPN 1999). Those channels that are most

Table 4.1. Summary of Channel Habitat Type (CHT) codes, names, and descriptions as described in the Oregon Watershed Assessment Manual (WPN 1999).

Code	CHT Name	Gradient	Channel Confinement	Size
ES	Small Estuary	< 1%	Unconfined to moderately confined	Small to medium
EL	Large Estuary	< 1%	Unconfined to moderately confined	Large
FP1	Low Gradient Large Floodplain	< 1%	Unconfined	Large
FP2	Low Gradient Medium Floodplain	< 2%	Unconfined	Medium to large
FP3	Low Gradient Small Floodplain	< 2%	Unconfined	Small to medium
AF	Alluvial Fan	1–5%	Variable	Small to medium
LM	Low Gradient Moderately Confined	< 2%	Moderately confined	Variable
LC	Low Gradient Confined	< 2%	Confined	Variable
MM	Moderate Gradient Moderately Confined	2–4%	Moderately confined	Variable
MC	Moderate Gradient Confined	2–4%	Confined	Variable
MH	Moderate Gradient Headwater	1–6%	Confined	Small
MV	Moderately Steep Narrow Valley	3–10%	Confined	Small to medium
BC	Bedrock Canyon	1– >20%	Confined	Variable
SV	Steep Narrow Valley	8–16%	Confined	Small
VH	Very Steep Headwater	>16%	Confined	Small

sensitive to disturbance are also likely to be most responsive to restoration efforts because these are channel types that are generally most "malleable," or easily influenced by changes in flow conditions or sediment loads. This CHT information can be used in conjunction with habitat survey and channel modification data to determine where stream channels are most disturbed relative to where restoration efforts have the greatest potential for success. Accordingly, restoration projects in degraded stream channels that are classified as sensitive (i.e., more responsive to restoration) CHTs should receive higher priority for implementation, as the likelihood for success is higher in these areas than in less sensitive CHTs.

RESULTS

A total of 599.1 miles of streams were typed throughout the watershed (Figure 4.1 and Table 4.2). The Rock and Lonerock creeks watershed comprises a number of channel habitat types that range in sensitivity to disturbances such as altered hydrologic and sediment-input regimes. Watershed wide, 12.4% of the total channel length (74.3 miles) is classified as highly sensitive to

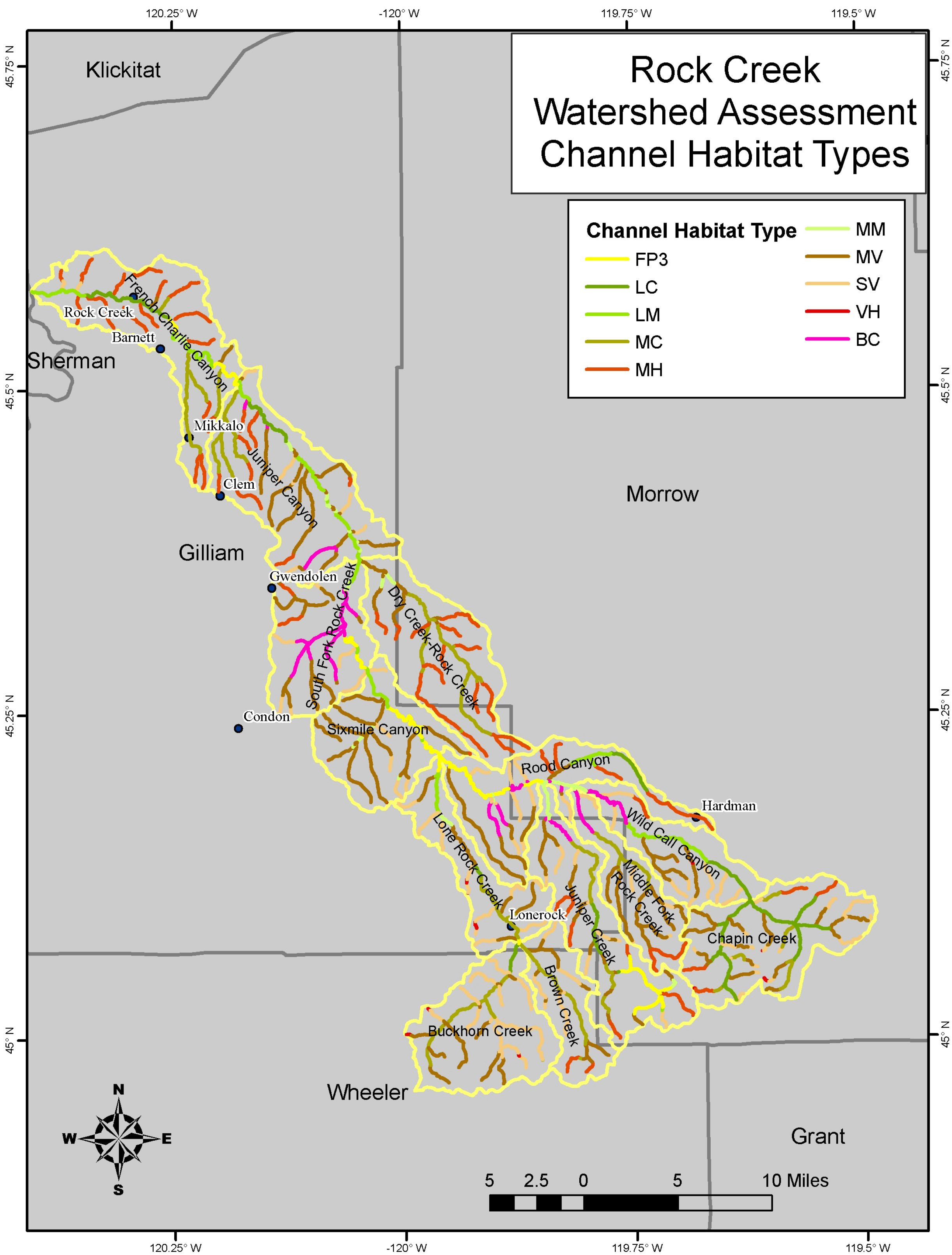

Figure 4.1. Channel Habitat Types occurring in the Rock and Lonerock creeks watershed, Oregon.

Table 4.2. Channel Habitat Types, in stream miles, occurring in subwatersheds of the Rock and Lonerock creeks watershed, Oregon.

	CHT										
Subwatershed	FP3	LM	MM	LC	MC	MH	MV	SV	BC	VH	Total miles
French Charlie Canyon	3.6	7.4	0.9	5.7	11.7	26.2	1.8	1.1	0.0	0.0	58.5
Juniper Canyon	0.0	7.6	2.1	3.8	10.5	11.4	25.8	6.7	3.2	0.0	71.2
South Fork Rock Creek	2.7	2.3	0.6	0.0	0.0	2.5	13.5	6.8	12.9	0.0	41.2
Dry Creek-Rock Creek	0.0	0.2	1.3	0.0	14.5	26.8	7.6	0.0	0.0	0.0	50.4
Sixmile Canyon	5.7	2.8	1.7	0.0	0.0	0.3	29.0	4.9	0.0	0.0	44.4
Lonerock Creek	1.4	2.7	1.1	0.8	5.1	0.0	9.1	13.5	0.0	0.6	34.3
Rood Canyon	7.4	3.0	2.5	3.0	0.0	9.3	15.5	10.7	5.3	0.0	56.8
Juniper Creek	7.4	0.2	2.8	3.2	7.4	8.7	11.7	6.8	2.1	0.0	50.4
Middle Fork Rock Creek	0.0	0.0	0.4	0.0	5.7	4.0	16.1	3.8	2.7	0.0	32.6
Wild Call Canyon	0.0	5.7	0.8	3.6	0.0	1.6	8.9	11.4	3.8	0.2	35.9
Buckhorn Creek	0.0	0.0	0.0	1.7	8.6	0.0	12.9	19.5	0.0	0.6	43.2
Brown Creek	0.1	0.0	0.0	0.2	6.8	2.0	7.4	7.3	0.0	0.0	23.8
Chapin Creek	0.0	0.0	0.0	17.2	6.4	5.6	17.1	9.6	0.0	0.5	56.4
TOTAL	28.3	31.8	14.2	39.2	76.8	98.3	176.4	102.2	29.9	2.0	559.1
	4.7%	5.3%	2.4%	6.5%	12.8%	16.4%	29.4%	17.1%	5.0%	0.3%	100%

disturbance. The most sensitive channel types occurring in the watershed include Low-Gradient Small Floodplain Channels (FP3), Low-Gradient Moderately Confined Channels (LM), and Moderate-Gradient Moderately Confined Channels (MM; Figure 4.2). These low-gradient unconfined channels (FP3) and Moderate-Gradient Moderately Confined Channels (MM) occur in the middle portion of the watershed, north and east of Condon, as well as in some of the upper reaches, particularly north and east of Lonerock and south of Hardman (Figure 4.3). Overall, responsive channel reaches are well distributed throughout the watershed, with the exception of Buckhorn, Brown, and Chapin Creek Subwatersheds. This suggests that large areas of the watershed are highly sensitive to land-use-related disturbances; as a corollary, they will also be very responsive to restoration activities.

Channels classified as moderately sensitive to disturbance represented 65.2% of the total channel length in the watershed (390.6 miles). Moderately Steep Narrow Valley (MV) channels represented 29.4% of the total channel length and included the upper stream reaches in most areas of the watershed. MV channels were the most common CHT in the watershed. In additional to MV channels, other moderately sensitive channel types occurring in the watershed included Low-Gradient Confined (LC), Moderate-Gradient Confined (MC), and Moderate-Gradient Headwaters (MH) channels. These moderately sensitive channels occur throughout the watershed and tend to represent the largest proportion of channel length in most of the headwaters throughout the watershed.

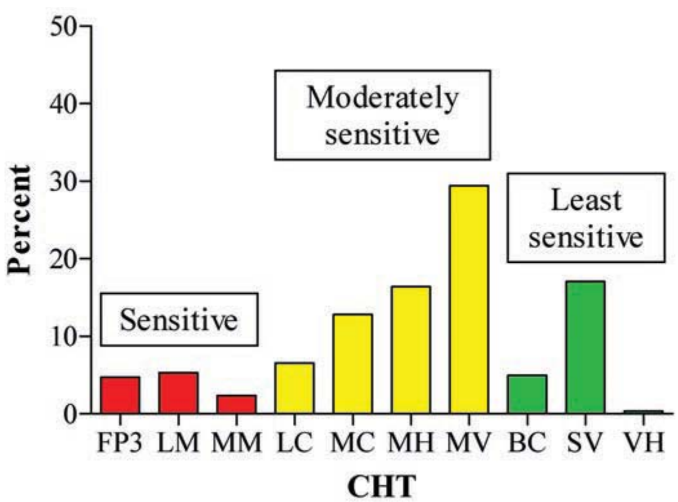

Figure 4.2. Relative occurrence of Channel Habitat Types in the Rock Creek and Lonerock Creek watershed.

Throughout the watershed, 22.4% of the channels are classified as CHTs that are least-sensitive to disturbances. These include the Steep Narrow Valley (SV), Very Steep Headwater (VH), or Bedrock Canyon (BC) CHTs. Because these CHTs are confined and relatively stable, they tend to be poor candidates for instream restoration projects. However, these areas should not be overlooked for riparian and upland restoration opportunities, as steep slopes, commonly associated with these channel types, can deliver large amounts of sediment to receiving waters if native vegetative cover is compromised.

DISCUSSION

Channel responsiveness to changes in discharge or sediment loads resulting from disturbance or restoration efforts is largely a function of channel confinement and gradient, as well as by other factors including underlying geology and hydrologic regime. Of the CHTs occurring in the watershed, the most responsive CHTs to restoration and enhancement are Low-Gradient Moderately Confined (LM) channels, Moderate-Gradient Moderately Confined (MM) channels, and Low-Gradient Small Floodplain (FP3). Collectively, these three channel types represent 12.4% of the total stream length in the watershed and present significant opportunities for instream habitat improvement where degraded conditions are identified. An additional 65.2% of watershed stream miles are classified as moderately responsive to restoration efforts and should also be a focus for stream restoration efforts as well. Figure 4.3 apportions the relative quantity of responsive CHTs by subwatershed, which should further allow land managers to focus restoration efforts.

Owing to the dominance of the watershed by moderately-to-highly sensitive channels, opportunities to improve channel

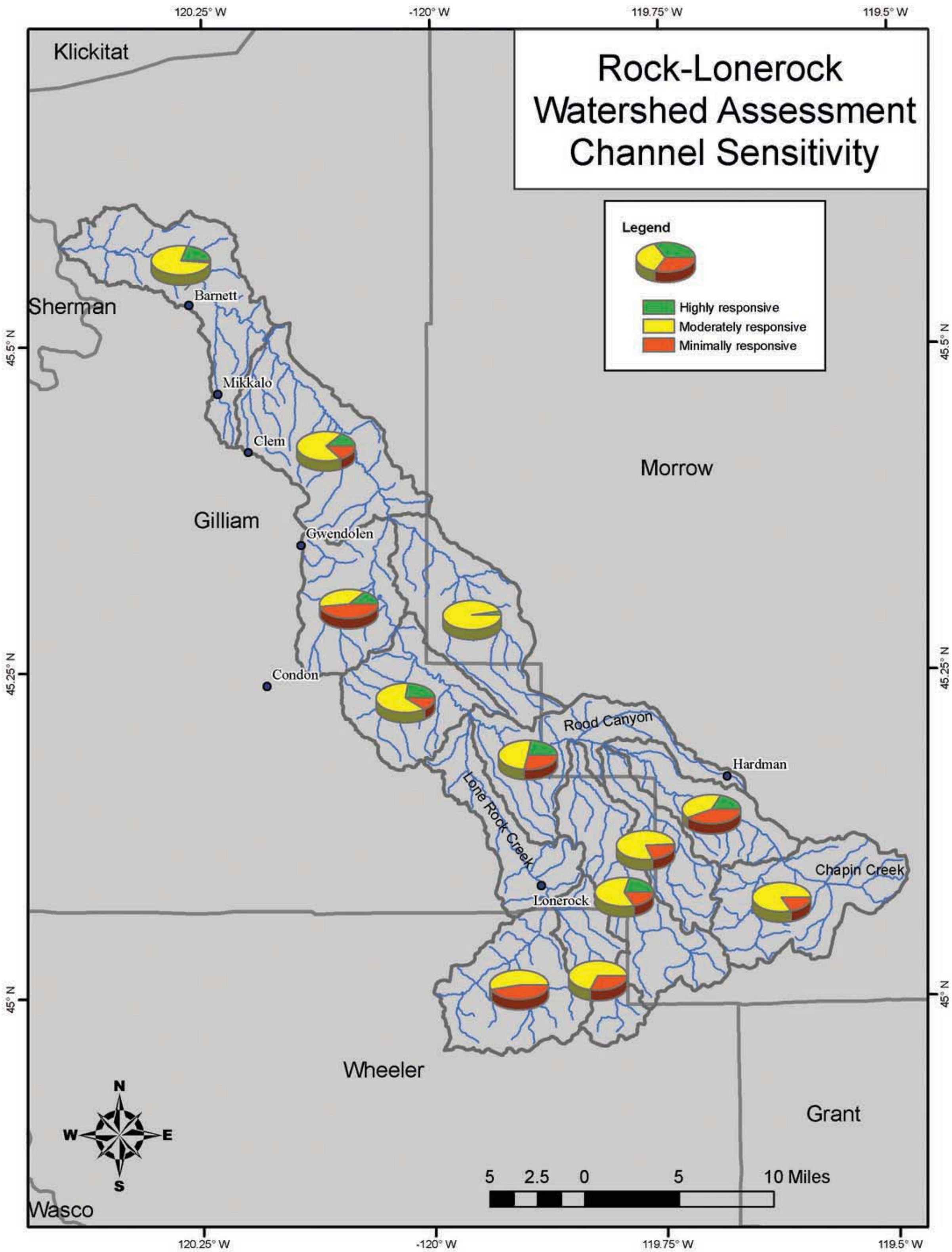

Figure 4.3. Relative occurrence of minimally, moderately, and highly sensitive/responsive channels in the Rock Creek and Lonerock Creek watershed, by subwatershed.

conditions where they are found to be degraded will also be significant. Degraded CHTs will benefit from the restoration of riparian vegetation, improved management of livestock around streambanks and channels, and other measures intended to restore the channel and its floodplain to a more natural condition that is capable of transporting water and sediment without significant changes to its channel dimensions or base elevation. Vegetation near streams also helps to absorb stream energy, stabilize stream banks, and reduce sediment loading and stream temperatures. The woody debris input from vegetated banks creates and maintains habitat for young salmonids and other aquatic life. Additionally, leaf litter and insects falling into the stream provide important food sources for stream life.

DATA GAPS AND RECOMMENDATIONS

A large number of CHTs were field-checked or photo-checked for accuracy; however, private land access and time constraints prevented a comprehensive check of all reaches in question. Future survey work can be performed to verify the current designations to ensure accuracy, as well as to determine the flow status of many of the small headwater channels. We suspect that that the total mileage of typed channels includes small draws and hollows where only seasonal or even intermittent flows occur. Ground truthing of these conditions should also be performed and the maps updated, as needed. Although channel habitat typing provides one source of information used in identifying potential restoration opportunities, they are no substitute for more intensive field-based surveys, such as Rosgen stream typing or a detailed hydrogeomorphic assessment. These latter approaches allow for further examination of stream channel conditions to both improve baseline information and to better quantify reach-specific channel conditions in the watershed for restoration opportunity identification and prioritization. Field work performed during this watershed assessment allowed for a more detailed examination of physical habitat characteristics in selected reaches throughout the watershed; similar reach-specific surveys should be performed in advance of implementing restoration projects in the basin.

CHAPTER 5: RIPARIAN & WETLANDS

INTRODUCTION

Riparian zones are the terrestrial areas immediately adjacent to rivers, streams, and wetlands. These areas exhibit soil and vegetative characteristics different from areas further upland, as they generally have higher soil moisture content which supports more diverse and productive plant communities. Riparian areas provide a number of important functions in the maintenance of aquatic ecosystems. Vegetation in these areas stabilizes streambanks and dissipates stream water velocities during higher flows, thereby preventing bank erosion. Riparian vegetation also provides stream shading, reducing the amount of solar radiation reaching the stream and, therefore, preventing accelerated warming of stream water. Fish populations benefit from both instream and overhead cover provided by live and dead riparian vegetation. Inputs of leaves, twigs, needles, and other vegetation from the riparian zone often provide the primary food source for stream macroinvertebrates that, in turn, serve as the food base for salmonids, amphibians, and other aquatic predators. Additionally, riparian vegetation provides a buffer between the stream ecosystem and upland land uses (Hunter 1991, Franklin 1992) and is believed to be important in controlling the amount of sediment and nutrients entering the stream channel.

Riparian areas are the primary sources of large woody debris (LWD), which also serves a number of important roles in rivers and streams. Large woody debris such as dead trees, root wads, and larger limbs help to shape stream channels by directing the flow of water and capturing sediments, gravels, and debris to increase channel habitat complexity through the formation of pools. More complex habitats and higher pool frequencies created by LWD benefit fish populations by increasing habitat quality. Large woody debris slows high water velocities, allowing sediments and organic matter to drop out of the water column. Stream productivity is effectively increased when these materials are retained in the local stream system for longer periods of time.

Adequate LWD loads in streams are maintained only if suitable numbers of larger, taller trees occur close enough to the stream to enter the water when they fall due to age, disease, or storms. The area from which the stream draws LWD is referred to as the riparian recruitment zone. Generally, the majority of functional wood from this zone occurs within 100 feet or less and is dependent on the ecoregion. A well-stocked riparian recruitment zone will ensure a steady supply of large woody material from a productive and well-functioning riparian area.

While large woody debris certainly played a critical role in stream conditions and functions in forested portions of the Rock and Lonerock creeks watershed, it likely served a less significant role in the historically non-forested portions of the watershed, which represent 75% of the total watershed area. In the non-forested portions of the watershed, riparian communities were frequently devoid of mature trees and often consisted of only shrubs and grasses (McAllister 2008). Consequently, the analyses in this section distinguish between expected riparian conditions in the forested and non-forested portions of the watershed.

METHODS

The OWEB Watershed Assessment process includes characterizing riparian zone conditions from aerial photographs with respect to overall condition, recruitment potential, and shading, as described herein (WPN 1999). County-provided digital aerial photographs from 2005 were used to assess riparian conditions in the Rock and Lonerock creeks watershed. Stream layers (Chapter 4: Channel Habitat Types) were overlayed on the photos in ArcMap 9.2 (ESRI, Redlands, CA) to assist with delineating stream channels and buffering left and right banks. The mapping unit used in this assessment of riparian areas is the Riparian Condition Unit (RCU), defined as a segment of the riparian zone of uniform vegetation type, size, and density, as well as channel habitat type (CHT) and ecoregion along a given stream (WPN 1999). RCU lengths vary with the length of contiguous habitat conditions but are generally approximately 1,000 feet in length.

RCUs were further subdivided by stream size and subwatershed. Each RCU was assigned an individual number and then classified or evaluated according to each of the following fields:

Stream Name—Streams were named according to the streams layer from the Oregon State GIS (ORGEO), where applicable.

