MOHAWK/McGOWAN

WATERSHED ANALYSIS

BLM

MAY 1995

Chapter 1
Introduction

What Is Watershed Analysis

Watershed analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Throughout the analytical process the Bureau of Land Management (BLM) is trying to gain an understanding about how the physical, biological, and social processes are intertwined. The objective is to identify where linkages and processes (functions) are in jeopardy and where processes are complex. The physical processes at work in a watershed establish limitations upon the biological relationships. The biological adaptations of living organisms balance in natural systems; however, social processes have tilted the balance toward resource extraction. The BLM attempt in the Mohawk/McGowan analysis is to collect baseline resource information and understand where physical, biological and social processes are or will be in conflict.

What Watershed Analysis Is NOT

Watershed analysis is not an inventory process, and it is not a detailed study of everything in the watershed. Watershed analysis is built around the most important issues. Data gaps will be identified and subsequent iterations of watershed analysis will attempt to fill in the important pieces.

Watershed analysis is not intended to be detailed, site-specific project planning. Watershed analysis provides the framework in the context of the larger landscape and looks at the "big picture." It identifies and prioritizes potential project opportunities.

Watershed analysis is not done under the direction and limitations of the National Environmental Policy Act (NEPA). When specific projects are proposed, more detailed project level planning will be done. An Environmental Assessment will be completed at that time. Watershed analysis is not a decision making document.

Products and Outcomes of Watershed Analysis

The watershed analysis will provide some of the following:

- A description of the resource capabilities, needs and opportunities.
- Spatially explicit information that will identify processes and functions operating within the watershed, and help facilitate environmental and cumulative effects analysis for NEPA.
- Identification of data gaps.
- Guidance for developing monitoring strategies and objectives.
- Guidance for designation of Riparian Reserves at the landscape level.
- A list of potential opportunities that are appropriate to the watershed under the Forest Plan.

The Legal Basis for Watershed Analysis

Watershed analysis is required by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (ROD)* and the *Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (S&Gs).* The term "Forest Plan" is used to denote the document that contains the ROD and S&Gs.

The Forest Plan provides a scientifically sound and legally responsible approach to managing Federal forest lands that takes into consideration all elements of the ecosystem. It focuses on reducing fragmented late-successional forests and restoring watersheds to provide healthy riparian and fish habitats. The Forest Plan is notable for focusing on all the components that make up the ecosystem rather than focusing on a single resource.

Watershed analysis focuses on implementing the Aquatic Conservation Strategy (ACS) of the Forest Plan. The Record of Decision for the Forest Plan states that "Watershed Analysis is required in Key Watersheds, for roadless areas in Non-Key Watersheds, and Riparian Reserves prior to determining how proposed land management activities meet Aquatic Conservation Strategy objectives. Ultimately, watershed analysis should be conducted in all watersheds on Federal lands as a basis for ecosystem planning and management" (USDA, USDI Record of Decision, 1994).

Watershed analysis was recognized as an evolutionary process whereby a system of pilot projects were initiated to test the *Federal Agency Guide for Pilot Watershed Analysis* (Regional Ecosystem Office, 1994). During an interim period, Fiscal Years 1994-96, non-pilot watershed analysis would consider using the *FY 1994-96 Watershed Analysis Guidelines* (Interagency Watershed Analysis Coordination Team, 1994). The Mohawk/McGowan watershed is not a pilot project and has followed the aforementioned "interim" guidance.

Steps Utilized in Watershed Analysis

The steps utilized in watershed analysis include:

- Identify issues and formulate key questions
- Identify and prioritize key processes and functions
- Assemble analytic information
- Analyze information using the Federal Agency Guide, the Eugene District Guide, or Washington's TFW (Timber, Fish, Wildlife) process
- Describe the past and current watershed conditions
- Describe key processes, functions, and linkages
- Describe likely future scenarios
- List management opportunities
- Develop guidance for monitoring strategy and objectives

Management Direction and Data Utilized

The Eugene District Leadership Team identified 3 watersheds as high priority for watershed analysis in 1995. These watersheds contain numerous potential projects for implementing the Forest Plan in 1995, 1996, and beyond. Mohawk/McGowan is one of those 3 watersheds. The following core team was formed to conduct the Mohawk/McGowan watershed analysis. These members relied on a network of District personnel to aid in data gathering and arrangement.

Member	Responsibility
Mabel Alejandro	Physical
Chris Haubrich	Geographical Information System
Lynn Larson	Vegetation
Lee Lauritzen	Management
Raul Morales	Biological
Patricia Wilson	Social
Jerry Richeson	Team Lead

This analysis was conducted using existing data; the time frame for analysis completion did not allow for additional data/information collection. The Area Manager (Lee Lauritzen) was satisfied with the data used to develop conclusions/opportunities in this analysis. If data did not exist to make a conclusion, then the conclusion was not made. An area identified as the Coburg Hills Fringe lies just outside the watershed to the west. Due to their "connectedness," certain values/issues (see Chapter 3) for this fringe area are included in this analysis.

Weyerhaeuser Company has conducted a watershed analysis for the upper Mohawk River and Mill Creek. Weyerhaeuser and BLM have signed a Memorandum of Understanding to share data. Various elements of Weyerhaeuser's analysis were reviewed, and the M/M core team decided to use the data and interpretations for some of those elements. The elements/areas where Weyerhaeuser's data/interpretations are used will be noted in the representative narratives. Maps created for those elements are a composite of BLM and Weyerhaeuser data/interpretations.

Public Involvement

On October 13, 1994, letters were sent to 24 key public contacts. Lee Lauritzen, Area Manager, contacted some key public contacts by phone or in person to discuss with them the Mohawk/McGowan analysis area. Public notices were published in the Eugene Register Guard and Springfield News to obtain comments from the public regarding the Mohawk/McGowan analysis area. Flyers were mailed to 110 individuals who had through a questionnaire expressed an interest in knowing when the Eugene District BLM would be conducting watershed analysis. Flyers were posted at 3 businesses within the Mohawk/McGowan watershed to let the public know we were doing watershed analysis and who they could contact to obtain information or give comments. The December 1994 Eugene District mailer includes an announcement about the Mohawk/McGowan watershed analysis process beginning and who to call for more information.

There was very little public response to the BLM letters and flyers. Upon the completion of the document, a briefing will be held for interested publics.

H:\RES\WP\CHAPT'1.M&M

References

Interagency Watershed analysis Coordination Team. 1994. *FY 1994-96 Watershed Analysis Guidelines*. Regional Ecosystem Office, June.

Regional Ecosystem Office. 1994. *A Federal Guide for Pilot Watershed Analysis*. January. Portland, OR.

USDA, Forest Service and USDI, BLM. 1994. *"Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Norther Spotted Owl, Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Fores related Species Within the Range of the Northern Spotted Owl."* April. p.B-20.

Chapter 2
Description of Mohawk/McGowan Watershed

Watershed Location

The Mohawk/McGowan Watershed is located northeast of Eugene/Springfield and covers 87,887 acres (see Figure 1). The watershed is within the Willamette Province established by the Forest Ecosystem Management Assessment Team (FEMAT) and the Regional Ecosystem Office (REO). Mohawk/McGowan Watershed lies in the McKenzie Resource Area of the Eugene District, Bureau of Land Management. The Mohawk River is the lowest major watershed in the McKenzie River system.

Coburg Hills Fringe Area - Approximately 3,952 acres that are not in the Mohawk/McGowan Watershed are included in this analysis for specific values/issues (see Chapter 3). This area is identified as the Coburg Hills Fringe Area and is in the upper elevations of the Coburg Hills west of the Mohawk/McGowan Watershed. This area is on the west aspect of the Coburg Hills with the streams draining directly into the Willamette Valley.

Climate

The watershed has a maritime climate characterized by mild temperatures and a long frost free growing season. Winters are wet with prolonged cloudy/overcast periods. Summers are characterized by fair, dry weather for extended periods of time produced by high pressure systems. Annual precipitation ranges from 40 inches at the western edge of the watershed to 90 inches at the eastern edge, with the majority occurring between October and April. The precipitation generally results from low pressure weather systems that approach from the Pacific Ocean on dominant westerlies.

Elevation ranges from 450 to 3,800 feet. The precipitation gradient (lowest in the south, highest in the east) is influenced by this elevation difference that creates orographic uplift of the storms that usually enter the watershed from the west. Precipitation at the lower elevations is primarily in the form of rain, with snow occurrence increasing as elevation increases.

Ownership and Land Use Allocation

- The following table describes the entire Mohawk subbasin including Wendling Drainage. Approximately 90 percent of the subbasin is zoned Forest by Lane and Linn Counties.

Mohawk River Subbasin by Zone Type (1994)

ZONING	ACRES
Residential	4,608
Commercial	4
Industrial	55
Public Facilities	61
Park and Recreation	61
Quarry and Mine Operation	1
Agricultural	5,924
Forest	103,399
Unknown	68

Source: McKenzie Basin Residential Land Use Pilot Analysis

Approximately 78 percent of the watershed is either BLM administered lands or large industrial forest lands. The small private lands may also be forested. The table below shows the ownership distribution for the Mohawk/McGowan Watershed. Map 1 shows the ownership for the watershed.

Ownership	Acres	Percentage
BLM	22,777	25.9
Large Industrial Private Lands	45,752	52.1
Small Private Lands	17,846	20.3
Lane County	17	<0.1
U.S. Govt. (other)	91	0.1
Local Municipal	19	<0.1
No Data	1,288	1.5

The Table below describes the acres per Land Use Allocation (LUA) on BLM administered lands. Approximately 52 percent of BLM administered lands are in the General Forest Management Area (GFMA), and approximately 37 percent of BLM administered lands are in the Riparian Reserves. Map 3 shows the LUAs for the watershed. Map 4 shows the Riparian Reserves according to the ROD.