Subwatershed—Streams were placed in subwatersheds based upon drainage patterns and 6th field watersheds.

Ecoregion—Ecoregion boundaries were determined from the ecoregion dataset from ORGEO. Ecoregion descriptions of the basin were obtained from the OWEB Watershed Assessment Manual (WPN 1999, Appendix A).

CHT—The layer of digitized Channel Habitat Types was overlain on the riparian layer and the CHT of the riparian condition unit assigned.

Stream Size—Derived from Oregon Department of Forestry (ODF) stream survey GIS data.

Riparian Area (RA1) Width—The width of vegetation occurring immediately adjacent to the stream (the riparian zone) that most influences water temperature, habitat value, streambank stability, and hydrodynamics of the stream. This width varied from 25 to 75 feet, depending upon channel confinement class and ecoregion.

Riparian Area 1 (RA1) Code—Riparian areas within each RCU were classified according to vegetation type, size, and density using 3-letter codes (Table 5.1)

Riparian Area 2 (RA2) Code—This portion of the recruitment zone was classified according to vegetation type, size, and density using the letter coding system used to classify RA1 vegetation (Table 5.1). The RA2 is the remaining portion of the riparian recruitment zone outside of the RA1 zone and also varies with ecoregion and channel confinement. Note that in several ecoregions within the study area, riparian recruitment is negligible, and thus receives a code of N/A.

Shade—Shade was visually estimated as high (>70%), medium (40–70%), or low (<40%) on each streambank. Banks were often difficult to distinguish on smaller streams, necessitating that each bank receive the same shade code.

Riparian Recruitment—The **riparian recruitment potential** was first classified as adequate or inadequate by comparing RCU conditions to potential riparian zone vegetative characteristics for that ecoregion and CHT. All RCUs classified as inadequate were then further classified according to their **riparian recruitment situation**, which characterizes the immediate land use conditions that are precluding proper adequate riparian zone recruitment. In non- forested ecoregions (i.e., Umatilla Plateau [10c] and Deschutes/John Day Canyons [10k]) the riparian zones would not have naturally supported enough large trees to establish a significant LWD source pool. Therefore, reaches occurring in these areas were classified N/A for riparian recruitment potential if the riparian zone condition was similar to that naturally occurring in the ecoregion. Otherwise, they were classified as being limited by the dominant land use adjacent to them. The following riparian zone recruitment situations were used to classify RCUs:

Adequate (ADQ): For a given ecoregion, the reach of stream is considered normal, and riparian recruitment is considered adequate to keep LWD in sufficient supply in the stream.

Agriculture (AG): Predominately small grain, haying, or cattle grazing within the riparian zone. Active or incidental loss of riparian and hydrologic structure and function has resulted.

Not Applicable (N/A): The ecoregion in question does not historically support the recruitment of LWD to a significant degree.

Small Stand Size (SS): Forestry or fire has resulted in smaller diameter trees than is normal for the ecoregion, thereby limiting recruitment potential.

Wetland (WET): The presence of wetlands reduces the presence of suitable tree candidates for recruitment.

Table 5.1. Vegetation classes along riparian areas (RA1) in the Rock and Lonerock creeks watershed, Oregon, as assessed using the Oregon Watershed Assessment Manual (WPN 1999). Three-letter categories refer to vegetation type (H= hardwoods, C= conifers, M= mixed, B= brush, G= grass), size (S= small, M= medium, L= large, N= no size; grass/brush), and density (S= sparse, D= dense, N= no density; grass/brush).

Subwatershed	GNN	BNN	HSS	HSD	HMS	CSS	MSS	CSD	MMS	HMD	Grand Total
French Charlie Canyon	98.4	15.1	2.4	0.0	0.4	0.0	0.0	0.0	0.0	0.4	116.6
Juniper Canyon	119.9	13.3	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	142.3
South Fork Rock Creek	63.7	6.2	0.0	0.0	12.4	0.0	0.0	0.0	0.0	0.0	82.4
Dry Creek-Rock Creek	97.0	3.4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	100.8
Sixmile Canyon	31.4	43.8	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	89.0
Lonerock Creek	22.6	8.3	0.0	0.0	2.6	13.1	13.2	5.8	3.3	0.0	68.9
Rood Canyon	61.7	36.3	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	113.1
Juniper Creek	47.8	7.0	2.2	15.0	0.0	14.0	7.2	7.9	0.0	0.0	101.0
Middle Fork Rock Creek	9.2	31.6	0.0	19.8	0.0	2.5	0.0	2.0	0.0	0.0	65.2
Wild Call Canyon	23.8	25.9	4.1	0.0	0.0	6.3	6.5	5.2	0.0	0.0	71.7
Buckhorn Creek	3.6	0.7	22.1	57.8	0.0	2.0	0.0	0.0	0.0	0.0	86.3
Brown Creek	5.6	0.7	36.9	0.0	0.0	4.1	0.0	0.0	0.0	0.0	47.4
Chapin Creek	10.8	1.9	89.6	10.6	0.0	0.0	0.0	0.0	0.0	0.0	112.9
Grand Total	595.5	194.3	157.3	103.2	53.8	42.0	26.9	20.9	3.3	0.4	1,197.6

Finally, data describing riparian vegetation conditions, riparian recruitment situation, and stream shading were summarized by subwatershed to help identify areas most in need of riparian zone improvement and restoration.

RESULTS

A total of 6,742 Riparian Condition Units (RCUs) were assessed, totaling 2,396 bank-miles. Because every mile of stream includes two miles of RCUs, RCUs along 1,198 miles of stream were assessed. The number of RCUs occurring in each watershed varied with the number of stream miles in the watershed and with the heterogeneity of streamside habitat.

RIPARIAN VEGETATION CONDITIONS

Riparian conditions varied widely throughout the watershed. Riparian zones occurring in lower elevation, non-forested ecoregions in the watershed (i.e., Umatilla Plateau [10c], Deschutes/John Day Canyons [10k]) were represented by a number of vegetation communities in the RA1 zone. Grassland, brush land, and pasture were the most common riparian condition classes (Figure 5.1, Table 5.1). According to assessment guidelines, vegetative communities in the secondary recruitment zone within non-forested portions of the watershed were not assigned riparian status (Figure 5.2, Table 5.2).

While the OWEB Watershed Assessment Manual suggests that riparian zones within non-forested ecoregions would have supported sparse stands of shrubs and hardwoods (Appendix A, WPN 1999), recent efforts to more comprehensively characterize historic riparian conditions in the John Day basin suggest a diversity of riparian conditions (McAllister 2008). For example, historical records suggest that in the Deschutes/John Day Canyons ecoregion alone, numerous riparian plant communities occurred, including prairie/wet meadows, riparian shrubs (noted as often dense), swampy bottomlands, and cottonwood timber (McAllister 2008). While we cannot be sure of the historic distribution of these riparian conditions across the middle and lower (non-forested) portions of the watershed, there is little doubt that existing conditions are less diverse and lacking in woody vegetation relative to historic conditions. Currently, vegetation within most of these riparian zones is composed of only grasses and shrubs. These riparian areas have generally been cleared and channels have been modified for agricultural purposes.

Within the non-forested ecoregions in the watershed, current assessment guidelines suggest that recruitment of LWD is negligible. While new information (McAllister 2008) suggests that this is not necessarily true in all cases, for purposes of this screening-level assessment, we followed existing ecoregion coding guidelines; therefore, riparian recruitment potential in the non-forested ecoregions was coded as not applicable (N/A; Figure 5.3, Table 5.3). The results presented below should be interpreted and applied while bearing in mind that riparian communities in the middle and lower portions of the watershed may have included cottonwood galleries or lush growth of willows and other shrubs, while other areas may have naturally been nearly barren of streamside vegetation, such as on heavily boulder-lined shores along portions of lower Rock Creek (as described by McAllister 2008).

Within the forested ecoregion portions of the watershed (represented primarily by the John Day/Clarno Highlands and a small region of the Maritime-influenced Zone), riparian conditions also varied widely, but are represented by a large proportion of partially intact riparian zones composed mostly of hardwoods (Table 5.1, Figure 5.1). Historically, riparian zones occurring in all of these ecoregions supported small hardwoods in the riparian zone; upland areas supported medium-sized, sparsely stocked stands of either conifers or mixed hardwood/conifers (WPN 1999).

RIPARIAN RECRUITMENT POTENTIAL AND SITUATIONS

Approximately 75% of the stream miles within the Rock and Lonerock creeks watershed occur within non-forested ecoregions, where woody material is not generally recruited into the channel. Of the remaining 25% of the stream miles in the basin that occur in forested ecoregions, only 1.9% have adequate riparian recruitment potential. Areas with adequate riparian recruitment potential have sufficient quantities of trees to provide adequate supplies of woody materials to stream channels. Such areas are uncommon within the watershed (Table 5.3; Figure 5.3). Clearing for

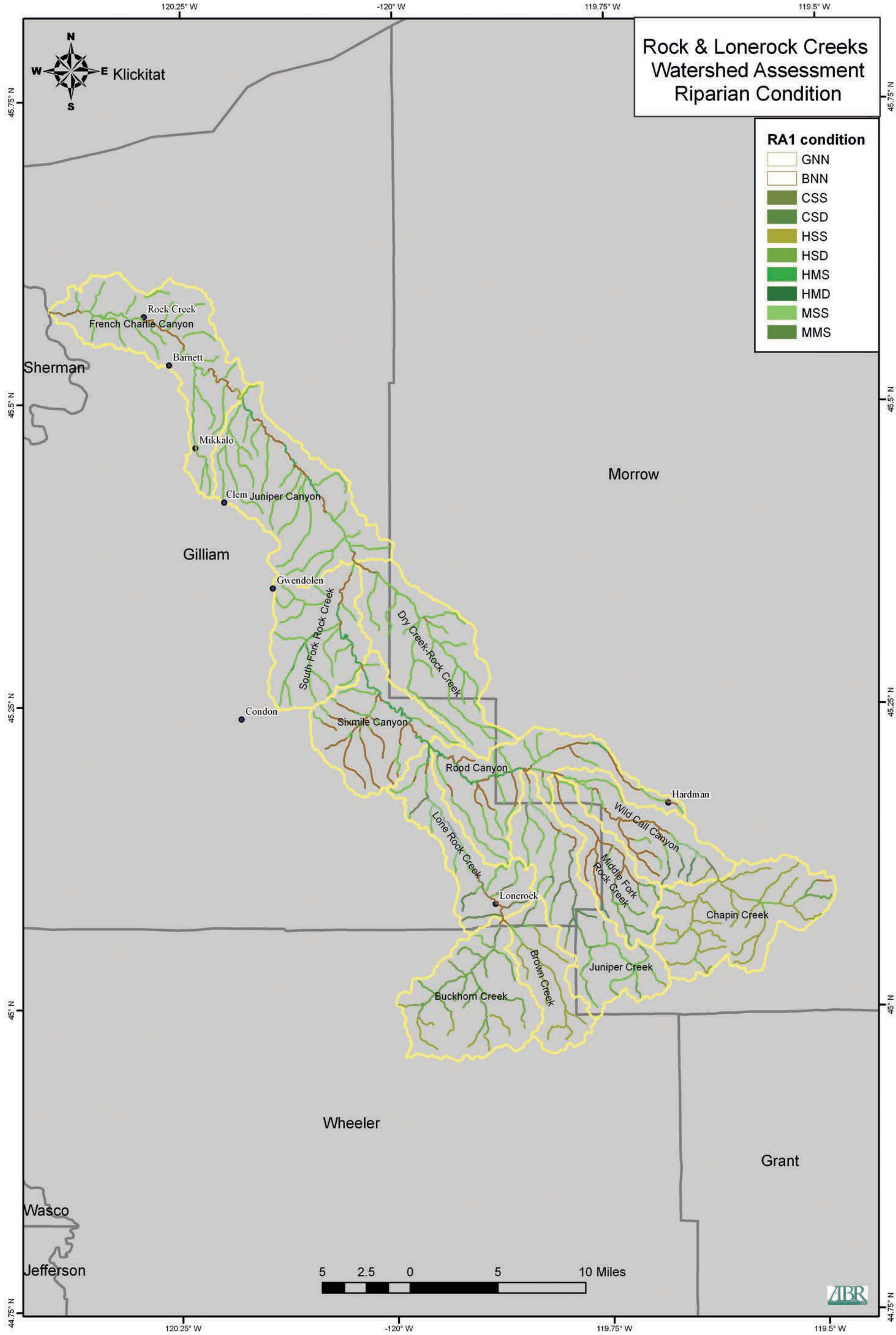

Figure 5.1. Vegetation classes along riparian areas (RA1) in the Rock Creek and Lonerock Creek watershed, Oregon as assessed using the Oregon Watershed Assessment Manual (WPN 1999), in stream miles. Three-letter categories refer to vegetation type (H= hardwoods, C= conifers, M= mixed, B= brush, G= grass), size (S= small, M= medium, L= large, N= no size (grass/brush)), and density (S= sparse, D= dense, N= no density (grass/brush).

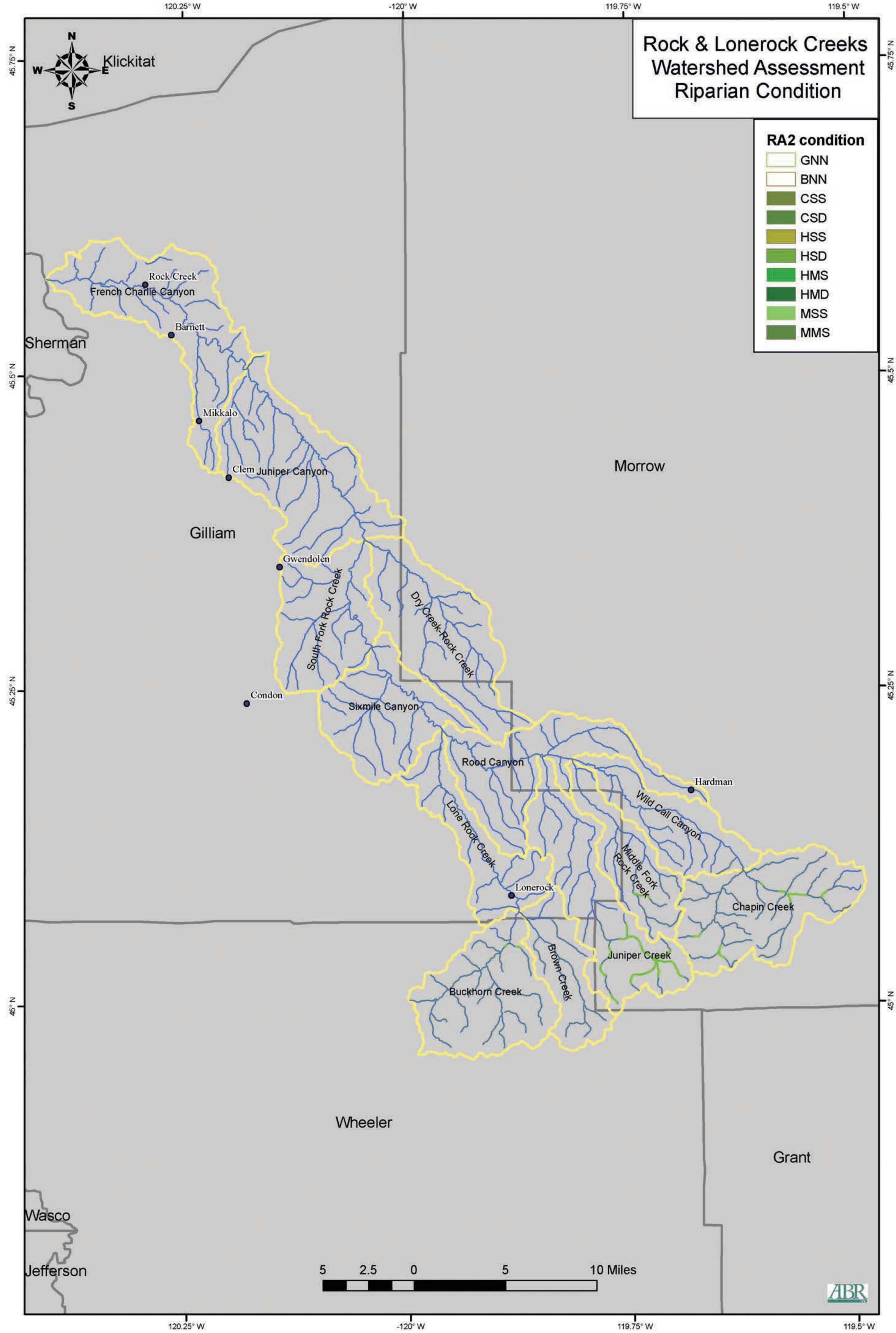

Figure 5.2 Vegetation classes within the secondary recruitment zone (RA2) in the Rock Creek and Lonerock Creek watershed, Oregon as assessed using the Oregon Watershed Assessment Manual (WPN 1999), in stream miles. Three-letter categories refer to vegetation type (H= hardwoods, C= conifers, M= mixed, B= brush, G= grass), size (S= small, M= medium, L= large, N= no size (grass/brush)), and density (S= sparse, D= dense, N= no density (grass/brush). Vegetative communities in the secondary recruitment zone within non-forested portions of the watershed were not assigned riparian status (N/A)

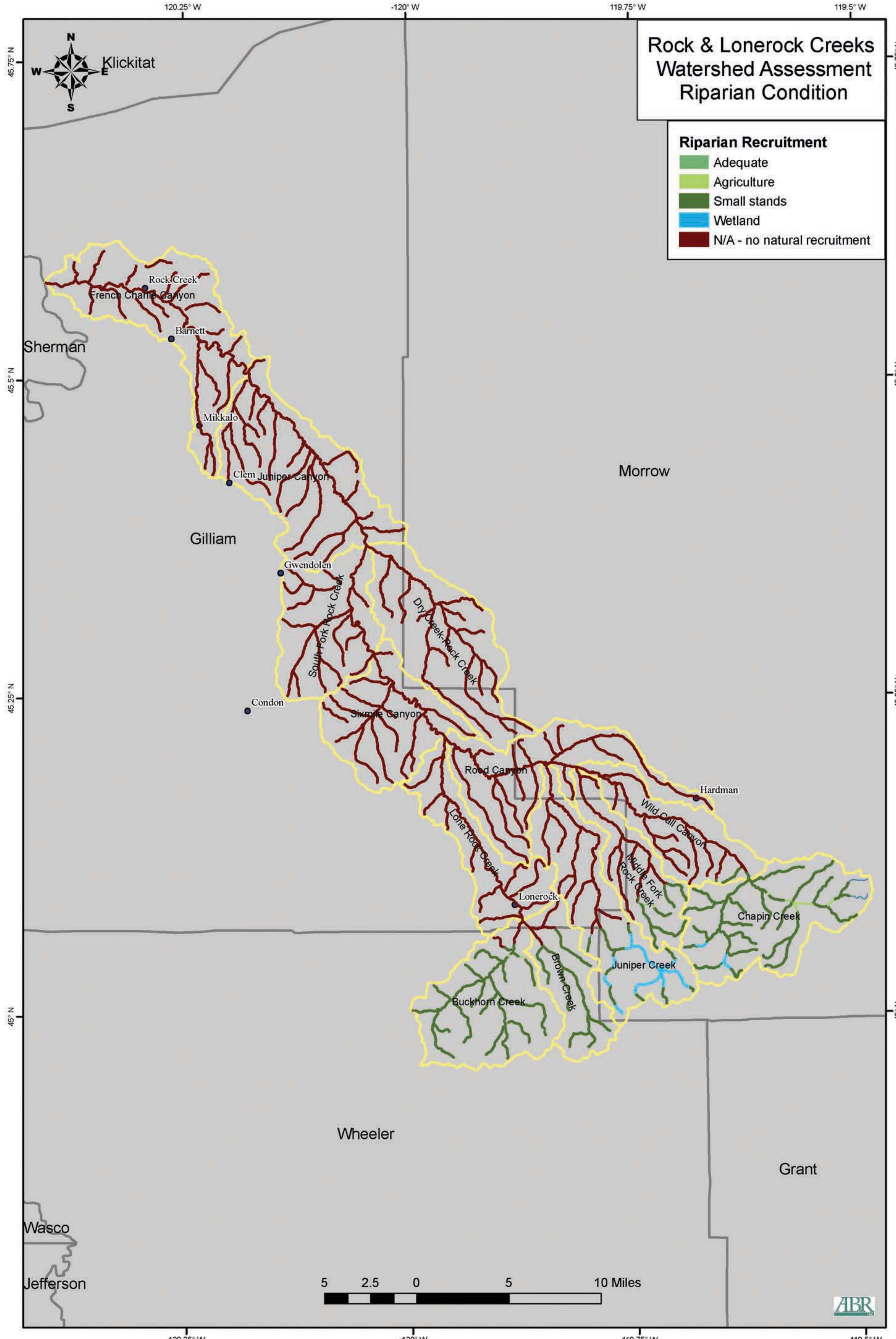

Figure 5.3. Riparian recruitment within the Rock Creek and Lonerock Creek watershed, Oregon, as assessed using the Oregon Watershed Assessment Manual (WPN 1999)..