Land Use Allocation	Forested Acres	Percentage
Connectivity	2,057	9
General Forest Management Area	11,907	52
Riparian Reserves	8,497	37
District Designated Reserves (DDR)	36	.1
Late-Successional Reserves (LSR)	266	1
Total acres	22,763	

In the watershed analysis area, there are approximately 1,20 acres of administrative outs. The following special areas are within the watershed:

Special Areas	Acres
Mohawk ACEC/RNA	290
McGowan Creek EEA	79
Horse Rock Ridge ACEC/RNA	378
Grassy Mountain ACEC	75
Relict Forest Island ACEC (RFI/ACEC)	1
Total	823

ACEC	Area of Critical Environmental Concern
RNA	Research Natural Area

The table below describes the acres per land use allocation on BLM administered lands in the **Coburg Fringe**. There are 2,481 acres in the Coburg Fringe. Map 2 shows ownership of this area.

Land Use Allocation	Forested Acres	Percentage
Connectivity	711	28.7
General Forest Management Area	915	36.9
District Designated Reserves (DDR)	657	24.5
Late-Successional Reserves (LSR)	198	8
Total Acres	2,481	

In the Coburg Fringe, there are approximately 1,290 acres of administrative outs. The bald eagle habitat areas total 802 acres and the RFI/ACEC is 488 acres.

Geology

Regional Geology

The McGowan/Mohawk Watershed are within the Cascade Range physiographic province, which is actually 2 parallel mountain chains. The older, deeply eroded Western Cascades are a sharp contrast to the High Cascades on the eastern flank. The formation of the Western Cascade Range began approximately 40 million years ago with eruptions of a chain of volcanoes just east of the Eocene shoreline. Due to the movement of enormous crustal plates, intense volcanic activity produced thick lava and ash deposits to form the Western Cascades. With uplift of this landmass, the Tertiary sea retreated progressively westward. Later, during the Miocene/Pliocene epochs, there was a massive outpouring of lavas in the Cascades.

Five million years ago, the Western Cascades were again tilted, creating a sloping ramp on the west side and a steep face on the east. This ramp of the Western Cascades casts a rain shadow over central and eastern Oregon.

Glaciers formed in the Cascade Range during the Pleistocene epoch, and the Western Cascades were subjected to additional uplift and some folding and faulting. Near the center of the mountain range, major north-trending faults developed such as the pronounced McKenzie-Horse Creek fault.

Local Geology

Stratigraphy - Ten rock units have been identified in the watershed as shown on Map 6. The oldest rocks in the watershed are exposed in the southwest corner of the study area. The Eugene Formation (Oligocene and Eocene) found here is arkosic and micaceous sandstone and siltstone deposited in a marine environment. Welded and unwelded tuff ("Tut" on Map 6) overlie the Eugene Formation at the southern Coburg Hills location. Small pockets of zeolite deposits were found in this rock near the Shotgun Creek Recreation Site 2 years ago.

Several rock units were deposited during the Oligocene and Miocene epochs. Rocks mapped as the unit "Tut" (Map 6) are a heterogeneous assemblage of deposits of basalt and basaltic andesite, including flows, breccia, and ash deposits. A subunit ("Tub") of basaltic lava flows and basaltic andesite lava flows is found primarily on the western edge of the watershed. Silicic vent complexes ("Tsv") of late Oligocene (and younger) age are found just west of the Mohawk River at 4 locations. These rocks are of rhyolitic to dacitic composition that commonly include multiple intrusions and breccia. At the northern end of the watershed, near the Lane/Linn county line, a rock deposit mapped as unit "Tmv" is identified. This rock unit is comprised of intrusive plugs and dikes and related near vent flows, breccia, cinders, basaltic andesite, basalt, and andesite. It is commonly in the form of eroded piles of red, iron-stained thin flows. On the easterly end of the watershed, an extensive deposit of basaltic and andesitic rocks is found and mapped as rock unit "Tbaa" of mid to late Miocene age. This deposit formed from lava flows and flow breccia. The source of the rocks is believed to be mostly from widespread, northwest and north-trending dikes and related plugs and lava cones. Along the lower reaches of Shotgun Creek and Cash Creek, a large volcanic intrusion of basalt is found, shown on the map as "Tib".

Younger geologic deposition took place during the Quaternary Period. During Holocene and Pleistocene times, large landslides ("Qls", Map 6) occurred along the east flank of the Coburg Hills and the upper reaches of the Mohawk River valley. These landforms consist of poorly sorted colluvium, massive mudflow and ash-flow tuff units, and are commonly rotated blocks. Elevated terrace deposits ("Qt") of alluvial silt, sand, and gravel are found along the lower portion of the Mohawk River. Poorly consolidated clay, silt, sand, and gravel ("Qoal") is more widespread along the Mohawk River, as shown on Map 6. This geologic unit is transitional into the terrace alluvial deposit "Qt". The most recently deposited geologic unit is alluvium ("Qal") consisting of clay, silt, sand and gravel, and is currently being deposited in river and stream channels.

Structure - The region was tilted and folded during the middle Miocene, followed by outpouring of lava contributing to the growth of the Western Cascade volcanic arc. The growth of the range was modest since the accumulation sank as quickly as it piled up. The Western Cascades were subjected to additional uplift, folding, and faulting between 4 -5 million years ago. In the center of the range, major north-trending faults developed and the pronounced McKenzie-Horse Creek fault to the east marks the boundary of the uplifted block of the Western Cascade range. Two faults are mapped in the watershed (see Map 6) - one runs parallel to Shotgun Creek and northwest into Owl Creek, and the other is a short distance away in the vicinity of Drury Creek.

Three large landslides were mapped by Walker et al. 1991, and are shown on Map 6. One of these features covers over 6 square miles in the vicinity of Parson's Creek. The landslides are visible in high altitude aerial photos showing escarpments at the head of the features, and hummocky terrain downslope. Smaller slope failures have occurred in the watershed but are not shown on Map 6.

Mining Activity and Mineral Potential

Eight placer mining claims have been located in the eastern end of the watershed in T. 15 S., R. 2 E., W.M., Sec. 19: SW¼. The extent of exploration or mining activity on these lands is unknown at this time.

Within the watershed, 6 rock quarries are developed on lands managed by the BLM. The McGowan Creek quarry is used often by individuals seeking landscaping rock. All of the sites have been used in the past in producing crushed or "pit run" aggregate for use in road construction work. Approximately 600 acres are considered to have high potential, and about 500 acres have moderate potential for salable mineral (i.e., quarry rock) development.

A portion of the watershed (20,391 acres) is considered to have moderate potential for the leasable minerals of oil and gas, and the entire watershed is considered to have low potential for geothermal resources. In the vicinity of McGowan Creek, approximately 2,750 acres are considered to have moderate potential for the locatable mineral, zeolite, used in the agricultural and electronics industries. There has been no exploration for, or development of these potential mineral occurrences on public lands in the area.

Geomorphology

Essentially the watershed has formed with a harder resistant cap rock on the north, east, and west edges with soft pyroclastic rocks in the center (Weyerhaeuser's "Upper Mohawk River Watershed Analysis," see Map 5). Aerial photo interpretation and subsequent field investigation revealed 6 general geomorphic surfaces in the Mohawk/McGowan analysis area (see Map 7). The table below gives the acreages and percentages for these surfaces. Each surface will be discussed below.

Summary of Geomorphic Units Within Mohawk/McGowan Watershed

Geomorphic Unit	Acres	Percent of Watershed
Unit 1	5,797	7
Unit 2	41,014	47
Unit 3	11,893	13
Unit 4	16,145	18
Unit 5	7,535	9
Unit 6	5,512	6

Geomorphic Unit 1 is the valley bottoms and consists of terraces and flood plains along Mohawk River and its major tributaries. This unit is composed of geologically recent alluvial deposits of unconsolidated sand, silt, clay, and gravel. It occurs on 5,797 acres (7%) of the analysis area.

Geomorphic Unit 2 is the largest in the watershed (41,014 acres; 47%) and occupies the lower elevations adjacent to the valley bottoms. This geomorphic surface extends to the higher elevation ridge tops in 3 areas that are lower elevation "saddles". The bedrock is mostly soft pyroclastics that weathers relatively fast and produces deep, fine textured soils. The bedrock and soils are relatively weak; therefore, gentle to moderate slope gradients are typical.

A few hard rock intrusions occur in this unit. They appear on the geology map as basaltic and andesitic intrusions and silicic vent complexes and occur at the southwestern end of the watershed and in the McGowan, Crooked/Owl, and Cash drainages. These hard rock intrusions are obvious on the landscape because they appear as the higher ridges and "points" with steeper slopes within this geomorphic unit.

Geomorphic Unit 3 is composed of large, old (last 10,000 years or so), deep-seated landslides that may have been associated with earthquake activity. The characteristic hummocky topography of landslide areas is typical of this geomorphic surface. Slope gradients are moderate with complex drainage patterns that are still reacting to the landslide movement. Soils are typically deep and fine textured. The 7 individual units that compose this geomorphic unit were taken from the geology map and Weyerhaeuser's data. Approximately 11,893 acres (13% of watershed) are in this geomorphic surface.

Geomorphic Unit 4 occurs on 16,145 acres (18%) of the watershed and is the prominent ridge tops and immediately adjacent steep slopes that rim the watershed to the north, west, and southeast. Typically underlaying this unit is hard rock (often basalt flows) that is more resistant to weathering than the softer pyroclastic rock underlaying Geomorphic Unit 2, which occurs at lower elevations. This unit forms the top of the Coburg Hills. These ridge tops are broad and rounded, often with steep scarps immediately adjacent. These scarps were created by landslides (Geomorphic Unit 3), which occupy areas immediately below them. Streams that originate on the ridge tops frequently cascade down the steep slopes and scarps of this unit. The scarps in this geomorphic unit appear to have stabilized.

Geomorphic Unit 5 occupies the lower elevations in the upper (east) end of the watershed and accounts for 7,535 acres (9%) of the watershed. Slopes have moderate to steep gradients that are often interrupted by benches created by small-scale rotational landslides. This geomorphic unit is different from Unit #2 because it has steeper slopes and a higher drainage density. Limited field investigation suggests that this geomorphic unit is underlain by a more competent (harder) rock. Several road cutbanks have exposed what appears to be flow breccia type bedrock. Small scale rotational landslides appear to have been a dominant factor in shaping the landscape of this unit.

Geomorphic Unit 6 occurs on 5,512 acres (6%), which are the highest elevations in the eastern portion of the watershed. This unit is on the broad ridge tops and adjacent sideslopes, which typically have moderate gradients. Competent andesite and basalt bedrock underlay the typically gravelly soils found in this unit.

Soils

The Mohawk/McGowan Watershed analysis area is dominated by highly productive soils, occupying 69 percent of the watershed. These soils are deep, well-drained, reddish-brown silty clay loams, with less than 15 percent coarse fragments in the soil volume. Less than 5 percent of the analysis area is occupied by soils with low productivity. These soils are generally found on steep slopes or in the higher elevations of the eastern portion of the analysis area, and are often associated with scattered rock outcroppings. The soils are shallow to moderately deep, well drained to somewhat excessively drained, and dark brown, with rock fragment content ranging from 15 to 75 percent.

Most of the analysis area is occupied by soils in the udic moisture regime. Thirty percent of the area has soils with a xeric, or drier, moisture regime. The latter group of soils are generally found at lower elevations, in the Mohawk River Valley and adjoining foothills. Ninety-six percent of the soils have a mesic temperature regime. The remaining 4 percent of soils have a cryic temperature regime and occupy the cooler, higher elevation sites in the far eastern portion of the analysis area.

Hydrology and Streams

Water Quality - All numerical water quality standards are being met in the Mohawk/McGowan Watershed.

The beneficial uses that have been identified are: Public-domestic water supply; Private Domestic; Irrigation; Livestock; Anadromous Fish Rearing; Salmonid Fish Passage; Resident Fish and Aquatic Life; Wildlife and Hunting; Fishing; Boating; Water Contact Recreation; and Aesthetic Quality. Six water quality parameters have been identified as not fully supporting these beneficial uses: nutrients, debris, erosion, turbidity, suspended sediment, and temperature. There are no other known water quality problems in the watershed.

Nutrients: Given the large acreage in agriculture and pasture, it is likely that a nutrient problem exists; however there is no data on nutrients.

Debris: This problem probably does not exist.

Erosion - Turbidity - Suspended Sediment Sediment rates, including those on BLM administered lands, have increased due to land use practices, including those on BLM administered lands. The impacts to the beneficial uses may or may not be significant because most of the sediment is transported out of the watershed.

Temperature: Summer water temperatures in the lower Mohawk River are too high to support salmonids and some other aquatic organisms.

Species	Preferred Range	Optimum Temp.	Lethal Temp.	Location	Temp (°F)
Chinook	45 - 58	54	78	At Mouth	77
Steelhead	45 - 58	50	75	Above Log C	71
Cutthroat	49 - 55	----	73	Shotgun Creek	50

Average Flows (Water Yield) - Average annual precipitation in the Mohawk watershed is approximately 60 inches. Of this 40.19 inches leaves the watershed as stream flow. This amount equals 379,300 acre-feet or 524 cfs. The Mohawk River has lower flows than other rivers in the McKenzie Basin. The Mohawk watershed is about 14 percent of the McKenzie watershed and contributes about 10 percent of the water.

Minimum Flows (Base Flow) - Since 1936 base flows for the Mohawk River have ranged between 10 and 34 cfs. The average base flow for the period was 19 cfs. A minimum flow of 20 cfs is required to be released from the Mohawk River for aquatic habitat and for downstream users. There are 139 water rights in the Mohawk Watershed and the river is over appropriated. No water rights have ever been shut off due to lack of water; however, most years the low flow comes close to the minimum flow required. The base flow for the Mohawk River is low when compared to most other rivers.

Peak Flows (Floods) - The largest flow recorded for the Mohawk River was 13,000 cfs on December 22, 1964. In 1977 the largest flood was 1200 cfs. Creeks in the upper portion of the watershed (Shotgun and Log creeks) are expected to be flashier and have relatively larger peak flows than the main stem of the Mohawk or the lower portion (Parsons and McGowan Creeks).

Land use practices, including forestry, have increased peak flows since Euro-American settlement. These increases benefit aquatic and riparian values if the channel and riparian areas have enough structure to handle the increase. If the increases overwhelm the system, larger peak flows will degrade aquatic and riparian habitats. In the developed flood plain of the Mohawk valley, increased peak flows degrade the river and cause an increase the amount of flood damage.

Vegetation

The forested plant communities in the watershed are within the low elevation (500 - 3,500 ft.), western slope, middle Cascade foothills, Douglas-fir zone. The major coniferous tree species are Douglas-fir (*Pseudotsuga menziesii)*, western hemlock (*Tsuga heterophylla*), and western red cedar (*Thuja plicata)*. Hardwood species present include red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), golden chinkapin (*Castanopsis chrysophylla*), Pacific madrone (*Arbutus menziesii)*, and Pacific dogwood (*Cornus nutallii*).

The shrub and ground cover species associated with these forested plant communities are varied and plant associations have not yet been developed for the watershed. Common shrub species include vine maple (*Acer circinatum*), hazel (*Corylus cornutta*), oceanspray (*Holodiscus discolor*), salal (*Gaultheria shallon*), Oregon grape (*Berberis nervosa*), elderberry (*Sambucus spp*), willow (*Salix spp*), rhododendron (*Rhododendron macrophyllum*), and poison oak (*Rhus diversiloba*). A variety of ferns, forbs, and other ground cover species are also present within the area. Invasive plant species including Scotch broom (*Cytisus scoparius*), tansy ragwort (*Senecio jacobea*), and others are present throughout the watershed.

Unique vegetation communities or special habitats occur in the Mohawk/McGowan Watershed. These are generally associated with wetlands; riparian areas; dry, rocky meadows; and rock cliffs. These known areas are mapped on the Timber Production Capability Classification (TPCC) photos and/or the watershed botany surveys.

Wildlife

The Mohawk/McGowan Watershed supports a wide variety of wildlife species. Although few wildlife surveys have been conducted, Appendix WL lists the vertebrate species known or suspected to inhabit this watershed. There are also many species of invertebrates that may occur within the watershed, which have yet to be surveyed or identified. Of the species known or suspected to occur, there is 1 Threatened species, the northern spotted owl; 15 Candidate species (6 vertebrates and 9 invertebrates); and 28 species (4 vertebrates and 24 invertebrates) identified as Bureau Sensitive, Bureau Assessment, or Bureau Tracking (Appendix WL2). In addition, this subbasin supports a number of recreationally important species such as Roosevelt elk, black-tailed deer, mountain lion, and black bear.

Fisheries

No population estimates or trends in abundance for cutthroat trout are available, although anecdotal reports suggest cutthroat are less abundant than they once were. Large adults in the upper Mohawk watershed are very infrequent today compared with times past. This is attributed to loss of adequate rearing space and habitat complexity (J. Ziller ODFW, pers. comm.). Trends in abundance of wild rainbow trout populations for the McKenzie or its tributaries are similarly difficult to determine (Howell et al. 1988). Angler data suggests catch rates have remained fairly constant since 1948. Since most of the changes to trout habitat in the Mohawk Basin occurred prior to that time, decreases in population would have occurred prior to the time records were available. There is no information to suggest wild rainbow populations are in decline. Total chinook run sizes (hatchery and wild) are considerably below historic levels, but appear to be stable. However, the Mohawk River is not considered by ODFW (Howell et al. 1988) to be suitable for spring chinook because of a lack of holding pools, warm water during the summer, and low flow during the spawning period. These conditions could affect other salmonids as well.

There are no special fishing regulations for the Mohawk system. General regulations for the Willamette zone apply.

Economics

The commodities produced in the watershed include commercial timber, special forest products, agriculture products, and recreation. There are a variety of small businesses in the analysis area such as restaurants, stores, golf club, and other service providing industries. The majority of the people in the watershed commute to Eugene or Springfield for work. In a survey completed in October 1994, 16 percent of those surveyed in Lane County stated that their immediate family is economically dependent on the timber industry. From the same survey, 23 percent of those surveyed in Linn County, stated that their immediate family is economically dependent on the timber industry.

Recreation

A variety of recreation activities takes place in the watershed. The location adjacent to the Eugene/Springfield area makes the Mohawk/McGowan Watershed a prime recreation area. The following is a list of activities: horseback riding, hang gliding, mountain bike riding, dirt bike riding, sightseeing, hiking, target shooting, etc. The BLM Shotgun Recreation area is also located in this watershed. These activities may occur elsewhere but may not be to the degree or within close proximity to Eugene/Springfield.

Population

Most of the population lives along the Mohawk River, and Parsons and Wendling creeks. This area received it first settlers around 1850. In the late 1800s the towns of Marcola, Wendling, and Mabel expanded with the logging industry and were considered logging towns. In 1990 the population in the Marcola Division had increased by 10 percent over 1980 trends.

H:\RES\WP\CHAPT'2.M&M

Chapter 3
Values/Issues and Key Questions

Major Values/Issues

The Core Team identified 5 major values/issues for the Mohawk/McGowan Watershed Analysis. After identification of these values/issues, the Core Team then selected a series of key questions that will assist in addressing each value/concern.

Value/Issue 1 - Aquatic Habitat - This issue focuses on conditions of aquatic habitats (riparian areas, streams, and uplands) and how these conditions have affected fish species distributions. Habitat requirements for anadromous fish is also a part of this issue.

Value/Issue 2 - Public Use - A series of public use issues are thought to be important in these watershed. These uses include: recreation, access and travel, hunting, fishing, and urban sprawl.

Value/Issue 3 - Water Quality and Quantity - This issue deals with understanding the roles of physical and hydrological events and processes within the basin. This understanding is translated into an attempt to determine water quality (sediment and temperature) and quantity (peak and low flows) for the watershed. An understanding of these processes will help determine whether it is in balance with the needs of the inhabitants and users.

Value/Issue 4 - Commodity Values - The focal point of this issue primarily deals with timber production and special forest products.

Value/Issue 5 - Terrestrial Habitat - Trends of vegetative communities and populations of terrestrial wildlife species within the watershed are the focus of this issue.