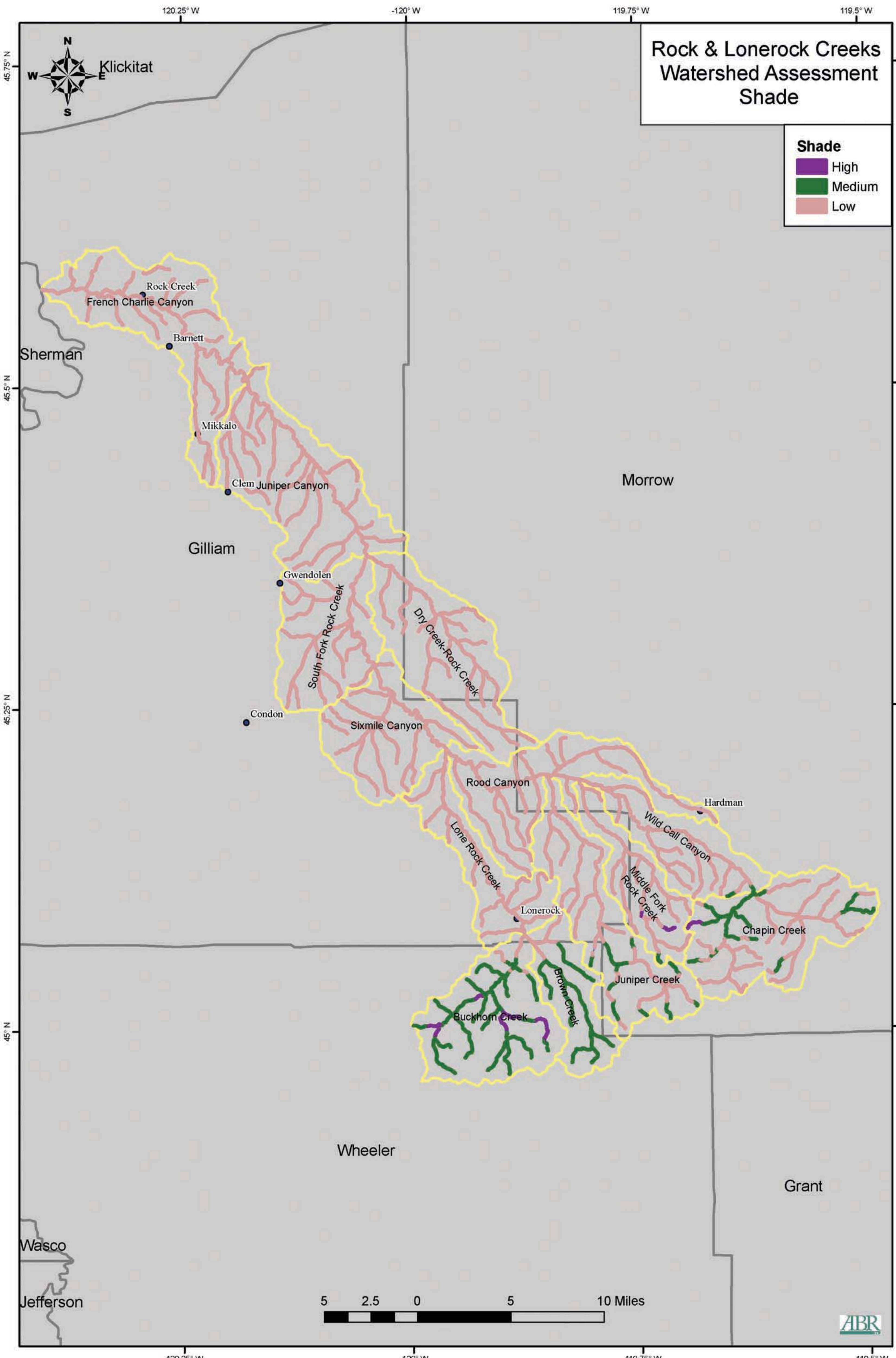

Figure 5.4. Shade characteristics of streams within the Rock Creek and Lonerock Creek watershed, Oregon.

Table 5.2 Vegetation classes within the secondary recruitment zone (RA2) in the Rock and Lonerock creeks watershed, Oregon, as assessed using the Oregon Watershed Assessment Manual (WPN 1999). Three-letter categories refer to vegetation type (H= hardwoods, C= conifers, M= mixed, B= brush, G= grass), size (S= small, M= medium, L= large, N= no size; grass/brush), and density (S= sparse, D= dense, N= no density; grass/brush). Vegetative communities in the secondary recruitment zone within the non-forested portions of the watershed were not assigned riparian status (N/A).

Subwatershed	N/A	CSS	GNN	CSD	CMD	CMS	Grand Total
French Charlie Canyon	116.6	0.0	0.0	0.0	0.0	0.0	116.6
Juniper Canyon	142.3	0.0	0.0	0.0	0.0	0.0	142.3
South Fork Rock Creek	82.4	0.0	0.0	0.0	0.0	0.0	82.4
Dry Creek-Rock Creek	100.8	0.0	0.0	0.0	0.0	0.0	100.8
Sixmile Canyon	89.0	0.0	0.0	0.0	0.0	0.0	89.0
Lonerock Creek	68.9	0.0	0.0	0.0	0.0	0.0	68.9
Rood Canyon	113.1	0.0	0.0	0.0	0.0	0.0	113.1
Juniper Creek	59.4	15.7	24.4	0.8	0.7	0.0	101.0
Middle Fork Rock Creek	43.2	17.5	2.2	2.3	0.0	0.0	65.2
Wild Call Canyon	67.2	3.3	0.0	1.3	0.0	0.0	71.7
Buckhorn Creek	5.3	68.1	1.1	11.9	0.0	0.0	86.3
Brown Creek	10.4	36.9	0.0	0.0	0.0	0.0	47.4
Chapin Creek	0.0	85.6	9.8	12.5	3.1	1.9	112.9
Grand Total	898.6	227.1	37.5	28.6	3.8	1.9	1,197.6

timber harvest operations and agricultural development are largely responsible for the alteration in riparian condition classes in the portions of the watershed occurring within forested ecoregions. Small stands, which are generally too small to provide for recruitment under the current conditions, limit 85.5% of the forested ecoregion area. Stands of smaller trees result either from recent forestry activities (i.e., harvest, replanting) or succession of fallow or replanted agricultural land. If allowed to attain larger tree sizes, these situations will eventually produce adequate amounts of LWD; however, if current management practices continue, large proportions of small tree sizes will persist and continue to deplete streams of important woody structural components.

Wetland areas limit riparian recruitment in 9.5% of the forested ecoregion area within the watershed. Areas where riparian recruitment potential is limited by wetland areas occur in the Juniper Creek and Chapin Creek subwatersheds and account for 86.2% and 13.8% of the stream miles limited by wetlands, respectively. Agriculture, a high-value land use in the watershed, also contributes to limited riparian recruitment potential in forested ecoregions. Such areas tend to have no or vary narrow riparian buffers along stream channels. However, only 3.1% of the forested ecoregion area within the watershed is limited by agricultural practices (Figure 5.3). Areas where riparian recruitment potential is limited by agriculture occur in the Chapin Creek, Middle Fork Rock Creek, and Buckhorn Creek subwatersheds and account for 64.3%, 23.6%, and 12.1% of stream miles limited by agriculture respectively (Figure 5.3). It is recognized that the bottomlands along streams can be the most valuable agricultural land in the basin; however, encouraging a larger buffer between land uses and streams will benefit water quality and stream health, which also have values for landowners in the basin (Elmore 1992).

STREAM SHADING

Stream shading varied across the watershed (Table 5.4, Figure 5.4). The highest stream shading

Table 5.3. Riparian recruitment situations (stream miles) within the Rock and Lonerock creeks watershed, Oregon, as assessed using the Oregon Watershed Assessment Manual (WPN 1999).

Subwatershed	N/A	Small stands	Wet/meadow	Agriculture	Adequate	Grand Total
French Charlie Canyon	117	0	0	0	0	117
Juniper Canyon	142	0	0	0	0	142
South Fork Rock Creek	82	0	0	0	0	82
Dry Creek-Rock Creek	101	0	0	0	0	101
Sixmile Canyon	89	0	0	0	0	89
Lonerock Creek	69	0	0	0	0	69
Rood Canyon	113	0	0	0	0	113
Juniper Creek	59	16	24	0	1	101
Middle Fork Rock Creek	43	20	0	2	0	65
Wild Call Canyon	67	5	0	0	0	72
Buckhorn Creek	5	80	0	1	0	86
Brown Creek	10	37	0	0	0	47
Chapin Creek	0	98	4	6	5	113
Grand Total	899	256	28	9	6	1,198

Table 5.4. Shade characteristics of streams within the Rock and Lonerock creeks watershed, Oregon, in stream miles.

Subwatershed	High	Medium	Low	Grand Total
French Charlie Canyon	0.0	0.0	116.6	116.6
Juniper Canyon	0.0	0.0	142.3	142.3
South Fork Rock Creek	0.0	0.0	82.4	82.4
Dry Creek-Rock Creek	0.0	0.0	100.8	100.8
Sixmile Canyon	0.0	0.0	89.0	89.0
Lonerock Creek	0.0	0.0	68.9	68.9
Rood Canyon	0.0	0.0	113.1	113.1
Juniper Creek	0.7	16.1	84.2	101.0
Middle Fork Rock Creek	2.3	1.2	61.7	65.2
Wild Call Canyon	0.0	2.3	69.4	71.7
Buckhorn Creek	11.9	68.1	6.4	86.3
Brown Creek	0.0	36.9	10.4	47.4
Chapin Creek	2.0	30.3	80.5	112.9
Grand Total	16.9	155.0	1,025.7	1,197.6

occurred in the higher elevations of the John Day/Clarno Highlands ecoregion (southern portion of the watershed; Figure 5.4). Approximately 85% of the riparian zone distance surveyed had stream shading of less than 40%; this primarily occurred in the lowlands where riparian vegetation has been cleared for agricultural purposes or in moderate elevation headwaters where water availability is limited. Improvements in riparian conditions would increase stream shading and help abate elevation of summertime water temperatures. Because water temperature is an important determinant of biological stream conditions, reestablishing desirable riparian conditions and shading should be a priority in the watershed.

WETLANDS

Digital National Wetlands Inventory information pertaining to the presence of wetland areas within the Rock and Lonerock creeks watershed was obtained from the United States Fish and Wildlife Service (USFWS). Wetland types occurring within the watershed include freshwater emergent wetlands, freshwater forested/shrub wetlands, and freshwater ponds (Table 5.5, Figure 5.5). Freshwater emergent wetlands were the most common type of wetland occurring in the watershed, comprising 86.5% of total wetland acres within the basin. Freshwater forested/shrub wetland and freshwater ponds accounted for 9.6% and 3.9% of the total wetland acres within the basin, respectively. Wetland areas are present in each of the subwatersheds; however, 66.0% of the total wetland area within the watershed occurs in the Juniper Creek subwatershed. Another 11.7% of the total area occurs in adjacent Chapin Creek subwatershed.

Historically, wetlands almost certainly occurred more extensively than they do currently. Throughout the region, wetlands have been drained to increase cropland acreages. Furthermore, the erosion of stream channels that often accompanies intensive agricultural land uses results in lower ground water tables and loss of riparian wetland areas.

DISCUSSION AND RECOMMENDATIONS

This watershed-wide, screening-level assessment provides a foundation for understanding current riparian conditions in the watershed relative to what occurred historically. Agriculture, forestry, and settlement patterns have altered riparian zone conditions throughout the Rock and Lonerock creeks watershed. These changes have resulted in reductions in stream shading and riparian recruitment of LWD. Riparian zones occurring in upper reaches of stream networks in primarily forested areas are currently being limited by small tree sizes or a lack of trees altogether. Existing information suggests that riparian areas in

Table 5.5. Wetland types (acres) within the Rock and Lonerock creeks watershed, Oregon.

Subwatershed	Freshwater Emergent Wetland	Freshwater Forested/Shrub Wetland	Freshwater Pond	Grand Total
French Charlie Canyon	1.5	6.3	1.6	9.4
Juniper Canyon	13.7	9.8	5.9	29.4
South Fork Rock Creek	4.8	6.7	1.1	12.7
Dry Creek-Rock Creek	10.6	0.0	1.7	12.3
Sixmile Canyon	26.1	13.6	0.5	40.3
Lonerock Creek	16.5	17.9	3.3	37.6
Rood Canyon	62.4	17.2	7.7	87.4
Juniper Creek	1,259.9	22.1	28.7	1,310.6
Middle Fork Rock Creek	43.8	21.8	3.1	68.7
Wild Call Canyon	23.0	22.0	2.0	46.9
Buckhorn Creek	26.1	32.9	3.4	62.3
Brown Creek	13.1	10.4	14.2	37.7
Chapin Creek	216.6	10.6	4.6	231.8
Grand Total	1,718.1	191.4	77.7	1,987.1

the middle and lower portions of the watershed (by virtue of the ecoregions within which these areas occur) were not historically stocked with high densities of larger trees. However, riparian vegetation, primarily in the form of shrubs such as small willows, was still abundant in many of these areas and provided many of the same functions as did larger trees. Such functions include increased stream bank stability, abatement of the effects of high flows, and partial stream shading. The lack of this riparian vegetation has contributed to degraded channel conditions in parts of the lower and middle watershed. Further stream channel degradation and losses of wetlands should be avoided to curtail additional loss of critical functions these areas provide within the watershed.

Protection and restoration of riparian zones within the watershed provides significant benefits to physical, chemical, and biological conditions. In recognition of these benefits, the Gilliam SWCD and the Gilliam-East John Day Watershed Council work with watershed landowners to improve riparian zone conditions. The single most important financial support mechanism for riparian zone enhancement in the region is the United States Department of Agriculture (USDA) Farm Service Agency's Conservation Reserve Enhancement Program (CREP). CREP is a voluntary land retirement program that assists agricultural producers with protecting riparian areas and other environmentally sensitive land and water resources. Under CREP, landowners receive financial compensation for removing riparian areas from agricultural production. These areas are often planted with small trees to promote recovery of these areas. Conservation Reserve Enhancement Program contracts typically last 10 years and can be renewed at the discretion of the landowner. In the Gilliam County portion of the Rock Creek watershed, nearly 750 riparian acres are currently retired from agricultural production under CREP (Table 5.6, Figure 5.6). Most of these acres occur along the mainstem of Rock Creek downstream of Six Mile Canyon (Figure 5.6, Figure 5.7). Riparian enhancement work was also observed in the Morrow County section of the watershed, such as along Davidson Canyon (Figure 5.8) during 2008 field surveys.

Table 5.6. Riparian agricultural land (acres) currently retired under the United States Department of Agriculture's Conservation Reserve Enhancement Program (CREP) within the Rock and Lonerock creeks watershed, Oregon.

Subwatershed	CREP acres	Percent
Sixmile Canyon	17	2.3
South Fork Rock Creek	83	11.3
Dry Creek-Rock Creek	96	13.1
Lonerock Creek	116	15.8
Juniper Canyon	185	25.3
French Charlie Canyon	234	32.0
Grand Total	732	100.0

As the benefits of riparian area restoration to land and water resources cannot be overstated, landowners should continue to be encouraged to create riparian buffers that aid in the establishment of vegetation appropriate to the ecoregion. Once set aside under CREP, additional measures can be used to enhance re-establishment of trees, shrubs, and other vegetation. Riparian fencing can effectively control livestock access to riparian areas and allow vegetation to regenerate, while tree and shrub planting will further expedite and enhance recovery. Healthy, well functioning riparian zones benefit both natural resources and the landowner by reducing or preventing erosion of productive valley bottomlands. Re-establishment and protection of these areas is vital to the long-term viability of both the Rock and Lonerock creeks watershed and the agricultural land uses it supports.

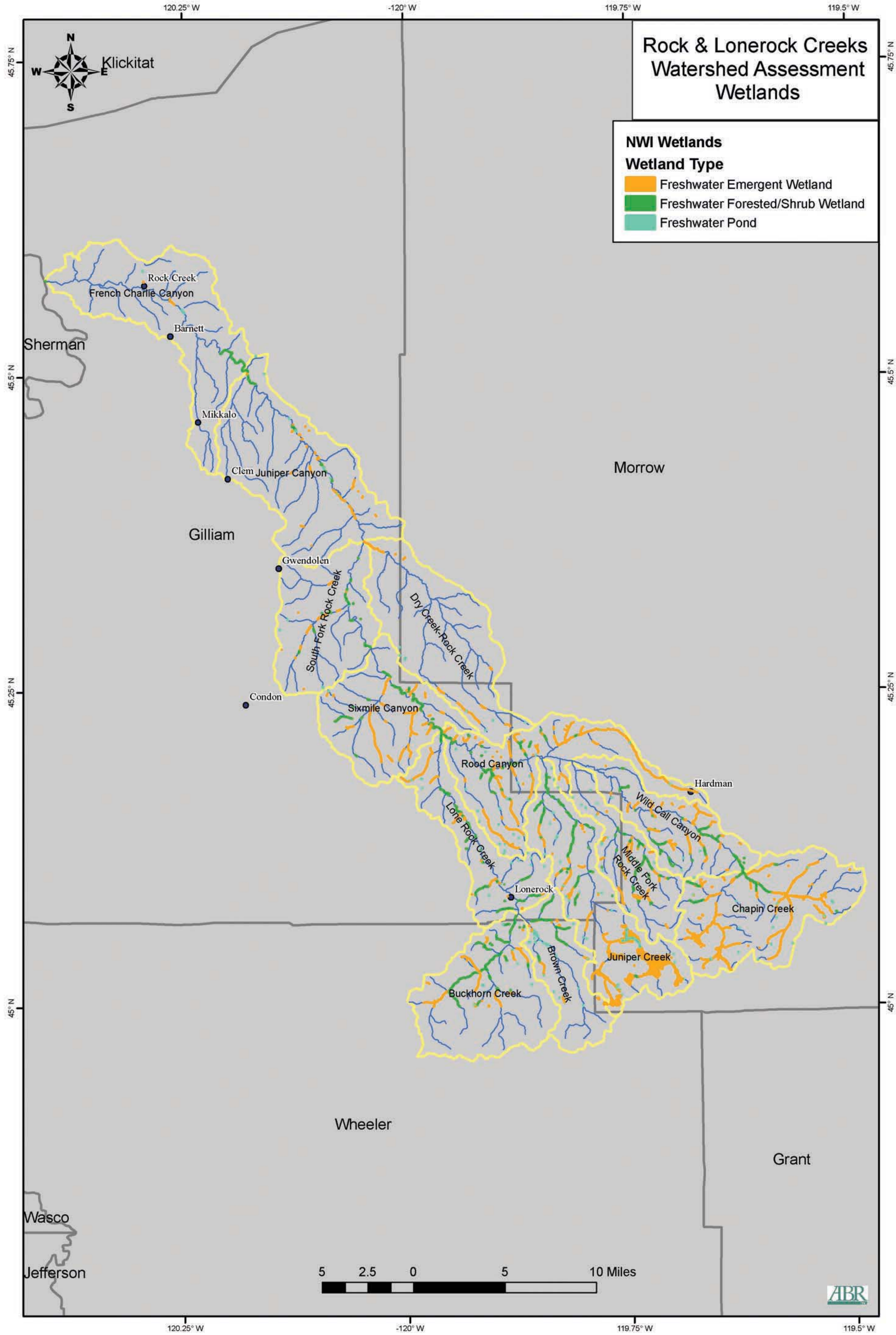

Figure 5.5. Wetland types within the Rock Creek and Lonerock Creek watershed, Oregon.

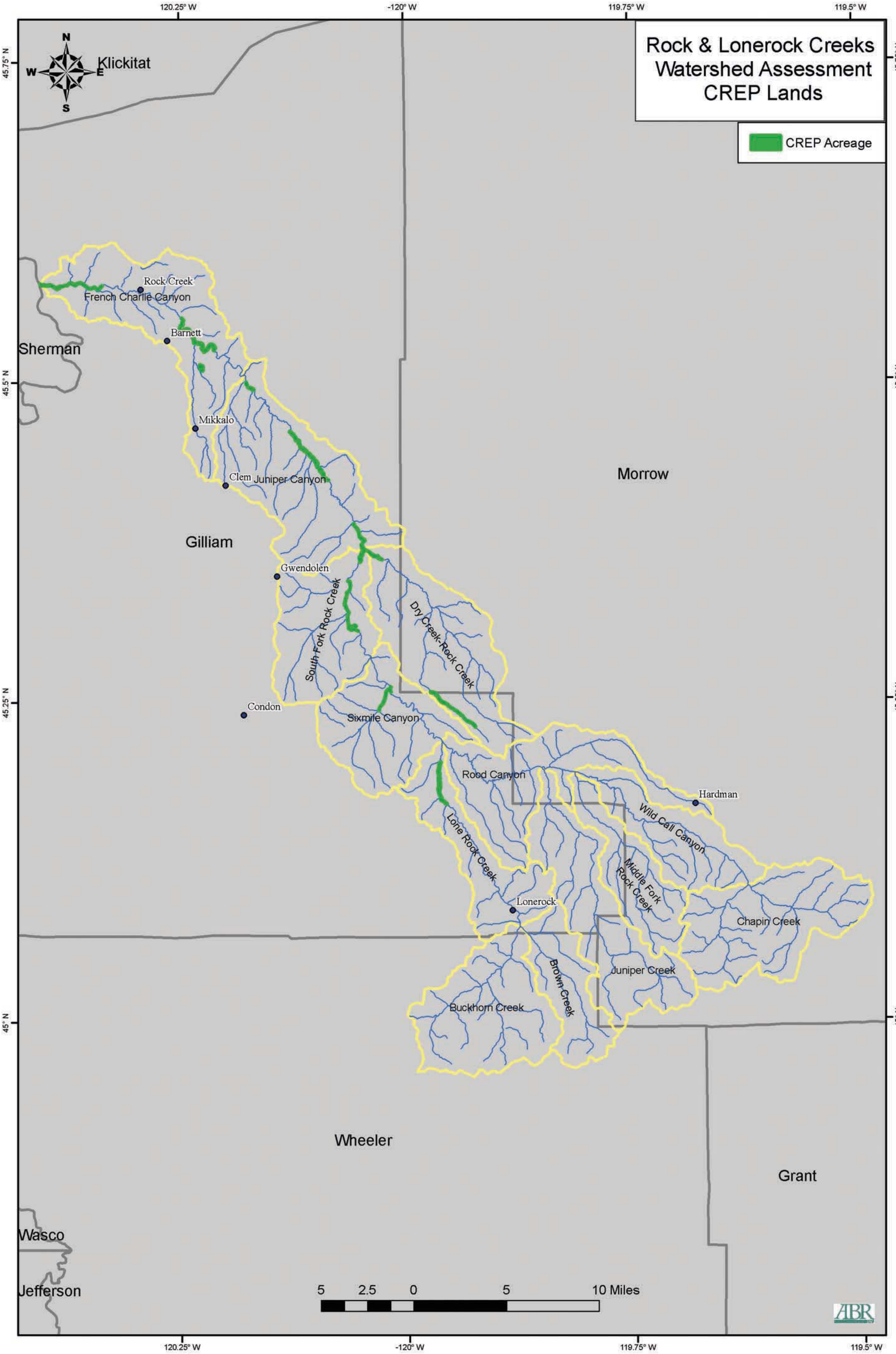

Figure 5.6. Riparian agricultural land currently retired under the USDA Conservation Reserve Enhancement Program (CREP) within the Rock Creek and Lonerock Creek watershed, Oregon.

Figure 5.7. Riparian zone restoration occurring on lower Rock Creek, Gilliam County, Oregon. The riparian area shown in the photograph was recently voluntarily placed into the USDA's CREP program by the landowner, and tree seedlings have been planted to promote recovery of riparian vegetation.

Figure 5.8. Riparian zone restoration occurring in Davidson Canyon in the upper portion of the Rock Creek watershed in Morrow County, Oregon. Tree seedlings have been planted throughout the area in the photograph. Also note the fencing on each site of the riparian area that effectively excludes cattle and has promoted regeneration of lush grasses and other herbaceous vegetation.

CHAPTER 6: HYDROLOGY AND WATER USE

INTRODUCTION

Hydrology is the study of the movement, distribution, and quantity of water throughout a drainage system. In the context of the Rock and Lonerock creeks watershed assessment, this hydrological assessment is a preliminary attempt to characterize and quantify the climatological, geological, and human factors that influence the flow of water from the headwaters to the mouth of Rock Creek at the John Day River. Understanding how the use of land and water can alter natural hydrologic processes requires an understanding of how water moves through a watershed. The hydrologic cycle describes the cyclical movement of water from the atmosphere, through the watershed, and back again by way of condensation, precipitation, infiltration, evaporation, evapotranspiration and runoff. In the atmosphere, water vapor condenses to form clouds, which in turn produce precipitation in the form of rain, sleet, snow, or hail. Precipitation, upon reaching the land surface, can infiltrate the soil, evaporate, or enter waterbodies as surface runoff. The amount of water that infiltrates the soil is related to topography, vegetation type, soil type, the rate of precipitation and the degree to which the soil is already saturated. Surface runoff primarily occurs when soils are saturated, covered by impervious surfaces, or when rates of precipitation exceed the rates of infiltration. Water is returned to the atmosphere through the evaporation of surface water and evapotranspiration through vegetation. Evapotranspiration is a combination of the evaporation and transpiration processes, whereby vegetation draws water in through roots and releases excess water from leaves.

Human activities, including forestry practices, agriculture, grazing, irrigation, urban development and road building can significantly alter these hydrologic processes. Effects of these activities on watershed hydrology can include changes in the timing and quantity of streams flows, resulting in increased peak flows, reduced ground water recharge, and altered timing and quantities of water yields. Changes in water quantity can consequently alter water quality, physical conditions, and aquatic communities. One of the most noticeable changes accompanying increases in peak streamflows are physical changes to the stream channel in response to having to convey larger quantities of water; such changes include erosion of the banks and streambed. Streambed erosion is called channel degradation because the elevation of the stream channel decreases. The degree of hydrologic alteration is largely affected by the location, extent, and type of land use activity.

The purpose of this component of the assessment is to evaluate the potential impacts of land and water-use practices on the hydrology of the Rock and Lonerock creeks watershed. The Watershed Assessment Manual includes screening-level assessments of each of the major land-use types occurring in the Rock and Lonerock creeks watershed to determine which land-use types are potentially altering hydrologic processes. An in-depth analysis beyond the scope of this project would be necessary to determine which specific activities were responsible for any hydrologic changes that have occurred.

HYDROLOGIC CHARACTERIZATION

GENERAL WATERSHED CHARACTERISTICS

Chapter 2 (Watershed Overview) provided a detailed overview of the location, setting, and ecoregions of the Rock and Lonerock creeks watershed. Elevation within the watershed ranges from 403 to 5 364 feet, with a significant percentage of some of the higher subwatersheds occurring above the "Rain-on-Snow" risk areas of greater than 3000 feet (Table 6.1). Mean annual precipitation generally increases with altitude, ranging from 10 inches per year near the mouth to 18.7 inches in the higher locations (HRCDF 2001; Figure 6.1).

CLIMATE

Oregon is divided by the National Climate Data Center into nine climate zones based on similar climatic conditions, including temperature and precipitation (Taylor and Hannan 1999). The Rock and Lonerock creeks watershed occurs wholly within Zone 6, the North Central Oregon climatic zone. The region is characterized by cool,

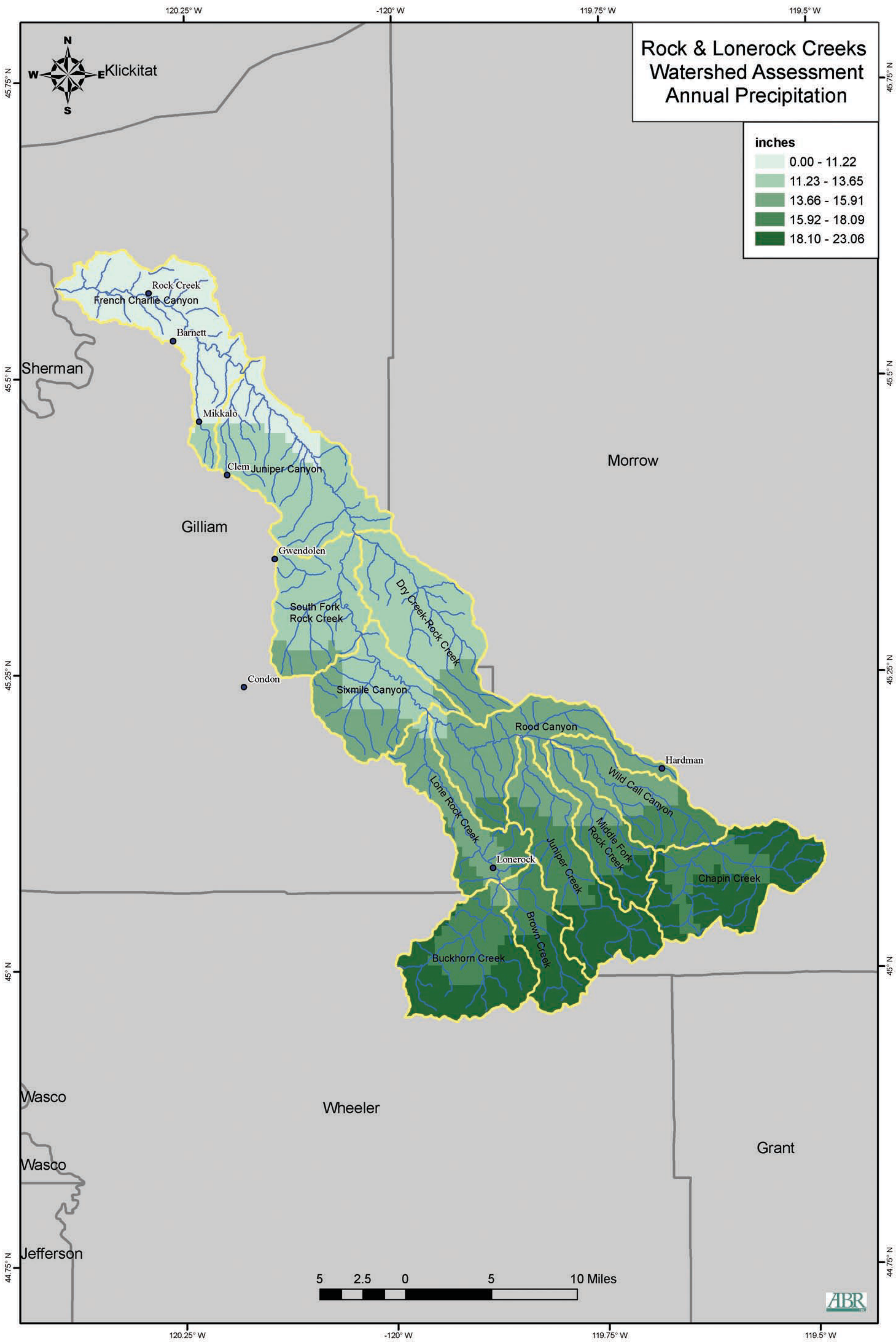

Figure 6.1. Annual precipitation occurring in the Rock and Lonerock creeks watershed, Oregon. (Source: PRISM Group, Oregon State University, http://www.prismclimate.org, created 4 Feb 2004).

Table 6.1. General characteristics of the Rock and Lonerock creeks watershed, Oregon, relevant to determining risk of increasing peak flows as a result of agricultural and forestry land uses.

Subwatershed	Area (Acres)	Elevation (feet) Mean	Min	Max	Average Annual Precipitation (inches)	Subwatershed Acres in Elevation Zone >3,000 feet	Percent of Area in Elevation Zone >3,000 feet
French Charlie Canyon	32,994	1,104	403	1,949	10.0	0	0.0
Juniper Canyon	35,867	1,794	941	2,587	11.7	0	0.0
South Fork Rock Creek	23,199	2,290	1,372	3,028	12.9	0	0.0
Dry Creek-Rock Creek	30,129	2,341	1,483	3,212	12.9	0	0.0
Sixmile Canyon	23,033	2,567	1,634	3,428	13.7	0	0.0
Lonerock Creek	17,783	3,163	1,942	4,316	15.4	3,977	22.4
Rood Canyon	26,576	3,066	1,982	3,970	14.8	5,913	22.3
Juniper Creek	28,722	3,905	2,700	4,695	17.5	25,522	88.9
Middle Fork Rock Creek	15,337	3,768	2,677	4,485	16.8	12,776	83.3
Wild Call Canyon	17,791	3,563	2,437	4,334	15.9	15,381	86.5
Buckhorn Creek	26,999	4,157	2,926	5,167	18.2	25,569	94.7
Brown Creek	14,260	4,169	2,925	4,820	18.3	13,060	91.6
Chapin Creek	29,607	4,093	3,406	5,364	18.7	29,607	100.0

wet winters and warm, dry summers, with mild temperatures predominating throughout the year. Temperatures range with elevation, with higher areas cooler in the winter and the summer months. Winter and summer temperatures in the North Central zone are moderated by the Columbia River Gorge. Precipitation primarily occurs as winter rainfall, and the amount of precipitation increases with elevation (OCS 2005).

DISCHARGE AND PEAK FLOW CHARACTERIZATION

Historically, there have been ten United States Geological Survey (USGS) stream gages which recorded data for varying amounts of time (Table 6.2, Figure 6.2). Some of the gages had a very short service life; only 4 gages (14047380, 14047390, 14047400, and 14047460) were in service for longer than 10 years.

Most of the watershed's peak-flow regime is dominated by late winter/early spring rainfall events (Figures 6.3 and 6.4). Some of the higher elevations lean towards spring snowmelt or occasional rain on snow events; however, there has been little investigation into or snow data collected on this phenomenon, so it is unclear on how much these events contribute to the observed regime.

Based on limited data, monthly mean discharge in Rock Creek and Lonerock Creek is highest in March (216 cubic feet per second [cfs] and 75 cfs in Rock Creek and Lonerock Creek respectively). As summer progresses, flows recede, often reaching their lowest in August (Monthly mean discharge: Rock Creek—2.1 cfs; Lonerock Creek—0.13 cfs). Extreme summer low flows appear to recur in some portions of upper Rock Creek, as were noted during this assessment and in earlier reports (Gilliam County SWCD et al. 1975). As Figure 6.2 indicates, a gage station has never

Table 6.2 Summary of stream gage locations and periods of record within the Rock and Lonerock creeks watershed, Oregon.

	Period of Record			
Gage	Start	End	Latitude	Longitude
14047380	1966	2006	45.0897220	-119.883889
14047390	1975	1989	45.263611	-120.019167
14047400	1965	1981	45.336389	-120.062500
14047420	1925	1926	45.367778	-120.046944
14047455	1965	1965	45.388611	-120.056667
14047460	1965	1976	45.500000	-120.176111
14047480	1965	1965	45.531944	-120.230556
14047490	1975	1976	45.557222	-120.256111
14047500	1965	1975	45.571944	-120.298333
14047800	1925	1926	45.574722	-120.380278

occurred in the upper reaches of Rock Creek above the confluence with Lonerock Creek, where summer flows appear to be lowest. Throughout the watershed, discharge increases substantially with the onset of the rainy season in October and November and is generally higher through April. Maximum peak discharge events on record in Rock Creek include 3,360 cfs on 5 May 1983 and 2,400 cfs on 23 February 1986 (period of record 1976–1989, USGS).

HYDROLOGIC ASSESSMENT

LAND USES

The Rock and Lonerock creeks watershed primarily supports land uses for production of livestock and livestock feed, agriculture including dryland cereal crop production on plateaus and irrigated crops on the valley bottoms, and areas within the upper watershed that support forestry (Table 6.3). The rural community of Lonerock (population of 20 as of 2006; Center for Population Research and Census, Portland State University) in the upper watershed represents the only concentrated settlement within the assessment area; there are no larger urban areas occurring within the watershed. For this assessment, we used OWEB screening-level assessment tools to assess the potential for the dominant land uses in the watershed to modify the hydrologic regime of the watershed. While these assessments focus on the risk of each land-use type at increasing peak flows (which create problems with stream incision, streambank erosion, sedimentation, and potential loss of productive agricultural lands, to name a few), these assessments also indirectly address the potential for these land uses to exacerbate low flows because when more water is released during rain events (increased peak flows), less water is captured and held for later discharge into the receiving surface waters as groundwater (decreased low flows).

POTENTIAL AGRICULTURAL & RANGELAND IMPACTS

The dominant land uses in the watershed consist of hay and grain farming and livestock grazing on pasture and rangelands. Grain farming consists of a range of production practices in the watershed, from a traditional clean tillage system (almost nonexistent in the county today), leaving bare ground from spring plowing until fall planting, to no-till systems that do not disturb the soil and maintain a layer of residue from previous harvests on the land, protecting it from wind and water erosion (Walter Powell, personal communication.). No-till systems are more management intensive, often requiring special equipment and more attention to detail on the part of the land manager to get ahead of any weed and pest problems that arise. Further, research has shown that no-till systems can often result in a lower crop yield (Juergens et al 2004). However, recent increases in fuel prices, coupled with volatile but increasing grain-commodity prices, render no-till practices more economically viable, as well as an effective means for soil conservation over the long term. Hydrologically, traditional clean tillage agriculture is the most influential practice to the flow regime of the watershed. Between bare exposed soil not being stabilized during rain and runoff events, along with the increased likelihood of suspended sediments running into waterways, the biggest impact on water flows can be ameliorated by practices such as no-till and minimum till (McCool et al. 2001).

Cattle ranching in the Rock and Lonerock creeks watershed is dominated by cow-calf production, where mother cows are bred yearly and

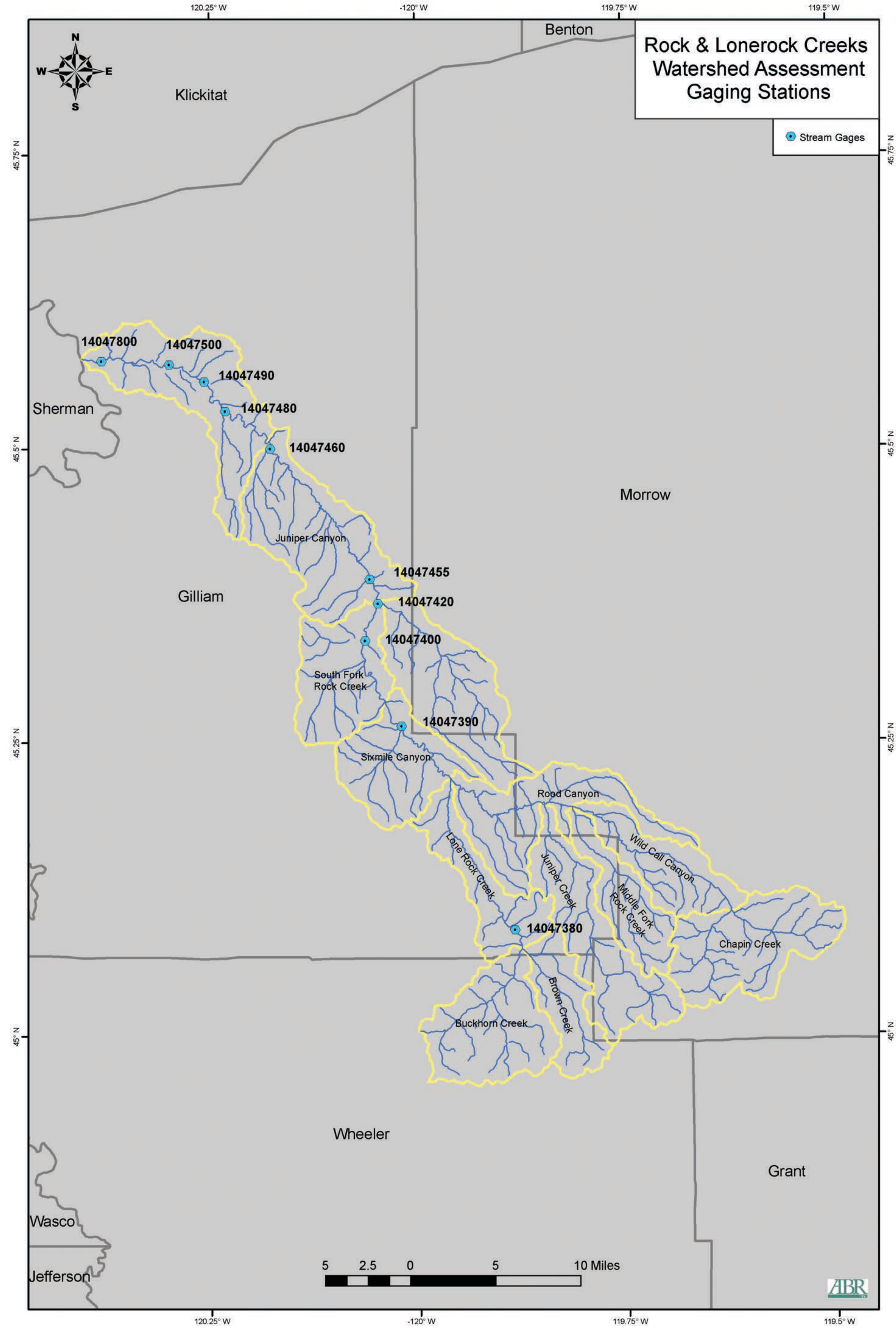

Figure 6.2. Locations of gage stations historically used to monitor streamflows in the Rock & Lonerock creeks watershed. No gage stations are currently in operation as of winter 2009 (gage locations data source: Oregon Water Resources Department).