Key Questions

The following is a listing of the key questions identified by major resource. Each question is numbered with the prefix identifying the resource group (e.g., V is Vegetation). Each question was ranked by the line officer as to importance and priority in the analysis to provide the core team with a sense of priorities for gathering information and completing the analysis.

Vegetation

Rank	Question #	Key Question
High	V1.	What natural and human-caused disturbances (historic) occurred within M/M watershed? What is the Range and Natural Condition (RNC) (spatially and temporally) and are current veg patterns within that range (e.g., Have human disturbances altered the historic veg pattern?) **NOTE**: Include riparian areas in this question.
High	V2.	Why is the current veg pattern the way it is (include a description of current veg pattern (seral stages, landscape elements))? **NOTE**: Include riparian areas in this question.
High	V3.	What are the special habitat/plant communities that exist in the M&M watershed?
High	V4.	What and where are the plant spp. (e.g., T&E, noxious, special forest products) of concern, and why?

Medium	V5.	How do vegetation and recreation interact? (How do they affect each other?)
High	V6.	What are the existing structural components of veg communities as they relate to biological and physical components? **NOTE**: Include riparian areas in this question.

Riparian Vegetation

High	R1.	Are upland disturbances impacting riparian areas? If so, how?
High	R2.	What criteria are important to consider in adjusting Riparian Reserve widths?

Fisheries

High	F1.	What is the current distribution and abundance of habitat for critical life stages of stocks at risk fish species? How does it relate to natural range of variability?
High	F2.	What is the distribution and abundance of habitat for critical life stages of aquatic species (e.g., native fish) other than stocks at risk?
High	F3.	How have/do historical/current disturbance events/activities (man caused and natural) impacted/impact habitat for all aquatic species? What are the aquatic habitat trends and how are they influenced by our actions?
High	F4.	What is the current and future availability of structural materials, primarily large woody debris, to provide for channel stability and habitat diversity?
Medium	F5.	What is the distribution and abundance of nonnative aquatic species, and what is their impact on natives?
High	F6.	Are there any barriers to fish migration or colonization routes? If so, blockage for what species and where do they occur? Consider barriers creating isolated populations.

Wildlife/Habitat

High	WL1.	What impacts do management actions (roads, agricultural activities) have on wildlife?
High	WL2.	What special attention, special status, and T & E species occur in the watershed?
High	WL3.	What is the impact to wildlife species from current LUAs?
Medium	WL4.	What high interest species (deer, elk, cougar, bear, accipiters, etc.) occur in the watershed?
High	WL5.	What introduced/exotic species occur in the watershed, and what are the impacts to native species from these exotics?
High	WL6.	What endemic species could occur, but currently do not occur, in the watershed?
High	WL7.	What biological data needs are there?

Water/Soil

High	WS1.	What mass wasting processes are active, and where is there evidence of, or potential for, mass wasting in the watershed (what areas are sensitive)?
High	WS2.	What is the hillslope erosion potential (e.g., what areas are sensitive)?
High	WS3.	What is the erosion and related sediment potential from roads?
High	WS4.	Where do erosion processes (mass wasting, hillslope, roads) deliver sediment to stream channels or other waters?
High	WS5.	What is the inherent, natural range of soils/site productivity and has it been affected by man?
High	WS6.	Is the amount of sediment transported to stream/water sufficient to cause a change in channel, habitat conditions, or beneficial use?
High	WS7.	What is the spatial distribution of channel response types?
High	WS8.	What were the historic channel conditions and have management actions altered them (include floods)?
High	WS9	What are the watershed conditions influencing hydrologic response (peak and base flows)?
High	WS10	Are all water quality standards (e.g., sediment, chemical, temperature) relevant to beneficial users and listed in Chapter 340 of Oregon Administrative Rules being met? What are the expected maximum summer temperatures?
High	WS11.	What are the beneficial users/uses of water?

Social

High	S1.	What commodities are, or likely will be, produced in the M&M watershed (include recreation, special forest products, etc.)?
Medium	S2.	How are market forces likely to drive private land and public land use, regulation, and zoning?
Low	S3.	What is the location and density of residences?
High	S4.	What is the land ownership pattern?
High	S5.	What are the existing recreation opportunities (ROS social, physical, and managerial settings, criteria, and attributes)? Include present scenic character and user preferences.
High	S6.	Where/how are recreation activities impacting the M&M watershed?
High	S7.	What and where are unique recreational values (sacred places)?
High	S8.	How do recreation and other activities affect private landowners?

High	S9.	How will future demographics affect recreation opportunities? and local people views on managing the forest?
Medium	S10.	What tourism opportunities are there?
Medium	S11.	Is there a need for "focused recreational" areas? If so, where?
High	S12.	What/where are existing recreation facilities, and what are their use levels?
High	S13.	How does the supply of recreation resources outside the area influence recreation within the area? Together, how do they provide a broad spectrum of opportunities from which to choose?
High	S14.	Is the recreation resource (supply) consistent with current human needs and demands?
High	S15.	Do conflicts currently exist between recreation activities? If so, where? Is resource damage currently occurring as a result of recreation activities and where?
Medium	S16.	How will new forest management direction change the need for interagency coordination (especially with Oregon Dept. Forestry fire protection agreement and with private landowners)?
Medium-Low	S17.	Where are utilities located? Are the utilities causing conflicts with resources or other uses? What utility needs are likely in the future?

Coburg Hills Fringe Area

As indicated on Figure 1, approximately 3,952 acres outside the Mohawk/McGowan watershed are included in this analysis and identified as the Coburg Hills Fringe area. A complete watershed analysis for this area was not conducted but, due to its "connectedness" to Mohawk/McGowan, certain values/issues are addressed in this analysis.

Major Values/Issues

Value/Issue 1 - Recreation - The major access routes for the Coburg Hills Fringe area are located in the Mohawk/McGowan watershed. Launch sites for hang gliders and scenic touring are a couple of values/issues that connect the Fringe area with Mohawk/McGowan watershed.

Value/Issue 2 - Terrestrial Habitat - Bald eagle habitat is a major value/issue for the Fringe area. Current vegetation relationships with bald eagle habitat is a focus of this issue.

The terrestrial assessment for the Coburg Hill Fringe has not been completed at this time. Currently, the assessment is being conducted and will be added to this watershed analysis when it is completed.

H:\RES\WP\CHAPT'3.M&M

Chapter 4
Past and Current Conditions

Social

Cultural Resources/Watershed History

The lower McKenzie River drainage (below river mile 26) including the Mohawk River and Camp Creek drainages has been inventoried more completely and the prehistory of the area is better known than any other drainage of a comparable size within the Eugene District with a similar amount of BLM administered land. Beginning as early as 1967 artifact collections were made and records completed for sites located on agricultural lands along the lower course of the Mohawk River. This effort was continued during the summer of 1970 as part of the Willamette Valley Prehistory Project and resulted in the recordation of 9 sites on agricultural lands along the lower portions of Camp Creek, the Mohawk River, and the McKenzie River.

Prehistoric Period - The discovery of a single Clovis point on a gravel bar in the Mohawk River following the 1964 Christmas flood raised the possibility that the prehistoric record for the Mohawk River drainage may span 10,000 years and that a site belonging to the Paleoindian period lies deeply buried somewhere along the course of the Mohawk River (Allely 1975). Evidence for sites belonging to later cultural periods from the Early Archaic through the Late Archaic and the Early Historic is much more concrete. See Appendix A for a listing of sites that have received some subsurface testing.

Ethnographic Period - Very little is known about the Kalapuyan peoples inhabiting the upper Willamette Valley beyond some basic information regarding the names of the Kalapuya bands inhabiting the southern Willamette Valley and the territorial boundaries of these bands. The Mohawk River, Camp Creek, and lower McKenzie River drainages between the area around the community of Vida (river mile 41) downstream to the junction of the Mohawk River have been identified as the territory of the Mohawk band of the Kalapuya. Immediately west of the Mohawk band was the territory of the Chafan band of the Kalapuya. The territory to the east was occupied by the Molala, a non-Kalapuyan group (Beckham 1976).

Ethnographic research with Kalapuya informants did not begin until the third decade of the twentieth century. See Appendix A for a synopsis of the Kalapuyan lifestyle.

Euro-American Settlement

Euro-American settlement in the southern Willamette Valley began in 1846 when Elijah Bristow, Eugene Skinner, Felix Scott, and William Dodson staked claims in what are now Pleasant Hill, Eugene, and Springfield. Over the next 20 years much of the arable land on the floor of the Willamette Valley and the valleys of the larger tributaries was staked. This included land in the Mohawk Valley, the lower Camp Creek valley, and land along the lower McKenzie River.

The pace of settlement in the lower Mohawk Valley was rapid. By 1860-61 all of the available bottomland had been claimed except for some small, apparently landlocked remnant tracts located between the previously staked donation land claims. The pace of settlement upstream from the area around present-day Marcola and in the upland areas to either side of the valley was much slower. The lower reaches of McGowan, Parsons, and Shotgun creeks were claimed during the 1880s. Much of the public domain in the narrow valley of the Mohawk River and the lower reaches of its tributary streams north of Marcola passed into private ownership via Homestead Entry or Cash Entry during the 1890s. There was, apparently, little interest in claiming the timbered uplands west of the Mohawk Valley or north of the townsite of Mabel until the first decade of the Twentieth Century. Then there was a rush to claim this suddenly valuable timberland and by 1909 most of the tracts outside of the O&C Grant lands had passed into private ownership via Cash Entry purchases. This essentially closed out the public domain lands available for settlement with the exception of a few scattered tracts in the upper valley that were patented by homestead entry as late as 1936.

Logging and Lumbering

The production of lumber for the local market began before 1854 in the Mohawk Valley. Land surveyors noted a recently constructed water-powered sawmill owned by William Simmons was in operation on the lower Mohawk River in 1854. Water-powered mills producing lumber for local markets continued to be constructed in the Mohawk drainage on the Mohawk, on Mill Creek, and on Shotgun Creek during the period between 1860 and the early 1890s. Lumber was hauled by wagon to markets in Eugene and as far away as Harrisburg. Columbus Cole, founder of Marcola, built the first steam-powered mill in the Mohawk Valley around 1891. However, the lumbering boom did not begin in the Mohawk Valley until the Southern Pacific Railroad acquired the O&C Railroad in 1896.