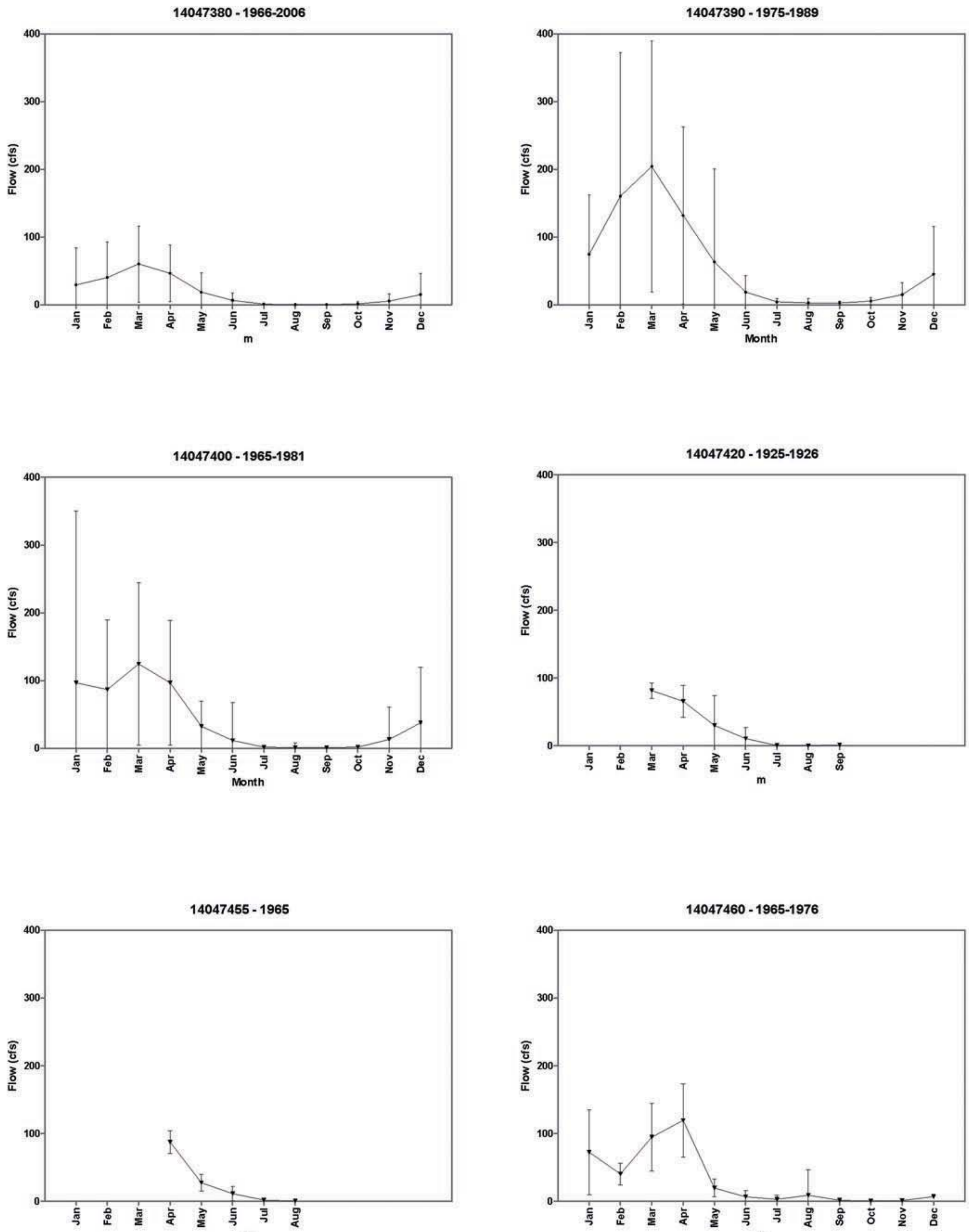

Figure 6.3. Average monthly flows of Lonerock Creek (upper left figure) and Rock Creek gage stations (remaining five figures) for periods of record indicated at top of each graph. Source of raw discharge data: Oregon Water Resources Department.

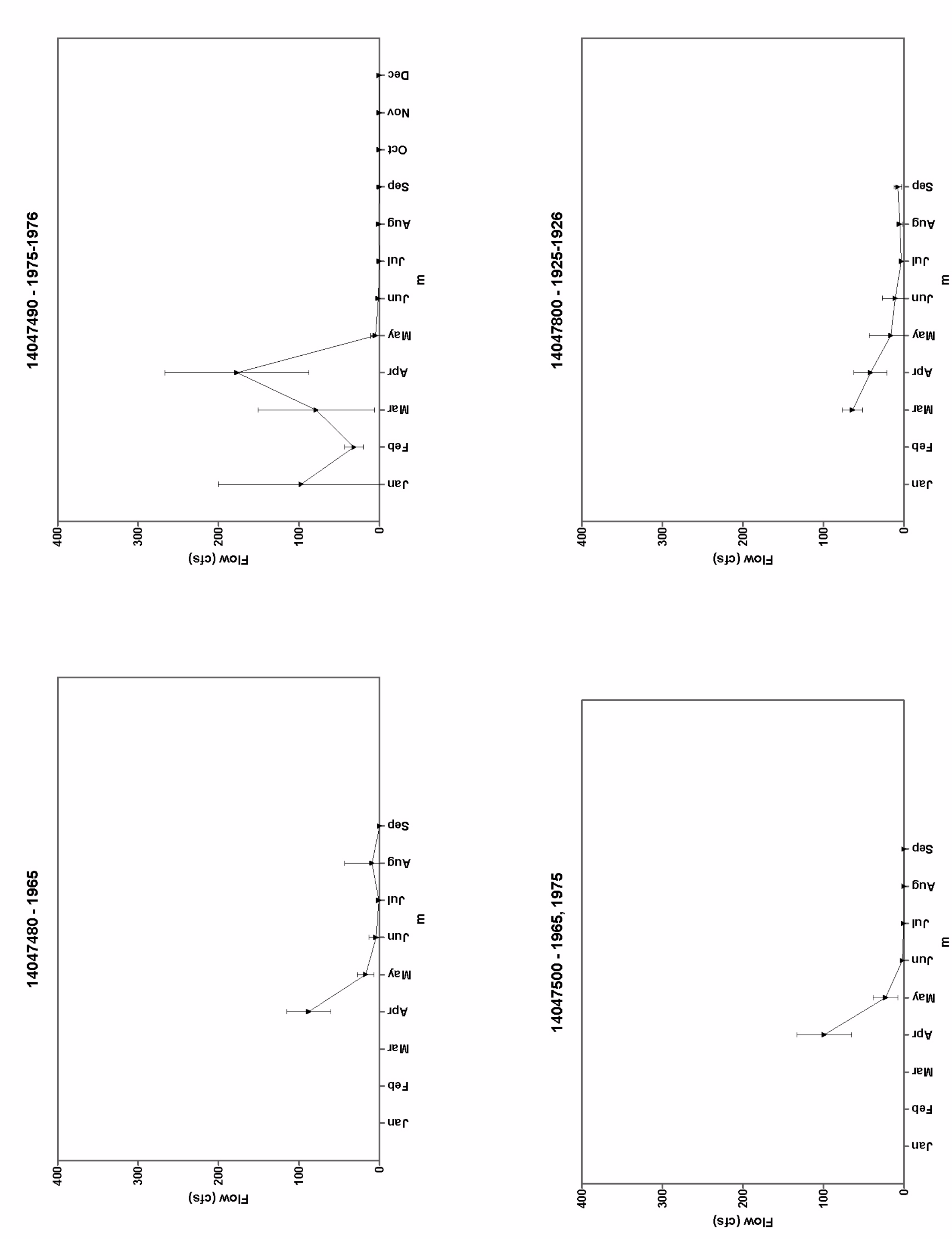

Figure 6.4. Average monthly flows of Rock Creek gage stations for periods of record indicated at top of each graph. Source of raw discharge data: Oregon Water Resources Department.

Table 6.3. Summary of land use in the Rock and Lonerock creeks watershed, Oregon (data provided by Gilliam SWCD).

		Forestry		Cropland		Range		Agriculture details[1]	
	Acres	Acres	%	Acres	%	Acres	%	CRP	Irrigated
French Charlie Canyon	32,994	0	0.0	17,623	53.4	15,371	46.6	1,538	1,010
Juniper Canyon	35,867	0	0.0	14,598	40.7	21,270	59.3	3,123	563
South Fork Rock Creek	23,199	0	0.0	5,416	23.3	17,784	76.7	1,425	61
Dry Creek-Rock Creek	30,129	0	0.0	6,054	20.1	24,075	79.9	2,851	12
Sixmile Canyon	23,033	0	0.0	5,197	22.6	17,837	77.4	1,707	0
Lonerock Creek	17,783	1,103	6.2	587	3.3	16,093	90.5	1	234
Rood Canyon	26,576	0	0.0	4,607	17.3	21,969	82.7	16	0
Juniper Creek	28,722	13,078	45.5	170	0.6	15,475	53.9	0	0
Mid. Fork Rock Creek	15,337	6,127	40.0	0	0.0	9,210	60.1	0	0
Wild Call Canyon	17,791	3,012	16.9	1,361	7.7	13,418	75.4	0	0
Buckhorn Creek	26,999	25,189	93.3	73	0.3	1,737	6.4	0	73
Brown Creek	14,260	9,664	67.8	220	1.5	4,376	30.7	0	2
Chapin Creek	29,607	29,557	99.8	50	0.2	0	0.0	0	0

[1]No data on CRP or irrigation were provided from Morrow or Wheeler counties.

the calves raised, weaned, and sold. Hay is often an ancillary enterprise to these operations, harvested in the bottomlands (whether irrigated or not) for feeding out through the winter. Uplands represent a greater proportion of the acreage of the watershed and are where a majority of the active grazing takes place. These areas are dominated by shrub-steppe vegetation including big sagebrush, deep-rooted perennial grasses (e.g., bluebunch wheatgrass, Idaho fescue and basin wildrye), and forbs.

Unlike tilled cropland, healthy rangelands and well managed pastures contribute to well functioning hydrologic processes—the capture, storage and safe release of the precipitation they receive. When degraded by poorly managed livestock grazing, by the removal of naturally occurring periodic fire and the subsequent increases of shrubs and encroachment of western juniper, these lands no longer contribute to proper hydrologic function. In extreme, yet common situations, as seen with the juniper encroachment in the Rock Creek and Lonerock watersheds, significant amounts of precipitation are intercepted by the trees and never reach the soil surface. Juniper's capacity to transpire soil moisture year-round allows it to successfully out-compete the native shrubs, grasses, and forbs for water, sunlight, nutrients and space. Soils exposed by the loss of vegetation in the tree interspaces are often subjected to the force of raindrop impact, resulting in high amounts of overland flow and severe erosion. Rather than being stored in the soil profile for spring and summer plant growth and to support long-term spring and stream flow, rain and snowmelt concentrate in the nearest adjacent drainage and leave the watershed. These surges of runoff in winter and spring are capable of down-cutting stream channels and eroding streambank, resulting in severe sedimentation, the desiccation of valley bottoms, abandoned floodplains and, most seriously, the high flow/no flow water regimes common to the region.

A GIS analysis integrating soils, rainfall (both average annual and 2-year, 24-hour precipitation), and land-use data was used to quantify the effects of existing land uses in the watershed upon the hydrologic regime. This is a screening-level analysis that uses low-resolution land-use data (i.e., not site-specific information) to provide a classification of subwatersheds most at risk for increased peak flows within the watershed. Soil data obtained from Natural Resources

Conservation Service (NRCS) and Gilliam SWCD were attributed with subwatershed data and filtered by Hydrologic Soil Group (HSG). Gilliam and Morrow county soils data were obtained from the Soil Survey Geographic Database (SSURGO; Gilliam and Morrow counties, 2006), while draft Wheeler soils data were obtained from the Gilliam SWCD (Roger Lathrop, Gilliam SWCD, 2008). Hydrologic Soil Group classifications quantify the relative rate of infiltration of a soil type, with "Group A" having the fastest infiltration/least runoff and "Group D" having the slowest infiltration/most runoff. In the case of the area of the watershed in Wheeler county, which does not yet have a finalized soil data layer, preliminary, but incomplete HSGs provided by Gilliam SWCD were digitized for this analysis. Thus, analysis from Wheeler County (namely Brown and Buckhorn creeks) should carry less weight until a soils analysis is complete.

Runoff curves were used with HSG, 2-year, 24-hour precipitation, and land-use data to determine the average change in hydrologic conditions above background conditions for each subwatershed. In the absence of extensive ground truthing, the developed land-use hydrologic condition was set at "fair," so as to be in keeping with the screening-level scale of this exercise. Background conditions (assumed to represent pre-settlement conditions), were set at "good" for the native species complement for the area.

Results of this hydrologic assessment of land use on increasing peak flows indicate that most of the watershed is at low risk of peak flow enhancement from land-use activities (given "fair" condition crop and pasture/rangeland). Only three subwatersheds present a moderate risk of peak flow enhancement due to land use; these included Rood Canyon, Lonerock Creek and Wild Call Canyon (Table 6.4). If there are localized areas of land use that would qualify as less than "fair," the risk of peak flow enhancement will rise accordingly.

These results appear to be driven by elevation through the tendency for precipitation to increase with increasing elevation. While less cropland and more rangeland occurs in the higher country, higher rainfall in these areas increases the likelihood of amplified runoff events. It is also worth noting that Rood Canyon, Lonerock Creek, and Wild Call Canyon are the highest elevation, historically non-forested (or minimally forested) subwatersheds in the assessment. Forested areas have a much lower runoff potential owing to the ability of forest vegetation to retain and store rainwater.

Juniper encroachment into open range is another aspect of rangeland management that must be considered when evaluating the potential effect of this land use on watershed hydrology. While Chapter 7 (Uplands) discusses the juniper expansion issue within the watershed in greater detail, it should be noted in this section that juniper expansion, estimated to have occurred on nearly 31,000 acres within the watershed over the last century, is potentially affecting the hydrology of the watershed by decreasing the amount of water captured, stored, and later released into Rock Creek and its tributaries during low-flow periods. Scientific study of the effects of juniper removal from across the arid west have conclusively demonstrated that increases in juniper abundance can lead to decreased stream flows (see Chapter 7 for more details).

POTENTIAL FOREST AND RURAL ROAD IMPACTS

For this screening-level assessment, road layers were compiled from Gilliam (all recorded public and private roads), Morrow (from the University of Oregon map library), and Wheeler (archive from Oregon Geospatial Enterprise Office, 2004; not currently available) counties and buffered with a 15' buffer in ArcGIS (30' total width) and broken out by subwatershed. The acreage of the buffered roads was compared to corresponding individual subwatershed acreages. A percent roaded value of greater than 8% indicates a high risk of peak flow enhancement, 4–8% a moderate risk, and less than 4% a low risk. All of the subwatersheds in the Rock and Lonerock creeks watershed are sparsely roaded and were assigned a 'low' risk of peak flow enhancement due to road runoff (Table 6.5). Under certain conditions, forest and rural road development has been recorded as influencing peak flows in watersheds (Harr et al. 1975, Bowling and Lettenmaier 1997). However, these studies were performed west of the Cascade Mountains, and thus may have limited relevancy to this location.

Table 6.4 Peak flow enhancement risk due to varying land use patterns in the Rock and Lonerock creeks watershed, Oregon. Hydrologic Soil Groups (HSG) were obtained from the NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/), while Wheeler County preliminary, incomplete soil data were digitized from data provided by Gilliam SWCD.

	Agriculture														Forestry			
Subwatershed Name	First HSG	Percent in 1st HSG	2y24h (inches)	Average change from the background (inches)	2nd HSG	Percent in 2nd HSG	2y24h (inches)	Average change from the background (inches)	3rd HSG	Percent in 3nd HSG	Average change from the background (inches)	2y24h (inches)	Weighted agriculture average runoff increase (in)	Forestry (%)	Forestry change from background (inches)	Total weighted increase in runoff (inches)	Peak flow enhancement risk
French Charlie Canyon	B	68.0	1.02	0.02	C	21.0	1.01	0.08	D	9.7	0.17	1.02	0.04	0.0		0.04	Low
Juniper Canyon	C	34.7	1.17	0.15	B	34.3	1.16	0.05	D	30.9	0.27	1.18	0.15	0.0		0.15	Low
South Fork Rock Creek	C	45.4	1.21	0.15	D	45.0	1.21	0.27	B	8.3	0.05	1.22	0.19	0.0		0.19	Low
Dry Creek-Rock Creek	C	71.4	1.22	0.15	D	24.1	1.22	0.27	B	4.5	0.05	1.20	0.17	0.0		0.17	Low
Sixmile Canyon	D	46.7	1.25	0.27	C	45.5	1.25	0.15	B	5.9	0.05	1.24	0.20	0.0		0.20	Low
Lonerock Creek	C	51.9	1.36	0.24	D	41.6	1.33	0.39	B	5.9	0.09	1.39	0.29	6.2		0.27	**Medium**
Rood Canyon	C	52.5	1.29	0.20	D	47.0	1.30	0.33					0.26	0.0		0.26	**Medium**
Juniper Creek	C	61.4	1.37	0.15	D	34.9	1.36	0.27					0.19	45.5	0.04	0.12	Low
Middle Fork Rock Creek	C	62.0	1.37	0.32	D	38.0	1.36	0.39					0.35	40.0	0.04	0.22	Low
Wild Call Canyon	C	61.6	1.36	0.24	D	37.69	1.35	0.39					0.29	16.3	0.04	0.25	**Medium**
Buckhorn Creek	C	53.4	1.39	0.24	D	46.2	1.40	0.39					0.31	93.3	0.04	0.06	Low
Brown Creek	C	77.6	1.40	0.24	D	17.2	1.40	0.39	B	5.2	0.15	1.40	0.26	67.8	0.04	0.11	Low
Chapin Creek	C	85.1	1.42	0.24	D	9.2	1.40	0.390	B	5.7	0.15	1.49	0.25	99.8	0.04	0.04	Low

Table 6.5. Percent of road coverage within the Rock and Lonerock creeks watershed, Oregon, by subwatershed. (Note: to generate roaded area using ArcGIS, roads were uniformly buffered to 30' wide.)

Subwatershed	Roaded Acres	Total Acres	Percent roaded	Risk of Peak flow enhancement[1]
French Charlie Canyon	235	32,994	0.71	Low
Juniper Canyon	296	35,867	0.83	Low
South Fork Rock Creek	168	23,199	0.72	Low
Dry Creek-Rock Creek	235	30,129	0.78	Low
Sixmile Canyon	151	23,033	0.65	Low
Lonerock Creek	164	17,783	0.92	Low
Rood Canyon	234	26,576	0.88	Low
Juniper Creek	323	28,722	1.13	Low
Middle Fork Rock Creek	196	15,337	1.28	Low
Wild Call Canyon	134	17,791	0.75	Low
Buckhorn Creek	335	26,999	1.24	Low
Brown Creek	153	14,260	1.07	Low
Chapin Creek	579	29,607	1.95	Low

[1] Risk of peak flow enhancement is high at percent roaded >8%, moderate 4–8%, and low <4%

POTENTIAL FORESTRY IMPACTS

Timber harvesting and associated road building can alter hydrologic conditions by affecting runoff, evapotranspiration, and infiltration rates. These alterations can lead to changes in peak flows and low flows, as well as surface and ground water yield within a watershed (WPN 1999). Forestry impacts are evaluated by first determining what peak-flow-generating processes occur in each subwatershed (WPN 1999). Areas within which rain-on-snow events are the primary peak-flow generating process are most at risk of significant changes to hydrology. Rain-on-snow events occur when snowpacks are melted by warm rains, which result in peak-flow events created by both melting snow and rainfall. Rain-on-snow events usually occur within an elevation zone in which transient snowpacks occur. If more than 75 percent of any subwatershed occurs in the rain-on-snow peak-flow-generating class, the analysis is continued to examine the potential effects of current forest conditions on watershed hydrology. In central Oregon, rain-on-snow events are the primary peak-flow generating process at elevations greater than 3600 feet. Historically, elevations greater than 3600 feet in the upper watershed may have supported forested communities with canopy crown closures exceeding 30 percent. The forested portion of the upper watershed, comprising nearly 88,000 acres, occurs primarily within the John Day/Clarno Highlands Ecoregion, which is known to have historically supported forests of highly variable characteristics (WPN 2001). We examined recent aerial photographs of this 88,000-acre area to estimate current crown closure relative to the less than 30 percent threshold level for inferring potential risk of peak-flow enhancement. Current crown closures great than 30 percent throughout most of the forested portion of the upper watershed; therefore, using the OWEB guidelines, current forest conditions pose only a low risk of increasing peak flows in the watershed. Observations made by ODF lend support to these results, as ODF staff report a healthy increase in crown closure in this area (Mitch Mund, ODF, personal communication, February 2009).

WATER USE CHARACTERIZATION

WATER RIGHTS

The Oregon Water Code, enacted on February 24, 1909, governs the use of the State's waters. This water code established four general principles to govern water use (Bastasch 1998):

- Water belongs to the public.
- Any right to use it is assigned by the State through a permitting system.

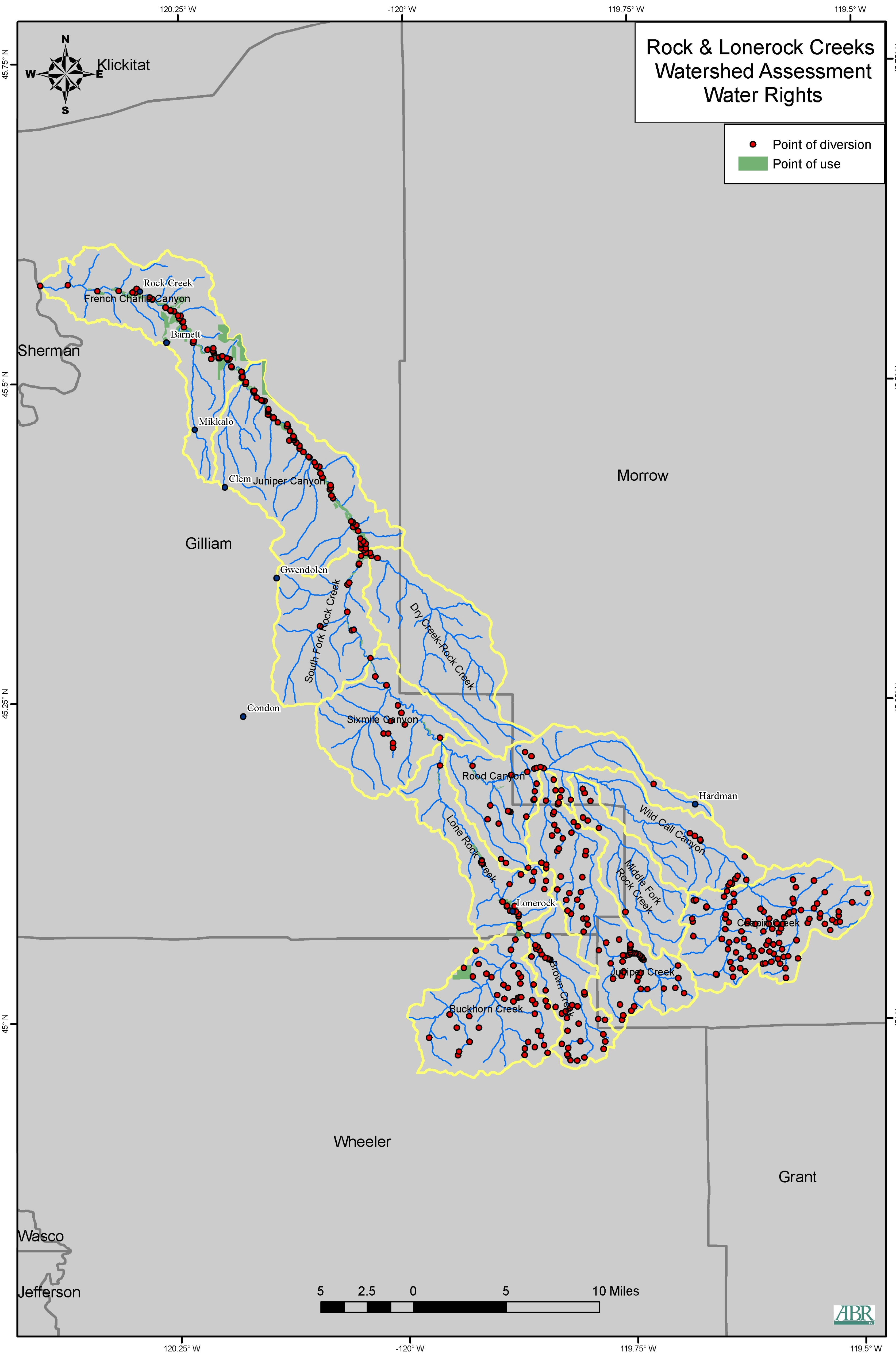

Figure 6.5. Points of surface water diversion and use on file with the Oregon Water Resources Department for the Rock and Lonerock creeks watershed, Oregon. .

- Water use under that permit system follows the "prior appropriation doctrine," i.e., older water uses get priority over newer water uses.
- Permits may be issued only for beneficial use without waste.

The Oregon Water Resources Department (OWRD) is responsible for executing the State's laws on water supply and use established in this code. To obtain a water right, an application must be submitted to this agency. The OWRD evaluates the request and, if appropriate, grants a provisional permit for water use to the applicant. When the State confirms water use is in accordance with the permit, a fully certified water right certificate will be granted to the applicant. Water use is appropriated at a certain rate of withdrawal, and is usually measured in cubic feet per second (cfs). Additionally, restrictions on the total amount of water withdrawn, and the months for which the water right is valid, are established.

Instream water rights are filed by Oregon Department of Fish and Wildlife (ODFW), Department of Environmental Quality (DEQ) or Oregon State Parks Department and held in trust for the people of Oregon by the OWRD for instream "public uses" such as recreation, navigation, pollution abatement or conservation. Instream water rights may also be held on a permanent or temporary basis by Water Right owners when participating in CREP or through incentive programs through groups such as the Oregon Water Trust. Unlike irrigation or other "consumptive-use" water rights, these water rights seek to ensure that a certain amount of flow is maintained in the stream. Like "consumptive-use" water rights, they are subject to regulation by priority date under the prior appropriation doctrine. Instream water rights have recently been applied for through OWRD for the Rock Creek and Lonerock Creek Water Availability Basin (WAB #70251). A water availability basin (WAB) is a watershed area for which water availability is estimated at the downstream end, or pour point, of that area.

CONSUMPTIVE WATER USE

Consumptive water uses, or uses which draw water out of the stream, are summarized and reported by the OWRD through the Water Availability Reporting System (WARS). Figure 6.5 depicts all points of use and diversion in the watershed on record with the OWRD. Importantly, many of these uses and diversions may not currently be active. Irrigation, municipal, domestic, agricultural, and storage uses were reported by this system for the Rock and Lonerock creeks watershed. Average ("50% exceedance") natural streamflow at the lower end of Rock Creek ranges from a low of 2.24 cfs in September to 123.0 cfs in March (Figure 6.6, Table 6.6). Monthly consumptive uses ranged from 0.0 cfs in December to 20.7 cfs in May. Consumptive use as a percent of the natural streamflow (at the 50% exceedance level; i.e., the flow at which half of the monthly flows exceed this value, or the median flow) is highest in the months of June through August (Figure 6.6, Table 6.6). When this use is greater than 10% of the streamflow, which can occur May through October in Rock Creek (Table 6.6), the greatest opportunity for flow restoration through conservation measures exists (WPN 1999). Using this criterion, flow restoration opportunities are greatest in the Rock Creek and Lonerock Creek WAB when consumptive uses and storage range from 17.2 to 151.2% at the 50% exceedance level during the months of May through October.

WATER USE ASSESSMENT

WATER AVAILABILITY

Water availability is the amount of water that can be appropriated from a given point on a given stream for new out-of-stream consumptive uses. It is obtained from the natural stream flow by subtracting existing instream water rights and out-of-stream consumptive uses (OWRD 2002). The Rock and Lonerock creeks watershed encompasses WAB #70251. Water availability basins are designated by the OWRD for water availability modeling purposes. Water availability is calculated for each WAB by the OWRD by subtracting the estimated consumptive use of existing water rights and instream water rights from the natural streamflow. These calculations are made for both 50% and 80% exceedance flow levels. The 50% exceedance flow is the flow at which half of the annual flows exceed this value, or

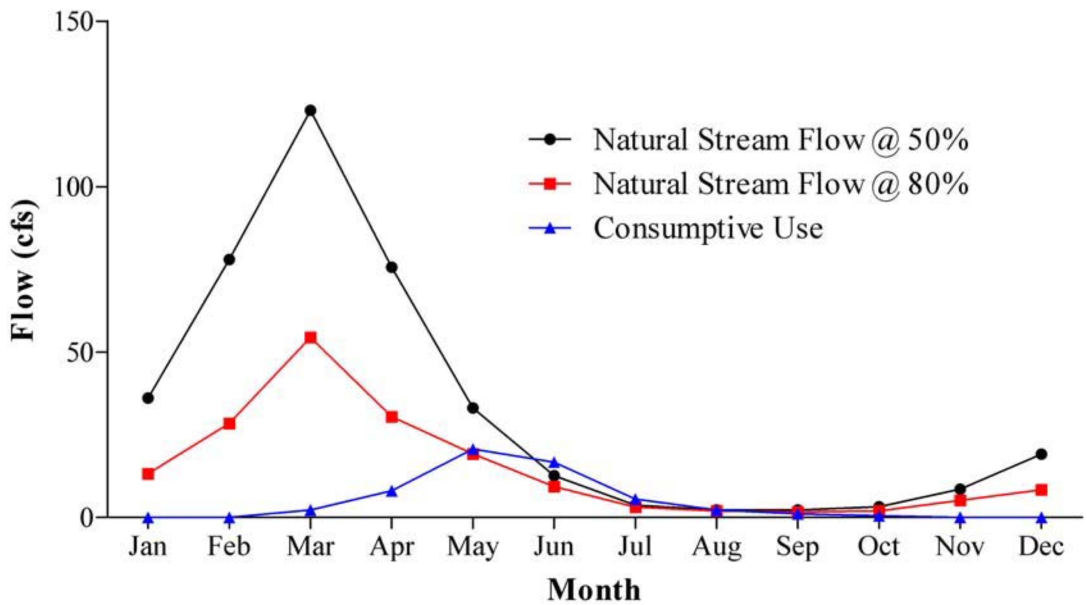

Figure 6.6. Natural streamflows at 50% and 80% exceedance levels and consumptive water use (green dashed line) of the Rock Creek water allocation basin #70251, Oregon. Data were obtained from the Water Availability Reporting System (WARS), maintained by the Oregon Water Resources Department.

the median flow. This flow value is used as an upper limit in developing instream water rights for protection of aquatic species and other in-stream beneficial uses (WPN 1999). The 80% exceedance level represents the stream flow that is in the channel 80% of the time over a 30-year period in order to include both wet and dry periods in the calculation. The Oregon Water Resources Department uses the 80% exceedance flow to determine whether new water rights can be issued in a WAB (WPN 1999); water rights are issued only when water is available at the 80% exceedance level.

An application for in-stream water rights for Rock Creek has been filed by the state of Oregon with the OWRD. These in-stream rights are intended to protect the hydrologic and ecological functions of the watershed, and while not yet finalized, are now used to calculate water availability in WARS for the Rock Creek WAB, as described above. In Rock Creek, expected flows (natural flows minus storage and consumptive uses) are consistently lower than the instream requirements that are currently under application review (Figure 6.7). When both consumptive uses and instream rights are subtracted from the natural streamflow to determine water availability, water is never available for new consumptive uses in the Rock Creek WAB under the 80% exceedance flows (Figure 6.8).

FLOW-RESTORATION PRIORITY AREAS

The Oregon Plan for Salmon and Watersheds establishes streamflow restoration priorities for the recovery of salmonids by WAB (OWRD 2003b). Water availability basins are ranked by flow restoration needs and opportunities, and are assigned a priority. Streams can be a "current resources priority," a "priority," "not a priority," or remain unprioritized. Need rankings range from 0 to 4, either being unranked, "low," "moderate," "high," or "highest," while opportunity rankings are also based on a 0 to 4 rating for being unranked, "poor," "fair," "good," or "very good." Although Rock Creek and Lonerock creeks have not yet been assigned a flow restoration priority ranking, the results of this assessment suggest that there are substantial opportunities for flow

Table 6.6. Natural streamflows (at 50% and 80% exceedances), consumptive use, expected streamflows, instream flow requirements, and water availability data for the Rock Creek Water Allocation Basin #70251. Data were obtained in February 2009 directly from the Water Availability Report System (http://apps2.wrd.state.or.us/apps/wars/wars_display_wa_tables/), maintained by the Oregon Water Resources Department.

Parameter	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natural Stream Flow (50% exceedance)	36.1	78	123	75.6	33.1	12.6	3.69	2.29	2.24	3.26	8.61	19.1
Natural Stream Flow (80% exceedance)	13.2	28.4	54.4	30.5	19.2	9.38	3.12	1.97	1.72	2.01	5.16	8.41
Consumptive Use	0.01	0.02	2.3	8.1	20.7	16.7	5.58	2.23	1.15	0.56	0.036	0
Consumptive Use, Percent of Natural Streamflow (50%)	0.03	0.03	1.9	10.7	62.5	132.5	151.2	97.4	51.3	17.2	0.4	0
Expected Stream Flow (50% exceedance)	36.1	78	121	67.5	12.4	**-4.1**	**-1.89**	0.06	1.09	2.7	8.57	19.1
Expected Stream Flow (80% exceedance)	13.2	28.4	52.1	22.4	**-1.51**	**-7.32**	**-2.46**	**-0.26**	0.57	1.45	5.12	8.41
Instream Requirement	34	57	57	57	32	11	4.7	3.09	2.47	2.72	6.67	21.8
Water Availability (50% exceedance)	**-8.21**	**-1.27**	**29.2**	**-8.75**	**-23.1**	**-15.1**	**-6.59**	**-3.03**	**-1.38**	**-0.02**	1.9	**-8.15**
Water Availability (80% exceedance)	**-31.1**	**-50.9**	**-39.4**	**-53.8**	**-37**	**-18.3**	**-7.16**	**-3.35**	**-1.9**	**-1.27**	**-1.55**	**-18.8**

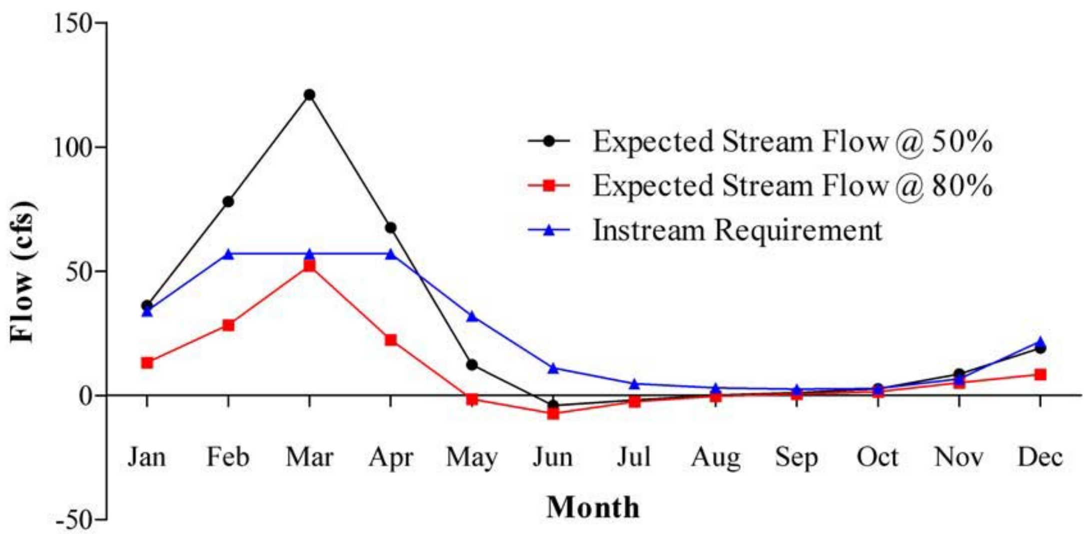

Figure 6.7. Expected streamflows (natural streamflow minus consumptive uses) at 50% and 80% exceedance levels and instream flow requirements (heavy green solid line) of the Rock Creek water allocation basin #70251, Oregon. Data were obtained from the Water Availability Reporting System (WARS), maintained by the Oregon Water Resources Department.

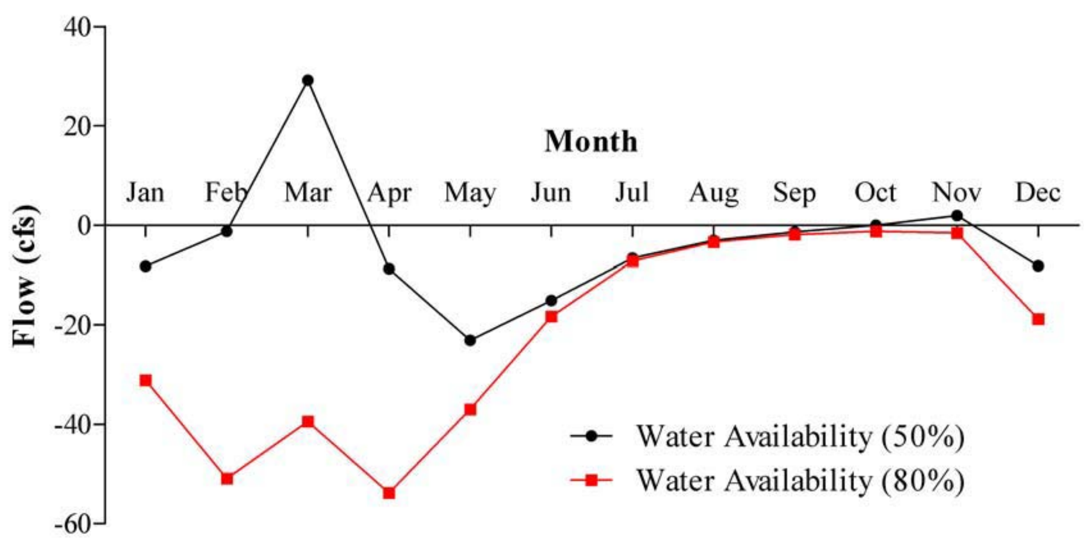

Figure 6.8. Water availability (at 50% and 80% exceedance levels) in the Rock Creek water allocation basin #70251, Oregon. Water availability at the 80% exceedance level is used by the Oregon Water Resources Department (WRD) to determine if water is available to issue new out-of-stream consumptive-use permits. Data were obtained from the Water Availability Reporting System (WARS), maintained by the WRD.

restoration, particularly in the summer months, when consumptive uses and storage are highest. Flow restoration is one of the primary objectives of the juniper control projects in the Lonerock watershed (see Chapter 7 for details). One thousand acre feet of water per year is an anticipate effort of the treatment, much of which is expected to result in longer-term flows of high-quality water (Hugh Barrett, personal communication).

CONCLUSIONS AND RECOMMENDATIONS

The Rock and Lonerock creeks watershed is characterized by low summer flows and late winter/early spring peak flows driven by rain and rain-on-snow events. These hydrologic characteristics have been exacerbated by currently degraded rangeland conditions and the aggressive expansion of western juniper. This screening-level assessment for potential effects of land use and roads on increasing peak flows indicated that road densities were sufficiently low so as to present only a low risk of peak-flow enhancement throughout the watershed. Results of the land-use effects assessment suggested that three subwatersheds are at moderate risk of peak flow enhancement due to agricultural land uses. These included Rood Canyon, Lonerock Creek and Wild Call Canyon, all occurring at higher elevations. While less cropland and more rangeland occurs in the higher country, higher rainfall in these areas increases the likelihood of amplified runoff events. Continued use of soil conservation practices, such as no-till seeding and placing agricultural land into the Conservation Reserve Program (CRP), should reduce the risk of increased peak flows in the watershed. Furthermore, re-establishment of a gage station on lower Rock Creek would assist with further characterizing the hydrologic regime of the watershed and would allow a closer evaluation of the effects of land and water conservation techniques on the watershed's hydrologic condition.

Average ("50% exceedance") natural streamflow at the lower end of Rock Creek ranges from a low of 2.24 cfs in September to 123.0 cfs in March, while monthly consumptive uses ranged from 0.0 cfs in December to 20.7 cfs in May. Consumptive use as a percent of the natural streamflow (at 50% exceedance) is highest in the months of June through August. When this use is greater than 10%, the greatest opportunity for flow restoration through conservation measures exists. Using this criterion, flow restoration opportunities are greatest in the watershed when consumptive uses and storage range from 17.2% to 151.2% of the natural streamflow during the months of May through October.

The state of Oregon has recently applied to obtain instream water rights for the Rock Creek and Lonerock Creek Water Availability Basin. Based on WARS data and including these instream water rights, no water is available for new consumptive uses in the watershed during any month of the year using the 80% exceedance flow for estimating natural stream flow. Clearly, additional water conservation measures should be considered in the watershed to help protect and improve stream flows necessary for maintaining natural aquatic communities. Based on the most up-to-date information, water conservation measures should include controlling the spread of juniper into areas historically dominated by native bunchgrasses and greater irrigation efficiency.

CHAPTER 7: UPLAND CONDITIONS

INTRODUCTION

Land use type in the Rock and Lonerock creeks watershed is approximately 49% rangeland, 24% agriculture (cropland and hayland), and 27% forest (Figure 7.1). Rangelands are used primarily for grazing cattle, which varies in intensity among ownerships. Agricultural lands include both irrigated agriculture, primarily along the valley-bottom floodplains downstream of Wolf Hollow, and dry-land agriculture (for cereal crop or grain production) occurring in both higher-elevation areas of the watershed, as well as in the lower portions of the basin.

RANGELANDS

Nearly half of the Rock and Lonerock creeks watershed is rangeland which occurs primarily on privately owned land, with small BLM and State of Oregon holdings. Although sheep ranching historically occurred in the watershed, only cattle ranching is currently practiced. Rangelands in the watershed were historically dominated by sagebrush steppe plant communities: Wyoming and/or mountain big sagebrush, with bluebunch wheatgrass and Sandberg bluegrass on lower elevation slopes on all aspects and entire south- and west-facing slopes. Idaho fescue is the dominant grass on the steep north- and east-facing slopes, while basin wildrye occurred primarily in the valley bottoms and hillslope swales (Hugh Barrett, personal communication; Table 7.1). Euro-American settlement of the watershed and the accompanying introduction of unmanaged grazing, fire suppression, conversion of rangeland to agricultural lands, alteration of the hydrologic regime, invasion of noxious weeds and juniper have altered these communities. These changes, particularly the uncontrolled spread of noxious weeds and juniper, threaten both the range land biodiversity of the watershed as well as the potential for recovery of overall watershed health and function (NWPCC 2004).