In 1896 Southern Pacific built a railroad bridge across the McKenzie River next to Hayden Bridge and built track up the Mohawk Valley reaching the location of the Booth-Kelly mill site at Wendling in 1900. This rail line provided ready access to eastern and midwestern markets and, during the next few years, large mills sprang up all over the Mohawk Valley. The Mohawk Lumber Company built a mill on McGowan Creek near Donna with a flume to move lumber to the railroad. Fischer Lumber Company built a mill on Parsons Creek with a flume to move lumber to their planing mill and the railroad siding at Marcola. Southern Pacific also operated its own mills with 3 mills operating near Marcola. The sawmills flumed rough-sawn lumber to the planing mill in Marcola. Booth-Kelly bought a small mill on Mill Creek and began constructing a large mill and company town at Wendling. The Coast Range Lumber Company, successor to the Hyland Lumber Company and the Sunset Lumber Company, operated a large mill in Mabel at the mouth of Shotgun Creek. Besides these large mills, a series of smaller mills were built at various localities and operated for varying periods of time. All used various combinations of pole roads, chutes, and splash dams as well as animal and steam power to move logs from the woods to the mill. Before farmers along the Mohawk River and Mill Creek raised loud complaints because their fields were periodically flooded, splash dams were used to drive logs on the Mohawk River and all of its tributary streams of any size.

Between 1906 and 1910 the larger mills such as Mohawk Lumber, Fischer Lumber, Booth-Kelly, and Coast Range Lumber Company began railroad logging. Over the next 10 to 20 years these and other companies built miles of track systems with impressive trestles spanning streams and cut many thousands of acres of timber.

There are logging companies and loggers that exist within the watershed. Since people are more mobile than in the early 1900s, loggers are not necessarily confined to the Mohawk/McGowan watershed analysis area. Therefore, the harvest levels at the county level may be more important than at the watershed levels. There are some indirect benefits to local businesses when there is logging occurring in the watershed, including the buying of supplies, food, and gas.

Most of Lane County is forested; 88 percent of the land contains or is used for growing trees. Over half of the county's land is managed by the Federal government; 10 percent by BLM and 44 percent by the Forest Service (North Fork of Siuslaw watershed analysis). In Lane and Linn County, timber production dropped significantly in 1989 by 30 and 40 percent, respectively. Linn County timber production remained fairly steadily from 1990 to 1993. Lane County timber production continued to slowly decrease from 1990 to 1993.

In Lane County from 1950 to 1961 the majority of the timber production came from private land. From 1962 to 1989 public lands have contributed more than private lands to timber production. From 1990 to 1993 private lands have contributed the most to timber production. In Linn County private lands have contributed the most to timber production since 1950 with the exception of 1987, 1988, and 1991.

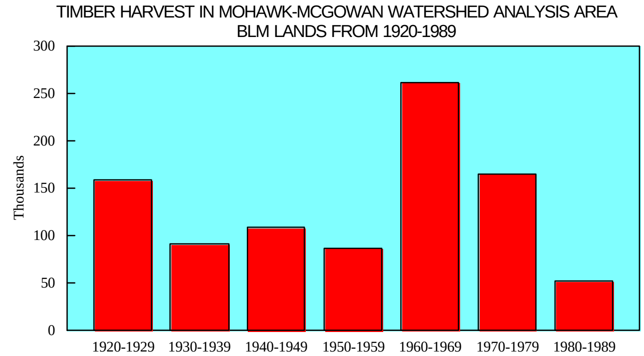
For the Mohawk/McGowan watershed the amount of timber harvested has decreased since the 1960s. The same is true for all forest land in both Lane and Linn counties. The table below shows the amount of harvesting by decade. The All Forest in Counties column represents timber harvested in Linn and Lane counties on private and Federal lands.

Table: Trends In Timber Harvest On BLM And All Forests Lands

	BLM in Watershed	% Change	All Forests in Counties	% Change
1960-1969	262,462		21,232,719	
1970-1979	165,591	-36	19,787,036	-7
1980-1989	52,669	-68	17,343,502	-12

Sources: BLM and Oregon Department of Forestry Data
NOTE: There were no timber sales sold in 1987-1989 within the watershed on BLM lands.

The Figure shows the trends of timber harvest within the watershed since 1920. In 1964 there was a major wind storm that caused many trees to blow over; the amount of harvesting in 1960s reflects the salvage of wood following the storm.



The amount of money received from the timber harvest has declined since the 1970s. There was a 68 percent decrease in timber harvest money in the 1980 decade over the 1970 decade; the 1960 decade had the most harvesting on BLM land and the counties as a whole.

Table: BLM Timber Harvest

Year	Dollars	Volume (MMBF)
1918-1919	33,81.25	24,000.00
1920-1929	276,460.92	158,418.60
1930-1939	150,573.55	91,188.60
1940-1949	544,410.15	109,250.00
1950-1959	3,039,130.87	87,387.00
1960-1969	10,952,914.28	262,463.00
1970-1979	28,419,210.00	165,591.50
1980-1989	10,692,023.65	52,669.60
1990-1992	3,602,699.00	12,086.00

Source: BLM data

Population

The Marcola Division census tract included information for the Mohawk/McGowan watershed analysis area and the Wendling and Camp Creek drainages. The table below shows that Marcola Division's population increased by 10 percent over 1980 levels. This increase is higher than that experienced in Lane County and the Eugene/Springfield area.

Table: Population Changes

Place	1980	1990	% Change
Lane	275,226	282,912	2.8
Eugene/Springfield	157,352	147,245	6.8
Marcola Division	3,953	4,329	10

Sources: 1980 & 1990 U.S. Census Data

In the Marcola Division there are 4,583 people who are 5 years of age or older. The table below describes the movement of people living in the Marcola Division. In 1985 there was an increase of 21 percent in the number of people residing 5 years or more in the same house over the 1975 level; this means people are staying longer in the same house. In 1990 at least 26 percent of the population had moved into the Marcola Division since 1985. There was a 10 percent increase in population.

	Residents in 1975	% of Total	Residents in 1985	% of Total	% Change
Persons 5 Years and Older	3,953		4,329		10
Lived in the Same House	2,160	55	2,613	60	21
Lived in Eugene/Springfield	708	18	565	13	-20
Lived in Lane County (not Eugene/Springfield)	472	12	551	13	17
Lived in Other Places in the U.S.	501	13	555	13	11
Lived Abroad	112	3	45	1	-60

Sources: 1980 & 1990 U.S. Census Data

The population resides mostly along portions of the Mohawk River, Parsons Creek, and portions of Wendling and Camp Creek roads. Twenty-seven percent more people worked in Lane County in 1990 than in 1980. The percentage of people who live in Marcola Division and commute to work outside the Division increased from 71 percent in 1980 to 81 percent in 1990. The Springfield area had the most increase in the number of people commuting to work from the Marcola Division.

WORK PLACE	1980	% of Total	1990	% of Total
Work in Lane County	1,502		1,915	
Eugene	567	38	765	39
Springfield	451	30	670	35
Cottage Grove	12	.007	11	.005
Junction City	0	0	12	.005
Remainder of Lane County	471	33	457	24
Outside of Lane County	51	.03	95	.05

Sources: 1980 & 1990 U.S. Census Data

Economics

Euro-American Settlement began in 1846 in the southern Willamette Valley (Southard 1995). The settlers tilled fields and constructed dwellings. Logging and lumbering occurred on a small scale. In 1896 Southern Pacific starting building tracks in the Mohawk Valley. With the coming of the railroad, the Mohawk Valley experienced growth in the population and in the logging industry. Marcola and surrounding areas were developed around the logging industry. Today the area still has logging. The area is also used for recreational purposes and special forest products collection. There are small businesses to provide services to the local people and people moving through the area.

Small businesses in the early 1900s were the following:

> Shin shoe repair, confectionery, drug store, Winter's Photo studio, doctor's office (briefly), bakery, butcher shop, barber shop, pool hall, livery barn, real estate-insurance-notary office, tavern, meat market, post office, Frank Mason's studio, railroad depot, several mills and logging companies, and a hotel.

In the early 1900s people worked and lived in the same town. There were small and large (Booth-Kelly) lumber companies. The lumber companies had mills along some of the major creeks. People had homesteads where they farmed and grazed animals; however, most had to work off the farm to make a living. Businesses existed that were needed to keep a town going on a day-to-day basis.

Small businesses in 1995 include the following:

> auto parts store, general construction company, real estate, tile and marble, wood work and design, herb company, masonry, fast foods, restaurant & gas, grocery stores, metal shop, boat shop, auto body and paint, logging company, software shop, post office, golf and country club, gun club, and riding stables.

In 1994 there were no mills in the watershed analysis area. With the availability of affordable vehicles, Springfield is less than 30 minutes away.

Income

The average household income in 1990 was $38,148, however, 23 percent of the households made $14,999 or less in the Marcola Division. The following table shows the income distribution as of 1990.

Table: Number of Households Per Income Level

INCOME	Number of Households in 1990	% Change of Total
Less than $5,000	125	7.5
$5,000 - $9,999	131	7.8
$10,000 - $14,999	125	7.5
$15,000 - $24,999	260	15.6
$25,000 - $34,999	276	16.6
$35,000 - $49,999	361	21.7
$50,000 or More	385	23.2

Sources 1980 & 1990 U.S. Census Data

Employment

There are 2,194 people in the labor force. Of that 143 are unemployed, (6.5%). The following Table shows what industries employed people in the Marcola Division. In 1990 manufacturing, retail trade, and education services had the highest percentage of the labor force 16 years and older.

Table: Industry Employment

Industry	Number Employed	Percent
Agriculture, Forestry, Fisheries	106	5
Mining	6	0
Construction	98	5
Manufacturing, nondurable goods	118	6
Manufacturing, durable goods	429	21
Transportation	120	6
Communications and other Public Utilities	43	2
Wholesale trade	81	4
Retail trade	309	15
Finance, insurance, and real estate	52	3
Business and Repair Services	106	5
Personal services	44	2
Entertainment/recreation services	5	0
Health services	119	6
Educational services	214	10
Other Professional and related services	93	5
Public Administration	88	4

Sources 1980 & 1990 U.S. Census Data

The mean travel time to work is 23.6 minutes. This may mean that the 92 percent of the workers over 16 are driving to work outside of the watershed analysis area. Since less than 1 percent are employed in agriculture, forestry, or fisheries, an assumption can be made that not many of the workers are driving into the forest or to farms for work.

Recreational activities directly impact local business within the Mohawk/McGowan watershed by generating foot traffic through those businesses. For example, social trails developed/maintained by dirt bikers provide trail opportunities touted by Berachah Farms to potential paying customers. Hang gliders get thirsty and patronize the Mohawk store. Teenage kids doing "vehicular snow boarding" get hungry and patronize the Marcola hamburger spot.

Tour de Lane is a rural economic development opportunity being planned to capitalize upon the strong bicycling interest. It aims to promote a network of existing and future bicycle trails and support facilities throughout rural communities with the goal of getting bicyclists to spend their money within those communities. Because of the already heavy bicycling use occurring within the watershed, it makes an excellent candidate for inclusion in the Tour de Lane effort.

A number of individuals are supplementing their income to a surprising degree within the watershed as a direct result of the recreation activities occurring within it. Regular patrols for bottles, cans, and brass occur weekly. Individuals who have been collecting for some time are very good at knowing where the good collection sites are located (e.g., party points, popular shooting alleys, rock piles, quarries, etc).

Recreation

The Mohawk/McGowan watershed analysis area is used for a variety of recreational activities. This area is used by mountain bike riders, motorcycle riders, 4X4 drivers, hang gliders, paragliders, remote-control gliders, horseback riders, hikers, campers, hunters, target shooters, and special forest product collectors. BLM's Shotgun Park, a day-use area, is located in the analysis area. On private lands there are Springfield Golf and Country Club, Emerald Empire Gun Club, and Berachah Farms.

Many recreation activities such as hunting, shooting, hiking and horseback riding have been occurring for a long time. Other recreation activities have recently emerged as a result of changing technology applied to recreation equipment (Mohawk Planning). The Mohawk Recreation Area Management Plan (MRAMP) process has started to reduce the different types of conflict occurring in the planning area for the benefit of providing sustainable recreation opportunities. The MRAMP will cover areas within and outside of the Mohawk/McGowan Watershed Analysis area.

Recreation activities occur throughout the watershed. Some activities are very specific in the type of setting that is needed for an activity (i.e., hang-gliding). Most of the activities that occur are not restricted to public land.

What is the Recreation Opportunity Spectrum (ROS) status within the watershed?

Lands immediately adjacent to Marcola Road are predominantly RURAL. The same is true for lands adjacent to Parsons Creek Road, McKenzie View Drive, Hill Road, and the handful of paved road segments east of Marcola Road. These areas are culturally modified yet attractive with rural residential developments, pasturelands, crop fields, public facilities (e.g., fire station, post office, schools), and small commercial businesses.

Lands within the McGowan Creek drainage, the lower Shotgun Creek drainage, the lower Drury Creek drainage, and the lower to middle sections of the Coburg Hills ridge line are predominantly ROADED MODIFIED. The same is true for lands adjacent to Road No. 16-2-10.1 and lower half of Road No. 16-2-10. Likewise, upland lands south of Marcola and east of Marcola Road are also ROADED MODIFIED. The ROADED MODIFIED lands are substantially modified because of considerable powerline intrusion and timber harvest activities. They possess few on-site controls of users. These controls are limited to gates, road and trail obstructions, and restrictive signage.

Lands within the remaining fabric of the watershed, with the exception of Shotgun Park and lands northeast of Mabel are predominantly ROADED NATURAL with pocket intrusions of ROADED MODIFIED (No field assessment has occurred for this area due to timeline). The environment appears mostly natural as viewed from sensitive roads and trails. On-site controls of users are like those noted above for the ROADED NATURAL settings with the addition of fences (e.g., Shotgun warehouse and water treatment facilities).

Shotgun Park represents an island of URBAN classification surrounded by a sea of predominantly ROADED NATURAL lands. The manicured lawns and nonnative facility components (e.g., asphalt volleyball court, ball field, heated changing rooms, playground, etc.) contribute to this unusual situation. It is only when a person leaves the core recreation area and hikes on an adjacent trail that there is the opportunity to temporarily enjoy a ROADED NATURAL experience consistent with the surrounding lands.

Existing Recreation Facilities, and Use Levels - Shotgun Park is approximately 20-25 minutes drive north of Springfield/Eugene area. Because of its location, the park is heavily used and is near capacity of the design level. The park provides picnicking, 2 group shelters, a hiking trail network,, swimming area, softball diamond, playground, volleyball court, and shower and toilet facilities.

The Springfield Golf and Country Club (private) consists of an 18-hole course, club house, restaurant, pro shop and cart shed (Rec. Module). The Emerald Empire Gun Club is a rural shooting range that can accommodate a variety of shooting activities (i.e., rifle, pistol, high-powered automatic, skeet, etc.). Berachah Farms is a rural horse riding, grooming, and boarding facility. They have approximately 44 stalls and are essentially fully rented out (Rec. Module). Mohawk and Marcola Elementary Schools and Marcola High School are rural recreational and educational sites. Area elementary schools provide playgrounds and gymnasium equipment. The Marcola High school provides playing fields, gymnasium equipment, and courts.

Existing Recreation Opportunities, Unique Recreation Opportunities

Trail users: A large network of social trails can be found throughout the watershed. Often serving a multi-use function, the trails are enjoyed by hikers, mountain bikers, dirt bike riders and, in some cases, 4-wheelers and horse riders. The trails are unique on several fronts: (1) they are low elevation (a rare commodity for area public lands) and, therefore, accessible year round; (2) they are extensive and often loop together (a highly desirable trail feature); (3) they are readily accessible; and (4) they offer a variety of technical challenge levels.

The lower half of lands within the watershed sustain regular horse riding use. Unique factors that facilitate area horse use include an extensive network of trails, granted permission by the private landowners for that use, and an adjacent commercial boarding stable. The unique factors make the lower half of the lands with the watershed a sacred place for horse riders.

The primary Off Highway Vehicle staging area (T. 16 S., R. 1 W., Section 5) is a highly valued place for OHV users. From it, the bulk of the more popular, heavily ridden OHV trails are accessed. This staging area is unique from other smaller staging areas found within the watershed because of its larger size and abundant "play" features (e.g., hills, depressions). Also, due to its greater nonvegetated surface area, easy access, unobstructed viewing opportunities, and easy to moderate terrain, the site serves as a key learning area for novice riders and their instructors.

Bicycling : The Lane County Board of Commissioners' Rural Community Improvement Council initiated an economic development bicycle project called Tour-de-Lane. Presently, numerous private individuals and public agencies (BLM included) are working to implement the project in an attempt to promote recreational tourism. The project proposes using State and Federal parks and recreation sites as launching points for bicycle touring on back roads and forest trails throughout Lane County.

The BLM has issued special recreation permits for competitive bicycling events within the Shotgun drainage of the Mohawk watershed. It would be expected that this would continue since competitive bicycling remains a popular activity and the watershed possesses characteristics that appeal to racing enthusiasts (e.,g., distance trails/roads, differing challenge levels, desirable scenery, etc.).

A mountain biking publication, Lane County Oregon Mountain Bike Ride Guide, is in its second printing. It describes in detail the numerous riding routes throughout Lane County and includes a write-up of the

Shotgun Creek, 12-mile route. This route is described as ". . . the most ridden route in the Coburg Hills. Almost every Wednesday there is a group of rabid mountain bikers who come to this area rain or starlight. They're on a nocturnal mission."

Motorcycle Riding: A motorcycle group, Emerald Trail Riders Association (ETRA), has its roots in the Mohawk watershed. Like other clubs of its type, ETRA sponsors group rides that can attract riders from outside the immediate community. These rides can focus on different aspects of the sport: competition; leisure, noncompetitive family outings; and group riding skill development. ETRA has and will likely continue to sponsor organized rides within the Mohawk watershed. Their area of preference are the lands west of Marcola Road.

Launch site users: A string of 3 high-elevation sites along the Coburg Hills are presently used for hang-gliding, paragliding, and/or remote-control gliding. One site, North Bowl, is just outside the watershed boundary by a factor of mere yards. This site and the road system leading to it are incorporated into the analysis for several reasons: (1) topographically speaking, it's very much within the watershed since it represents a ridge line condition before dropping off towards the Willamette Valley, (2) it is a high-use recreational site for a number of activities, some that are very unique, and (3) it is part of the Mohawk RAMP planning area and will likely be targeted for some type of management focus due to item No. 2 above and subsequent site conflicts that have been identified . The North Bowl site and the other 2 are unique within the Willamette valley because of a number of key factors that allow for good flight conditions: slope, orientation, smooth air flow, clear launch sites, convenient road access, and available space for vehicle parking and equipment set up. This makes this a valued place for the above activities.

Locations

North Bowl - The site is at the terminus of a 13.4 gravel road, west of the most northern paved section of McGowan Creek Road (16-2-27). The site is on public land managed by the BLM.

1700 Road - The site is on private land managed by Willamette Industries (T. 16 S., R. 3 W., Section 23 NE¼).

Mt. Tom - The site, near the terminus of Road No. 15-2-31, is on private land managed by Willamette Industries (T. 16 S., R. 2 W., Section 6). This site is recommended for acquisition by BLM using equity equalization.

Hang Gliding & Remote Control Gliding : Both activities utilize the Coburg Hills area. Both recreational activities have potential for developing an organized event component, competitive and otherwise. Historically, these uses have remained at an informal level, where individuals or single clubs have engaged in the gliding activity. However, members of the ValleyVille Hang Gliding Association and the Academy of Model Aeronautics have expressed a desire to work with the BLM in developing some level of formal gliding events within the watershed.