JUNIPER EXPANSION

The expansion of western juniper into rangelands is an issue of concern in the Rock and Lonerock creeks watershed, elsewhere in the John Day subbasin, and across the semi-arid west, alike. Post settlement juniper expansion in the region is thought to have been driven by several factors, including climate conditions, introduction of livestock, industrial increases in atmospheric carbon dioxide, and fire suppression (Miller et al. 2005). If not managed, juniper can come to dominate rangeland (Bedell 1993), resulting in reduced groundcover which may increase overland flow, loss of topsoil, and delivery of sediment to streams. Also, reduced populations of native bunchgrasses and other high-forage-value vegetation impact the quantity and quality of available forage for both livestock and wildlife.

Hydrologic function of rangeland watersheds is maintained by managing for vegetative communities that provide optimum conditions for capture, storage, and safe release of water. Scarce moisture east of the Cascades makes proper hydrologic function of watersheds particularly critical. Juniper encroachment potentially modifies hydrologic functioning by intercepting and evaporating water that would otherwise be retained in the soils to support native plant growth. This lack of water suppresses the growth of native shrubs, grasses, and forbs and thereby increases soil erosion in areas devoid of vegetation. Additionally, juniper transpires large quantities of soil moisture, depriving other plants of water. These changes result in fewer plants, less soil cover, lower water infiltration rates, higher overland flow and soil erosion rates, greater nutrient losses, less productive rangeland sites, and altered local hydrologic conditions (Bedell 1993).

Recent estimates suggest that juniper has encroached on more than 30,000 acres of rangeland in the Rock and Lonerock creeks watershed over the past century (Walter Powell, personal communication, June 2008). Encroachment of juniper onto rangelands is clearly evident to long-time residents of the watershed, as they have watched hillsides become overtaken by western juniper. This is particularly evident in the upper areas of the watershed around the town of Lonerock. 1946 aerial photographs of the watershed in the vicinity of Lonerock show expansive open grasslands and small patches of forest, likely dominated by pines (Figure 7.2). No evidence of junipers occurs in this photograph. In

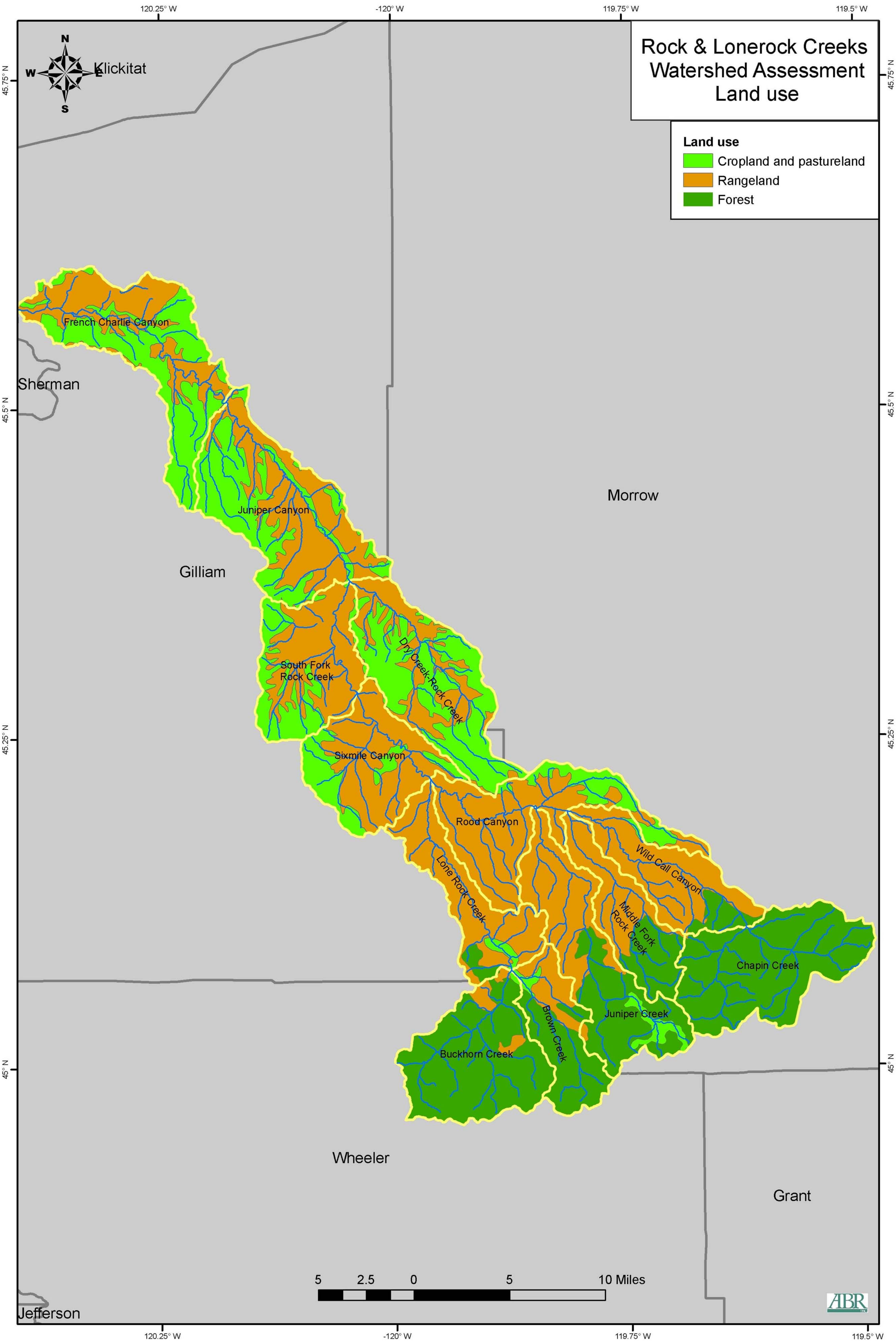

Figure 7.1. Land-use types occurring in the Rock and Lonerock creeks watershed, Oregon. Light green shading represents cropland, orange shading represents rangeland, and dark green shading represents forestland.

Table 7.1. Natural vegetative communities and land-use types occurring in the Rock and Lonerock creeks watershed, Oregon.

Land Use/Vegetation Community Type	Acreage
Agricultural cropland and pastureland	77,137
An. grasslands/Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass canyon grassland	10,305
Big sagebrush-needle-and-thread grass/Big sagebrush-cheatgrass	1,429
Bluebunch wheatgrass/Big sagebrush-Idaho fescue	1
Bluebunch wheatgrass/Rigid sagebrush-Sandbergs bluegrass	32,997
Bluebunch wheatgrass-Idaho fescue-Sandberg bluegrass canyon grassland	85,082
Idaho fescue-Junegrass canyon grassland	26,566
Rigid sagebrush-Sandbergs bluegrass	535
Sandy bitterbrush steppe	4
Western juniper-bunchgrass	932
Total grasslands/rangeland	157,851
Douglas fir-true fir-ponderosa pine-western larch forest	6,471
Ponderosa pine forest and woodland	52,273
Ponderosa pine forest and woodland/Idaho fescue-Junegrass canyon grassland	7,242
Ponderosa pine-Douglas fir-true fir forest	1,261
Ponderosa pine-Douglas fir-western larch-lodgepole pine forest	20,065
Total forested	87,312
Grand Total	322,298

stark contrast, aerial photographs taken in 2005 show a landscape abundant with junipers in some areas, with some juniper coverage through most of the area (Figure 7.3).

As the expansion of juniper over the past century has been documented and its effects on western rangelands and watersheds understood, treatment on public and private lands is now occurring in the eastern Oregon. Treatment methods vary and have regionally included pulling, cutting, bulldozing, and burning. Often, topography and vegetative cover will guide selection of the most appropriate method (Miller et al. 2005; Walter Powell, Gilliam SWCD, personal communication, June 2008). In very steep areas, cutting is the method of choice as a matter of necessity. Cutting must occur at or below ground level; otherwise, if any bud is left above ground, re-sprouting will likely occur (Sue Greer, Wheeler SWCD, personal communication, October 2005). Pulling or pushing with a large trackhoe has been an effective way to remove juniper in some areas, but other methods may be preferred when disturbance to soils or damage to native bunch grasses by heavy equipment is a concern (Miller et al. 2005; Walter Powell, Gilliam SWCD, personal communication, June 2008). Because many sites have minimal natural recruitment potential, some reseeding may reduce invasion by non-native plants. Several area projects have included broadcasting perennial seed before equipment was used to promote good seed contact and improved germination (Sue Greer, Wheeler SWCD, personal communication, October 2005). Fire has been re-introduced since 1990 to help manage western juniper (Miller et al. 2005). Primary factors that influence post-burn response include pre-treatment plant composition and seed pools, fire extent and severity, and pre- and post-fire climatic conditions. Miller et al. (2005) provide a comprehensive overview of each of these methods and the factors that influence the success of each.

With the current emphasis on recycling and conservation, rather than burning on-site, cut juniper can be used or sold for fire wood (Walter Powell, Gilliam SWCD, personal communication,

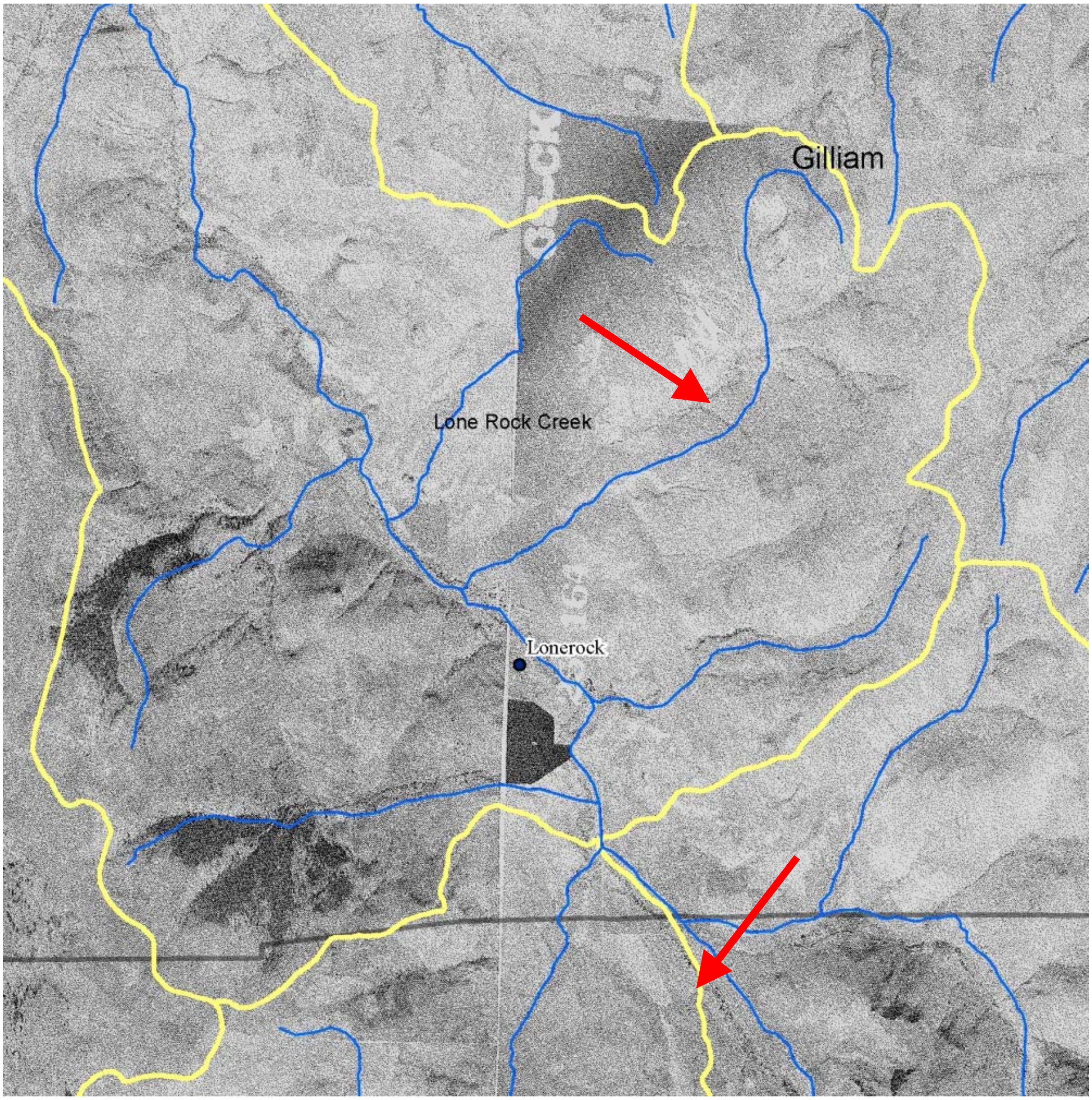

Figure 7.2. Aerial photograph from 1946 of the Lonerock Creek watershed in the vicinity of the town of Lonerock. Dark areas are small patches of pine-dominated forest, while light areas are expansive range/grasslands. Note the absence of the any dark spotting or speckling elsewhere, indicating an absence of trees or larger shrubs throughout the grassland area. Arrows point to two locations of note for comparison with photographs in Figure 7.3.

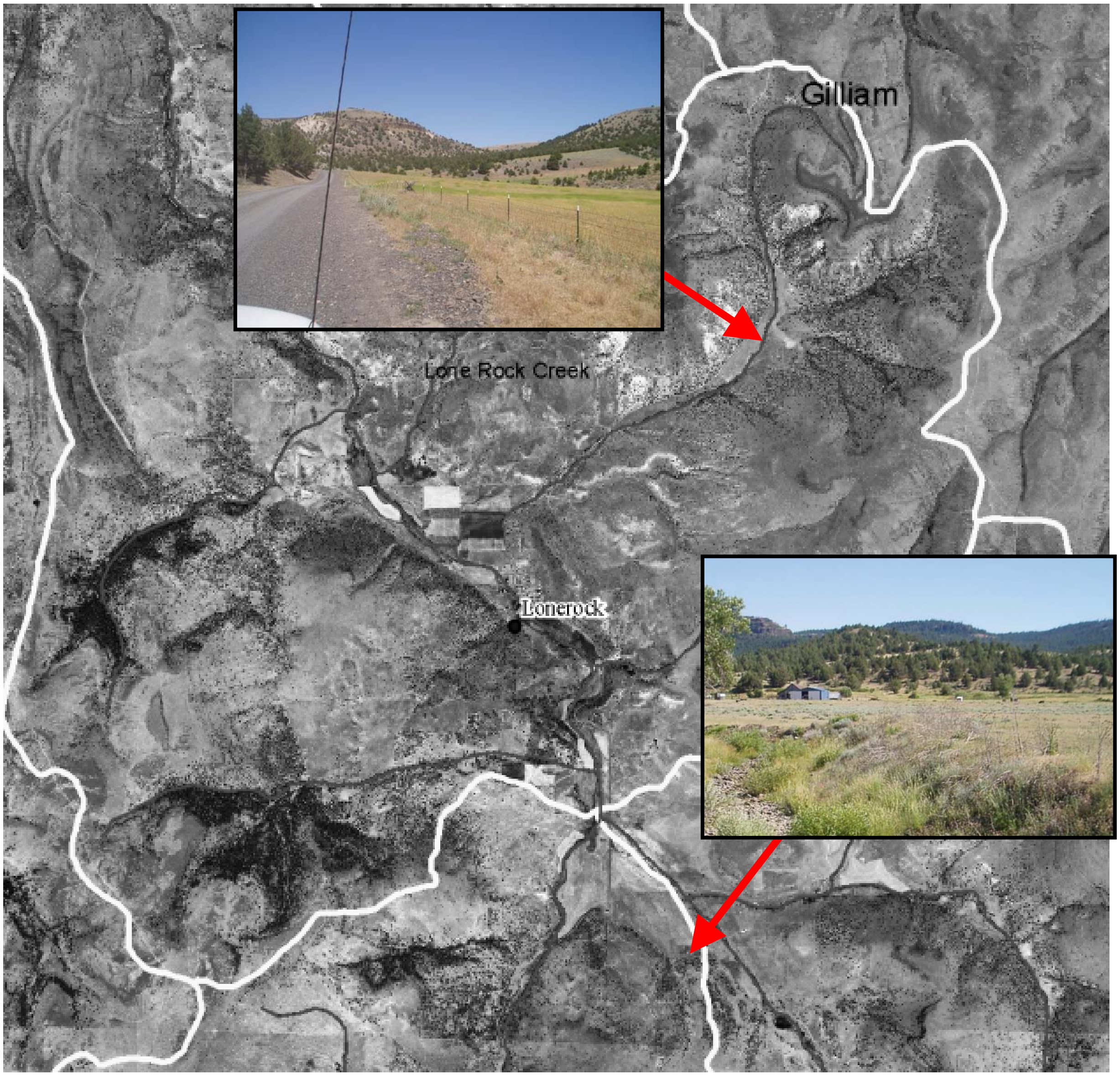

Figure 7.3. Aerial photograph from 2005 of the Lonerock Creek watershed in the vicinity of the town of Lonerock. The larger dark areas are small patches of pine-dominated forest, while light areas are range/grasslands. Note the abundance of dark spots/speckles throughout much of the historic grassland area (see Figure 7.2 for comparison). Inset photographs depict the extent to which juniper now occupy this landscape in some parts.

June 2008). Additionally, organized efforts are now being made to commercialize juniper and develop markets for its use through the Western Juniper Commercialization Project (http://juniper.oregonstate.edu/index.php). The project, led by Oregon State University (OSU), seeks to better utilize western juniper wood products for a variety of uses beyond fence posts and firewood.

Efforts to control the spread of juniper are currently underway in the Rock and Lone rock creeks watershed (Figure 7.4). The Gilliam SWCD has received funding through OWEB and NRCS EQIP for a juniper removal project near Lonerock totaling approximately 3,500 acres. The SWCD has applied for additional grant funding that could increase the total acreage of the project by 1,500 acres. In order to ascertain the potential effect of the project on improving local hydrologic conditions, flow from a spring at the base of one of the project areas was measured before project and after project implementation; spring flow from this 40-acre project area increased from 3.8 gallons per minute (gpm) in the fall of 2008 to 6.5 gpm in the fall of 2009 (Walter Powell, Gilliam SWCD, personnel communication, June 2008). This project will include extensive monitoring, including peizometers for measuring the ground water table and flow weirs for measuring changes in flow in Johnson and Robinette creeks in response to the juniper removal efforts. Other juniper removal efforts in the region have already resulted in tangible benefits, including increased streamflows and groundwater supply, ephemeral streams changing to intermittent and sometimes perennial flows, and revitalized historic springs and new springs occurring following removal (Tim DeBoodt, OSU Extension, via Sue Greer, Wheeler SWCD, personal communication, May 2006).

NOXIOUS WEEDS

The uncontrolled spread of noxious weeds has been identified as one of the primary issues of concern for the Rock and Lonerock creeks watershed. The Oregon Department of Agriculture's (ODA) Noxious Weed Control Program states in a recent publication (ODA 2008):

> Noxious weeds have become so thoroughly established and are spreading so rapidly on private, state, county, and federally-owned lands, that they have been declared by ORS 570.505 to be a menace to public welfare. Steps leading to eradication, where possible, and intensive control are necessary. It is further recognized that the responsibility for eradication and intensive control rests not only on the private landowner and operator, but also on the county, state, and federal government.

Noxious weeds threaten native ecosystems by out-competing native vegetation and changing forage availability for wildlife. Invasive weeds can also adversely affect watershed functions and conditions by increasing runoff and erosion (Whitman 2002). In the Rock and Lonerock creeks watershed, common weed species include Dalmatian toadflax; medusahead; kochia; spotted, diffuse, and Russian knapweeds; Scotch thistle; and poison hemlock, among others (Teri McElroy, Gilliam-East John Day Watershed Council, personal communication, October 2008). These invasive weeds have been introduced into the watershed in a number of ways, including by hitching rides on footwear, clothing, animals, and/or automobiles; arriving in hay from outside areas; and perhaps from the John Day River, where seeds can be transported for miles down the river from other areas in the basin.

Control of noxious weeds is necessary to ensure the health of the native rangeland vegetative communities. As noxious weeds crowd out native vegetation, wildlife habitat and food resources are compromised. Also loss of native vegetation increases soil erosion and impairs hydrologic function of the watershed. Noxious weed control involves both eradicating weeds where they occur and taking preventive measures to prevent or minimize the further spread of these weeds. The Eastern Oregon Noxious Weeds Partnership recommends the following activities to help control invasive weeds:

- Learn to identify the weeds (and other plants) in your area—don't pick and transport flowers you can't identify.