Living History Interpretation -- The Ford Umpqua Muzzle Loaders have discussed with BLM a potential opportunity for identifying a location(s) within the watershed that could be used for a living history event highlighting the pioneering era and its accompanying outdoor activities. Coinciding this event with a logical event companion (e.g., Marcola's Mary Cole Days) merits consideration as a economic development opportunity.

Other diverse users: Target shooters, hunters, and diverse campers are found throughout the area. Target shooters also are found wherever rock quarries or piles are located.

Supply and Demand

The Mohawk/McGowan Watershed Analysis area provides recreational opportunities such as hang gliding, horseback riding, and OHV use that are not available near the Eugene/Springfield area or are limited in other areas because of the physical setting and land ownership patterns. This watershed analysis area provides for a wide range of recreation activities that cannot be found within 30-miles in either direction. Some of the activities are very unique and not readily duplicated regionally. The proximity to Eugene/Springfield area and different types of recreation opportunities available makes this area a destination point for many users.

For the MRAMP process, several public meetings were held. The following is an abbreviated list of needs generated at the meetings that indicate current recreation areas/facilities are not meeting the recreational demand:

- Allow/create limited camping at Warner Lake
- Develop campgrounds of various sizes
- Develop hang gliding launches on public land
- Develop a horse trailer parking area/trailhead
- Identify a network of legal mountain bike and motorcycle trails

Recreation Activities' Potential Impacts on Private Land

- Private landowners' privacy is diminished because of unregulated use and encroachment by recreational users.
- Ownership boundaries are blurred and increased use on private lands is the result.
- Possible objections of users to timber harvest actions on private lands for reasons of visual quality, access, etc.
- Fires started by recreationalists on BLM administered lands by users will spread to privately owned lands

Private landowners are concerned about the quality of their property and the ownership being impacted by recreationists' activities and viewpoints. See Appendix R for a listing of some potential impacts of recreation activities.

Affect of Future Demographics on Recreation Opportunities

In general, demographic trends linked to anticipated changes on both private and public lands include the following:

- Increased recreational use of the watershed considering its close proximity to a metropolitan area and a national trend citing increased favor of long weekend trips and trips closer to home over the traditional, extended two-week vacation.

- Recreational opportunities provided in the future will be designed and managed to facilitate people of all abilities in response to legal obligations outlined in Section 504 of the 1973 Rehabilitation Act and the 1990 Americans with Disabilities Act.

- Visitor use will increase as a result of travel and tourism efforts supported by neighboring cities and rural communities. An example is the Tour de Lane project designed to promote a network of bicycling opportunities throughout Lane County, particularly on lands adjacent to rural communities (e.g., Marcola, Brownsville, Mabel, etc.)

- The recreating public will be older, but healthy and desiring to recreate as a means of enhancing their quality of life. Census figures project a 50 percent increase in individuals aged 55 years and older by the year 2010. The general population is estimated to increase by 15 percent within this same period. By the year 2000, one in four Americans will be 65 years of age or older.

- Until alternatives are offered that serve the fundamental needs of area youth, serious problems of youth delinquency and violence will continue to escalate and manifest themselves on lands close to metropolitan areas where larger youth populations exist. Anticipated problems include vandalism, car clouting, rape, bodily injury, resource damage, drug manufacturing and drug-based parties, and potential loss of life.

Special Forest Products

In 1994 the harvest of firewood decreased by 76 percent over the 1993 level; the harvest of greens and moss has increased by 65 percent and 53 percent, respectively, over the 1993 level. The decrease in firewood has contributed to a decrease in total dollars collected from special forest products.

Table: Quantity of Some Special Forest Products Collected

Years	Dollars Collected	Firewood Quantity Cords	Greens Quantity Pounds	Moss Quantity Pounds
1985	148	72	500	0
1986	1,994	73	2,550	100
1987	350	9	2,750	0
1988	8,096	6.57	1,400	0
1989	5,739	360	2,000	433
1990	1,648	506	1,400	0
1991	1,829	121	3,750	1.033
1992	2,327	551	3,150	69
1993	3,194	1,082	5,075	5,100
1994	1,514	256	8,408	7,800
		3,036.57	30,983	14,535

There are other special forest products collected such as bolts and shakes, boughs, burls, cascara bark, corral poles, Christmas trees, cones, fern, mushrooms, post line, rails, sawtimber, wilding, and yew bark. The amounts collected above fluctuate from year to year.

Land Use Allocations

Twenty-two percent of the people live on properties that are less than 1 acre. Less than 1 percent of the people, 5 years or older, live on farms. Only 4 percent of the Mohawk River watershed is zoned residential (Schaffner). The portion of Linn County that is within the analysis area is zoned agricultural and forest. In the Mohawk subbasin, the Lane County portion is 75 percent forest and the Linn County portion is forest and agricultural, which is 14.7 percent of the subbasin.

AQUATIC ECOSYSTEM

Erosion

Mass Wasting Erosion Assessment - Mass wasting is the downslope movement of soil and rock material through a variety of landslide movement mechanisms. It is an important natural physical process that has helped create the landforms in the Mohawk/McGowan analysis area. The material generated by mass wasting events can have beneficial effects downstream by supplying structural components such as gravels, cobbles, and woody debris to stream channels. On the other hand, the water-charged debris torrents resulting from mass failures can scour stream channels and remove needed structure. Mass wasting events can also have detrimental impacts on public safety, private property, roads, bridges, and water quality. Although mass wasting is a natural process in this landscape, the natural frequencies and magnitudes can be influenced by human activity.

Important factors contributing to slope instability include steep gradients; low soil strength; declining root strength; ground water accumulation; alteration of natural water routing; and high frequency, duration, and intensity of precipitation. Landslide movement types include shallow, rapid translational failures; deep-seated rotational slumps; debris avalanches; and torrents. A mass movement potential map of the Mohawk/McGowan area (see Map 9) was developed using GIS with topography (slope steepness), stream location, and Timber Productivity Capability Classification (TPCC) (for field identified unstable areas) themes, and aerial photo inventory (rotational slumps). Three categories of relative potential for mass movement, High, Medium, and Low, were mapped using criteria discussed in the methods. The Table below summarizes the percentage and number of acres in each category.

Table: Mass Wasting Potential

Mass Wasting Potential	Acres	Percent of Watershed
Low	73,263	83
Moderate	14,299	16
High	325	<1

Less than 1 percent of the analysis area was predicted as having a High potential for mass failures. Some of this mapping category is composed of small, active failures identified in the field during the TPCC inventory or during other field investigations. Most of the areas mapped as High potential for mass failure are steep slopes adjacent to streams and can result in shallow, rapid translational failures. Translational failures are uncommon in the analysis area but can occur on steep slopes with shallow soils, as a result of road related excavated material sidecast onto steep slopes (>65%), or due to road cut or fill slope failures.

Areas predicted to have a Moderate potential for mass failure occupy 16 percent of the watershed. These areas are primarily represented by the large, natural rotational failures of recent geologic history (Holocene and Pleistocene epochs), and evident in the McGowan Creek, Parsons Creek, Log Creek, and the upper reaches of the Mohawk River drainages. Deep-seated rotational slumps is the major type of landslide movement occurring in the analysis area and is consistent with the volcanic geology of the watershed. Rotational slumps are generally associated with the deep, fine textured soils and gentle to moderate topography prevalent in the Mohawk/McGowan landscape.

Eighty-three percent of the analysis area was predicted to have a Low potential for mass movement.

TPCC surveys and limited aerial photo inventory indicate road building is the human activity most commonly resulting in an increase in the frequency and magnitude of mass failures in the analysis area. Sidecasting of road excavation on steep slopes, road drainage increasing ground water storage in headwall areas, and cut and fill failures can increase the risk of failures, particularly on steep slopes. Road locations that compromise the natural buttressing ability of slope components can increase failures in old, rotational slump topography. Harvesting and site preparation methods (broadcast burning) may increase the risk of failure in landslide prone areas through a reduction in slope stabilizing root strength.

Surface Erosion Assessment - Hillslope erosion occurs on slopes where detachable soils on moderate to steep slopes are exposed to rainfall and overland or surface flow. Sediments generated by surface erosion processes can affect water quality and aquatic habitat. Surface flow is uncommon in the Mohawk/McGowan landscape because of the presence of organic layers in the forest landscape that provide a protective layer minimizing the opportunity for soil detachment and overland flow. Any soil detachment that does take place under natural conditions in the analysis area is at a very small scale and the result of freezing/thawing, rainfall, windthrow of trees, landslides, and animal activities. The occurrence of overland flow can be increased by human activities that result in soil compaction or where site preparation or harvest activities have reduced the surface organic layer. Factors determining the susceptibility of soil to erosion include type and amount of vegetation, topography, climate, and soil properties such as cohesiveness, infiltration rates, and texture.

The relative potential of hillslope related surface erosion for the Mohawk/McGowan watershed analysis area was analyzed by developing a soil erosion potential map. The factors used in the GIS analysis were topography (slope steepness) and soil erodibility (soil K-factor). The K-factor is a relative measure of the erodibility of bare, freshly tilled soils. The assumption is certain, easily detachable soils (low soil strength) occurring on steep slopes are most susceptible to surface erosion and overland flow. Vegetative cover and climate were not included in the analysis.

The location of Soil K factor classes (Strong, Moderate, and Weak), are depicted in Map 10 and information on the acreage and percent of the analysis area are summarized in the following Table. Less than 1 percent of the watershed was predicted to have Weak soils with a high potential for detachability. Over 94 percent of the watershed analysis area is occupied by soils with Strong soil strength.

Table: Soil K-Factor Categories

Soil K Factor Category	Acres	Percent of Watershed
Weak (K<.25)	562	<1
Moderate (K=.25-.4)	3,498	4
Strong (K>.40)	83,405	95

Map 11 indicates the location of each topographic class (Gentle, Moderate, Steep) in the analysis area. Two percent of the analysis area is in the Steep slope class (>60% slopes) (Table, below). Seventy-four percent of the analysis area is in the Gentle slope class.