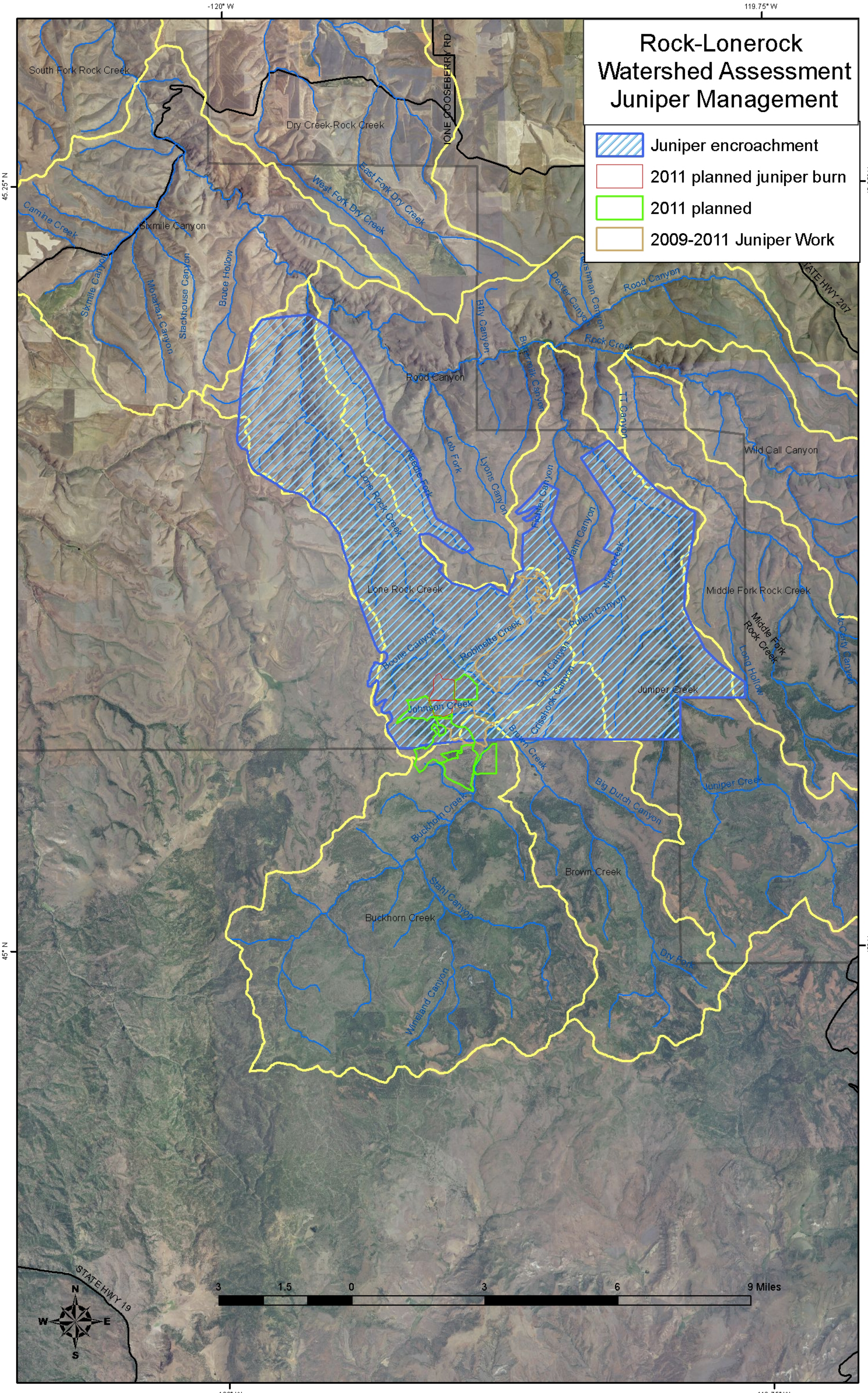

Figure 7.4. Juniper management activities.

- Drive, bicycle, walk and pack on established roads or trails, away from weedy areas.
- Check your undercarriage, boats, hitches, shoes, pant cuffs and animals' fur and hooves before and after moving through an area, and safely dispose of any clinging seeds.
- Be an informed gardener—don't plant invasive, "exotic" (non-native) plants in your yard.
- Control weeds on your property. Replant disturbed soil with beneficial plants to keep the weeds out.
- If you find a few weeds without flowers or seeds, pull them and leave them where found. If flowers or seeds are present, place the weeds in a plastic bag or similar container and burn them in a safe place.
- Contact your local natural resource agency, County Weed Board or Weed Control Department for a listing and photos of the "most wanted" weeds, and information about controlling them.

The Gilliam County Weed Department (GCWD) has applied for and received noxious weed control grant funding from the Oregon State Weed Board to control noxious weeds in the upper Rock Creek and Lonerock Creek watersheds. These integrated weed management area grants have been used for many years to control the spread of noxious weeds in the watershed. The grant funding allows the GCWD to utilize a helicopter to spray noxious weed infestations in the deep, rugged hills and canyons that make up the landscape.

The GCWD's efforts also include maintaining a geo-referenced database of known locations of noxious weed infestations. While no complete watershed-wide inventories of noxious weeds have occurred in the watershed, the GCWD has a thorough working knowledge of both problem areas and effective treatment methods. The ODA maintains an interactive mapping website that is designed to allow identification, reporting, and verification of weeds in Oregon (http://www.weedmapper.org/index.html). The program allows users to view maps of reported occurrences by county and by species and provides information for reporting new occurrences.

We recommend that all landowners acquaint themselves with these noxious weeds, learn to recognize them, take steps to prevent their spread, and treat infestations as they're identified. The GCWD (541-384-4222) and the ODA, Noxious Weed Control Program (http://www.employment.oregon.gov/ODA/PLANT/WEEDS/about_us.shtml), can provide additional and updated information to interested parties.

Current efforts to control noxious weeds in the Rock and Lonerock creeks watershed focus on land-owner-specific treatment of weeds in areas of high infestation. The GCWD maintains a prioritized list of target species occurring in the county (Table 7.2). Don Farrar, the weed control specialist for the county weed department, can be reached at 541-384-4222 for additional information about weed control. Methods used to treat weed infestations depend on the type of weed and can be one of the following or a combination of biological, chemical, and/or mechanical control, as integrated pest management (IPM). Combining several of these tools is often the most effective approach in weed control. The following information, originally obtained from the Eastern Oregon Noxious Weeds Partnership, will aid in the identification and control of some of the more common noxious weeds in the watershed:

Dalmatian Toadflax

(source:http://www.employment.oregon.gov/ODA/PLANT/WEEDS/profile_dalmatiantoadflax.shtml)

Description: Perennial; blooms summer to fall. Grows two-three feet tall. Leaves waxy, green, heart-shaped and one-three inches long. Flowers are one inch long and similar to snapdragons. Spreads both by seeds and creeping lateral roots. This deep rooted perennial out-competes desirable forage plants for moisture and nutrients. Dalmatian toadflax thrives in arid rangelands, pastures, and railways.

Table 7.2. Gilliam County classification list of weeds species (January 2008 version) maintained by the Gilliam County Weed Department.

"A" List Noxious Weeds	"B" List Noxious Weeds	"T" List Noxious Weeds
Buffalobur	Bull Thistle	Dalmatian toadflax
Distaff Thistle	Canadian Thistle	Kochia
Field Dodder	Dalmatian/ Yellow Toadflax	Leafy Spurge
Hydrilla	Diffuse Knapweed	Rush Skeletonweed
Johnsongrass	Field Bindweed/ Morning Glory	Spotted Knapweed
Kudzu	Himalayan Blackberry	Yellow Starthistle
Leafy Spurge	Jointed Goatgrass	Russian Knapweed
Murtle Spurge	Klamath Weed/ St. John's wort	Poison Hemlock
Musk Thistle	Kochia	
Purple Loosestrife	Poison Hemlock	
Rush Skeletonweed	Puncturevine	
Salt Cedar	Russian Knapweed	
Spartina	Sandburr	
Spotted Knapweed	Scotch Thistle	
Sulfur Cinquefoil	Spikeweed	
Tansy Ragwort	Whitetop	
Yellow Starthistle		
Yellow Flag Iris		

"A" designated weed: A weed of known economic importance which occurs in the county in sufficiently small infestation levels to make eradication/containment possible; or not known to occur but its presence in a neighboring county makes future occurrence seem imminent. Recommended Action: Infestations are subject to intensive control when and where found.

"B" designated weed: A weed of economic importance, which is regionally abundant, but of limited distribution in other counties. Recommended Action: Moderate to intensive control at the state or county level.

"T" designated weed**:** Targeted species for Gilliam County Cost Share.

Control: Application of the herbicides Telar® and Tordon®, used in combination and with a surfactant added are ef fective at controlling Dalmatian toadflax (D on Farrar, Gilliam County Weed Department, personal communication, October 2009). Five biocontrol agents are approved for relea se. Two of these, a flow er feeding beetle and a stem weevil, are established in Oregon.

Medusahead Rye

Description (Figure 7.5): Medusahead is an annual grass which c an grow 6-24 inches tall. Medusahead is almost worthless as forage as the high silica content of the leaves render the plant unpalatable to livestock. In an ef fort to control medusahead, the U SDA-Agricultural Research Service, in partnership with the BLM, has developed the Medusa Challenge Strategic Plan. This far-reaching plan serves to enhance and coordinate education, research, and management of medusahead-infested rangeland throughout Oregon, Washington, Idaho, California, Utah, and Nevada.

Control: Herbicides applied in late fall or early spring will reduce medusahead. Consult your local weed board for info rmation. Landmark has recently received a label for restoration. Plateau is also used, but it's more expensive than Landmark and isn't as efficient (Don Farrar, Gilliam County Weed Department, personal communication, October 2009). A low, hot burn immediately before the seeds drop will redu ce medusahead. Disking and plowing can also reduce seeding.

Figure 7.5. Photographs of six noxious weed species occurring in the Rock and Lonerock creeks watershed. Upper row (left to right) includes Dalmatian toadflax, medusahead, and Russian knapweed. Lower row (left to right) Scotch thistle, poison hemlock and whitetop. Photos courtesy of Richard Old, Eric Coombs, and the Eastern Oregon Noxious Weeds Partnership.

Russian Knapweed

Description (Figure 7.5): Russian knapweed is a woody perennial that can form dense colonies. The entire plant is more or less white woolly when young. It infests alfalfa and grain fields, irrigation ditches and waste areas. It spreads by seed and rootstock and can produce up to 27 rootshoots a year. The deep, extensive root system (up to 23 feet) makes it especially difficult to control. It emits a substance that inhibits the growth of other plants around it. The leaves are bitter and unpalatable to livestock. Causes "chewing disease" (trachea paralysis) in horses.

NOTE OF CAUTION
(from http://tncweeds.ucdavis.edu/esadocs/documnts/centdif.html):

> As a precaution, anyone working with diffuse knapweed or other knapweed species should wear protective gloves and avoid getting knapweed sap into open cuts

> or abrasions. Workers should wash their hands and exposed skin with soap and water following contact with this plant. An e-mail message widely broadcast to land managers around the nation in September 1997 (Niefoff 1997, detailed below) indicated several knapweed species may contain a cancer causing compound. It is difficult to determine the veracity of this report and an extensive search for mention of this compound or any cancer-causing properties of knapweeds in the medical and other scientific literature failed to turn up anything.

Jerry Niefoff (1997) of the Idaho Panhandle National Forest sent a broadcast e-mail message reporting that he had gotten knapweed sap rubbed directly into abrasions on his right pinkie and ring finger while pulling the plants and later developed a lump in his pinkie. The lump persisted and grew and so he had it removed by a surgeon who said it was a "very aggressive benign tumor." Niefoff reported that a month or two later the tumor reappeared and he had it removed again. After the second surgery, the tumor started to spread towards the hand, so the surgeon removed Niefoff's right pinkie. Shortly after the removal of his little finger, a tumor developed in his ring finger so he visited the cancer Center at the University of Washington. Several surgeries failed to eliminate the tumor so his right ring finger was eventually removed too. Niefoff reports that the tumors were all in the tendon sheaths of his fingers could not be treated with chemotherapy or radiation, only physical removal. He reported that two and a half years after the removal of his ring finger the tumor no other problems had appeared in his other fingers or hand. Niefoff reported that a doctor at the University of Washington told him cancer-causing compounds had been isolated from Russian knapweed and probably occurs in spotted and diffuse knapweed also.

Control: Sheep and goats will graze the new growth while it is succulent, but this control method requires repeated grazing each year to effectively reduce the knapweed colony. Reseeding with fast growing grasses can prevent new invasions. Continuous tillage combined with fall herbicide application can be effective. Otherwise, tillage or pulling only serves to spread it. Wear gloves when pulling! Chemical control is most cost-effective application is during the rosette stage. Spring and fall applications are recommended. Milestone is the current chemical of use. Consult your Weed Board for more details.

Scotch Thistle

(source:http://www.employment.oregon.gov/ODA/PLANT/WEEDS/profile_scotchthistle.shtml)

Description (Figure 7.5): Biennial that sometimes acts like an annual; blooms May-June. Often produces a rosette the first year but when acting annual it can grow 2–4 feet the first year and is capable of heights over 10 feet in the second. Large amount of soft white hair on upper leaf surface. Towering height, depending on available moisture. Winged tissue along stem. Purple flower. Stands dense and practically impenetrable because of spiny nature and large size. Spreads by seed. Scotch thistle is a wasteland weed that generally inhabits moist sites or drainages in dry locations. If not controlled, it presses into farmland or forms dense canopies in any area overgrazed or not under intense cultivation. It is a major issue in rangeland management in northeastern Oregon.

Control: Application of Milestone in the fall is an effective control for Scotch Thistle the following spring. Milestone is "water friendly" and can be applied to the water's edge (Don Farrar, Gilliam County Weed Department, Personal Communication, October 2009). No approved biological control agent is available.

Poison Hemlock

Source:(http://www.employment.oregon.gov/ODA/ PLANT/WEEDS/profile_poisonhemlock.shtml)

Description (Figure 7.5): Biennial; blooms early summer. Grows 3 to 7 feet tall. Stems erect. Leaves alternate, one per node, petioled and pinnately divided. Flowers are white in compound stemmed umbels, mostly flat on top. Enlarged taproot is the most easily recognizable feature. Poison hemlock grows in pastures, streams, and irrigation ditches. Several deaths of livestock and humans are attributed each year to this species. Juice from the poison hemlock taproot and its crown are extremely poisonous. An extract of this species was used to execute Socrates in ancient Greece. It has also accidentally poisoned many who have mistaken it for parsley. Poison hemlock is considered to be one of the most poisonous plants in North America, and is often mistaken for water-parsnip or other edible members of this family. Poison hemlock is a native of Eurasia.

Control: Several herbicides can be used to control the emergence of poison hemlock sprouts, including the sulfonylurea herbicides, chlorsulfuron (Telar®) and metsulfuron (Escort®). No approved biological control agent is available.

Whitetop

Description (Figure 7.5): Whitetop can establish itself in a variety of soil types and environmental conditions: dry pastures, hay meadows and roadsides, cultivated crops. A single plant can send out 400 shoots in a year . Roots develop to depth of several feet, making control difficult. It spreads by seed and root.

Control: Integrated pest management is the best method of controlling this weed. Dense stands of perennial grasses will out-compete white top. Pasture grasses will slow spread if not over grazed. Growing small grains in infested fields will suppress whitetop once a canopy is formed. No insects or parasites are available in the United States (as of Nov. 1991). Whitetop is most easily controlled with foliar herbicides applied during rosette stage. Depends on where infestation is located, what kind of herbicide and application is allowed. Telar® is the chemical currently being used. Cultivating fallow ground no more than 10 days after weed emergence will eventually eliminate the weed. Close mowing will also reduce seed production but will not eliminate.

DATA GAPS:

- Comprehensive inventory of noxious weed locations and acreages. The current maps are not necessarily up-to-date or complete.

FOREST LANDS

Forest land is restricted to the higher-elevation headwaters of the Rock and Lonerock creeks watershed and currently represents approximately 27% of the total watershed acreage. These forests are dominated by Ponderosa pine, which has been extensively harvested from the upper watershed several times during the last 70 years (Mitch Mund, ODF, personal communication, February 2009). Until the mid-1990s, much of the timbered upper watershed was owned by Kinzua Pine Mills Company, a lumber mill company. Kinzua Pine Mills Company owned much of the forested portion of upper Brown Creek, upper Juniper Creek, and upper Buckhorn Creek, as well as some timberland in the Chapin Creek drainage. Additionally, Kinzua Pine Mills Company held timber deeds to some other parcels in the watershed that were not owned by the company in exchange for use of Kinzua lands as summer pasture. In 1995, Kinzua Pine Mills Company sold off their timberlands. The new owners, in turn, sold the timber deeds to Boise Cascade. Through the mid-to-late 1990s, Boise Cascade cut through much of the timberland in the upper watershed. These harvest operations in the upper watershed resulted in significant disturbance to the land and produced sedimentation problems for Rock Creek (Tim Unterwegner, ODFW, personal communication, June 2008).

Forestlands in the upper watershed have since been sold again, and are now owned in smaller parcels by a number of land owners. Aside from localized thinning, minimal timber extraction has occurred in the upper watershed since the late 1990s (Mitch Mund, ODF , personal communication, February 2009). As market conditions for wood products are currently poor, no significant harvest activity is expected in the near future.

Forest health has been an issue of increasing concern over the past several decades in the Blue Mountains Ecoregion and throughout the arid west. Logging, fire suppression, and grazing, among other factors, have changed the forest structure to types more vulnerable to insects and disease (Langston 1995). Drier low and mid-elevation forests of the Blue Mountains Ecoregion, such as those occurring through much of the upper Rock Creek watershed, were historically dominated by ponderosa pines (Jaindl 1996). Areas on north-facing slopes likely also supported some Douglas fir and grand fir (Jaindl 1996). Frequent fires through these forests maintained open, park-like stands of large, mature trees with little understory or ground cover.

Fire suppression became standard forest management policy for the USFS by the 1930's (Langston 1995). Fire suppression allowed fire-intolerant species, such as Douglas fir and true firs, to invade areas once dominated by ponderosa pine. In drier areas, such as south-facing slopes, these changes resulted in mixed ponderosa pine/Douglas fir stands. In wetter areas, including north-facing slopes, complete replacement of ponderosa pine by Douglas fir/true fir forests sometimes occurred (Jaindl 1996). The extent to which these changes occurred in the Rock Creek watershed is unknown, but fire suppression policy resulted in widespread change in forest conditions across the Blue Mountains Ecoregion.

Logging also has altered forest stand composition and structure in the watershed by producing conditions that are more conducive to the survival and growth of Douglas fir and true firs. Forest stands across the region are generally composed of denser stands of younger trees than they were pre-fire suppression and harvest. Stand densities in the upper watershed, by estimation from recent aerial photographs, appear to be moderate. While densities and crown closure were significantly reduced by the harvest that occurred in the late 1990s, postharvest planting and natural regeneration have promoted recovery of these forest conditions over the last decade (Mitch Mund, ODF, personal communication, February 2009). While timber harvest on private lands is often driven primarily by market conditions, sustainable forest management also considers the negative effects of both overharvest and no management on forest and watershed health. Forest management that serves to protect and restore watershed conditions and functions strives to achieve a forest that is neither over nor understocked, as each can have deleterious effects on watershed conditions.

DATA GAPS:

- Forest stand size and structure and deviation from expected historic conditions.

CROPLANDS AND IRRIGATED AGRICULTURE

Croplands represent approximately 24% of the Rock and Lonerock creeks watershed area. Dry-land farming occurs throughout the watershed (Figure 7.6, top photo), while irrigated agriculture largely occurs on the historic Rock Creek floodplain from Wolf Hollow downriver through most of the lower reaches (as in Figure 7.6, bottom photo), as well as on portions of the valley floor along Lonerock Creek. Irrigated crops include alfalfa, meadow hay, and cereal hay crops, including forage barley, triticale, and wheat. Dryland grain crops within Rock Creek watershed occur where bunch-grass and mixed sagebrush/bunch grass communities occurred prior to Euro-American settlement of the watershed. The risks posed by the shift from native vegetative communities to non-native monocultures on altered watershed hydrology or sediment regimes within the watershed are discussed in the Hydrology and Sediment Sources chapters, respectively.

The Gilliam SWCD has been working with land owners within the watershed to protect highly erodible croplands through the Conservation Reserve Program (CRP), administered by the Farm Service Agency. The Conservation Reserve Program seeks to reduce soil erosion, protect food and fiber production, reduce sediment runoff into rivers and streams, improve water quality, and improve wildlife habitat. Land owners participating in CRP are paid an annual rental payment for the term of a 10-year contract to convert highly erodible cropland to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Conservation Reserve Program contracts close to expiring can typically be rolled over into a new contract. Currently, nearly 9,500 cropland acres within the Gilliam County portion of the Rock and Lonerock creeks watershed are in CRP (Table 7.3 and Figure 7.7). At present, Gilliam County's CRP acreage allotment has been reached and additional acres cannot currently be enrolled. Approximately 15,000 acres will be coming out of enrollment in 2011, and most acres are expected to be re-enrolled (Walter Powell, Gilliam SWCD personal communication, March 2011). Those whose lands will be coming out of CRP can consult with FSA if they wish to re-enroll or with Gilliam SWCD staff for assistance with managing these areas post CRP.

Improved management of croplands through conservation tillage practices potentially benefits both landowners and watershed conditions and functions. The Gilliam SWCD is informing landowners of minimum-tillage or direct-seeding methods that can improve soil health and