Table: Slope Class Summary

Slope Class	Acres	Percent of Watershed
Gentle (<30%)	64,711	74
Moderate (30-65%)	21,058	24
Steep (>65%)	2,118	2

The distribution of Hillslope Erosion Risk Classes of Low, Moderate and High, derived from the information from the Soil K factor and Slope Class maps, is shown in Map 12. Less than 1 percent of the watershed analysis area is in the High Erosion Risk Class (Table, below). Most of the sites in this class are river wash or fluvents, which are susceptible to erosion due to their proximity to strong water flows. Other notable locations are rocky sites. Ninety-six percent of the soils in the analysis area is in the Low erosion risk category.

Table: Hillslope Erosion Class

Soil Erosion Potential	Acres	Percent of Watershed
Low	84,457	96
Moderate	2,860	3
High	157	<1

Confidence in this analysis is moderate because no erosion measurements were collected. In addition, the soil K-factor values were developed for agricultural conditions and have not been adapted for forest environments. Also, the K-factor values are for bare, tilled soil, a level of disturbance atypical for the forest environments of the analysis area. The erosion potential map can, therefore, be seen as a "worst case" scenario. Limited field investigations were conducted indicating no evidence of significant surface erosion in the analysis area.

Road Related Erosion and Sediment Assessment

Road related erosion can be a significant source of sediment to streams, potentially degrading aquatic habitats, domestic water supplies, and water quality for other beneficial uses of water. Whereas cutslopes and fillslopes will eventually revegetate following initial road construction, thereby reducing erosion from these sources, the road running surface remains unvegetated, and can continue to erode and provide sediment to streams for as long as the road is in use. Sediment from road surfaces is routed from the road prism to streams by flowing water in culverts, roadside ditches and, where road drainage failure has occurred, as overland flow. Although all roads can generate erosion, only some portions of roads have the potential to deliver sediment directly to streams. Important factors influencing delivery of sediment to streams are the amount and condition of the road prism that drains directly into streams, the log truck traffic levels on a road, and the type of road surfacing present.

Road related erosion and sediment production for the Mohawk/McGowan Watershed Analysis area was assessed using the method described in the Washington Department of Natural Resources Watershed Analysis Manual (Version 2.0, 1993). In this assessment, an estimate of sediment production is determined by sampling roads for characteristics such as road prism, drainage system design, and traffic level in relation to how they influence sediment delivery to the stream system. Other factors included in the analysis are differing conditions of the road surface (i.e., natural, gravel, paved), cut and fill slope vegetative cover, parent material, and age of the road.

Roads in the Mohawk/McGowan area were sampled to determine the proportion of roads with the potential to contribute sediment to streams. Weyerhaeuser Company conducted a road erosion and sediment analysis using the same manual and procedures for the eastern portion of the analysis area in 1994 ("Upper Mohawk River Watershed Analysis, Weyerhaeuser Co., June 1994). Since their analysis area and results include information on roads on other private lands and BLM, only those roads in the area west, or outside of their analysis area, were inventoried. Map 13 indicates the boundary between the BLM and Weyerhaeuser road inventory and analysis areas.

There are approximately 356 miles of road in the BLM inventoried portion of the Mohawk/McGowan analysis area. Approximately 108 miles (30%) are within 200 feet of a stream, 10 miles (3%) within 75 feet of a ridge, and 238 miles (67%) are midslope roads. Eighty-one percent of the roads are surfaced, with 17 percent paved roads and 64 percent gravel surface roads. Road density is 4.48 mi/sq.mi. on BLM lands, 3.67 mi/sq.mi. for large private industrial lands, and 3.70 mi/sq.mi. for other private lands.

An important factor in the assessment is traffic level. The manual presents guidelines for placing roads into either a high, moderate, light, or nonuse traffic category based on the expected amount of long-term average use by log trucks. Traffic levels in the watershed analysis area were assumed to be in the light category. Fourteen percent of the roads, consisting of half of the paved roads and a few gravel roads serving as active secondaries, were placed in the moderate use category. No roads were classified as expected to have heavy log truck traffic. The following Table lists the totals for sediment delivery to streams by road surfacing type, cut slope vegetative cover, and traffic level.

Mohawk/McGowan WA - Sediment Yield from Roads

Road Surface	Cutbank Veg. Cov. %	Traffic Level	Road Length Delivered Sediment (Miles)	Annual Sediment Yield (Tons/Yr)	% of Annual Sediment Yield From Roads
Native	>80	Light	46	1,303	37
Gravel	>80	Light	51	1,032	29
Gravel	<80	Light	4	154	4
Gravel	>80	Medium	7	441	12
Paved	>80	Light	7	105	3
Paved	>80	Medium	22	506	14

TOTALS: 137 miles = 3,541 tons/year

Total sediment delivery was estimated to be 3,541 tons/year (0.06 tons/ac/yr). Thirty-eight percent of the total road miles were determined to have the potential to contribute sediment to streams. Of this total, 37 percent contribute runoff and sediment directly to stream crossings, and 1 percent to crossdrains within 200 feet of a stream. (In the analysis a portion of the runoff and sediment from crossdrains within 200 feet of a stream are predicted to reach stream channels.)

Native and Gravel roads with light traffic level contribute the majority of the sediment from roads. There are far more gravel, light traffic roads (214 miles) than native surface roads (69 miles). Native surface roads, due to their lack of surfacing, have a higher potential for eroding and subsequently delivering sediment to streams. In addition road inventory showed native surface roads were generally in poor condition, exhibiting road drainage failures and associated gullies routing sediment directly to streams or to roadside ditches of surfaced roads, resulting in a larger percentage of the road length (i.e., 67 percent versus the average of 37 percent) contributing sediment directly to streams.

The background sediment yield for this portion of the Mohawk/McGowan Watershed was estimated to be 3,744 tons/year (0.06 tons/ac/yr) (see the following section on Sediment Routing for discussion on background sediment yield). The percent increase in sediment delivered by roads is approximately 95 percent of the background level.

The road delivery segment of this analysis has the following limitations and opportunities for improvement in the future:

1. A sample of roads on small private lands, in particular in the lower half of Parson's Creek and in the Mohawk Valley floor, was not included in the road inventory.

2. Due to a lack of information on road locations and surfacing on private lands, satellite imagery and GIS were used to estimate the location of roads. Road inventory data and local knowledge were used to identify road surface type. Road inventory results indicate there are more native surface roads in the western half of the analysis area than were mapped.

3. Although gravel roads were adequately sampled during the road inventory, paved and native surface roads received relatively less sampling. Therefore, confidence in the sediment delivery values for these roads is low. The lack of information on native surface roads is important for the reasons stated above.

4. The western half of the analysis area (i.e., McGowan, Parson's and Shotgun drainages) is heavily used by dirt bike and mountain bike enthusiasts, and an extensive trail system is present in the area. The trail systems use existing logging roads, old skid trails, and trails created exclusively for bike use. These trails are unsurfaced, lack drainage relief and, at times, intersect streams or roadside ditches. Bike trails were not sampled in this analysis and, therefore, the extent of sediment delivery from these trails is unknown. An inventory of these trails and knowledge of their location relative to streams would assist in assessing their potential for contributing sediment to stream systems.

Stream Crossing Inventory - The road inventory for the sediment delivery analysis included the inspection of stream crossings in order to identify locations of concern. Stream crossings were investigated to identify the type and size of the crossing or culvert, and to note whether the crossing was actively eroding, did not allow or was hampering fish passage, or was too small to allow for adequate movement of flow and materials down the channel network.

A total of 529 stream crossings were investigated. Of these 4 percent were log culverts and 7 percent were "canon" culverts. Log culverts are generally a concern because of the possibility fish passage is impacted and the knowledge that this type of crossing could deteriorate at any time. Less than 1 percent of the canon culverts were actively eroding. Four percent of the crossings were failing or otherwise actively eroding. Twelve percent of the culverts were identified as undersized for the stream crossing. Features such as a build-up of woody debris or the development of a wetland (agrading) on the upstream end of the culvert were used to determine whether a culvert might be too small for the stream. Fish passage was a potential problem on 11 percent of the crossings.

Although an analysis of the contribution of sediment from eroding stream crossings is not possible, it is useful to know where problem areas are located and how widespread the problem is in a particular drainage. This inventory indicates culvert type and size is the most common problem, potentially impacting both fish passage and the ability of materials to move through the channel network.

Sediment Routing - Sediment yield, or the processing, storage, and transporting of weathered material through a watershed influences channel morphology, aquatic habitat, domestic water supply, and other uses of water. Of concern are forest management and other human activities that change input rates, particularly of fine-grained material, influencing sediment routing throughout a watershed, and potentially affecting the suitability of streams for fish habitat and water quality.

The purpose of this assessment is to identify areas in the watershed with the potential to produce increases in sediment affecting water resource values. Previous discussions on the importance of hillslope, mass movement, and road-related erosional processes can be used to develop an understanding of the relative increase in fine sediment yield in comparison to natural background sediment yield.

Natural background sediment yield was determined using the method described in the Washington Department of Natural Resources Watershed Analysis Manual. The procedure assumes soil creep is the major source of sediment under natural conditions. The annual soil creep erosion rate is estimated using length of the stream channels in the basin, average soil depth, and a creep rate as a length per year. This procedure results in a very gross estimate of soil creep, but is the best estimate available in lieu of information on local conditions.

For the Mohawk/McGowan Watershed Analysis area, the source of the background sediment yield was assumed to primarily be the result of soil creep. The hillslope and mass movement erosional processes previously discussed indicated these processes do not generate significant amounts of erosion and sediment. Aerial photo interpretation and field reconnaissance revealed only few small, active landslides. Although landslides can contribute significant amounts of sediment in the short-term, no attempt was made to quantify the contribution of sediment from landslides over a long period.

The natural background sediment yield was estimated to be 3,744 tons/year (0.06 tons/acre/yr) for the BLM inventoried portion of analysis area. The road erosion analyses estimated erosion from roads is contributing 0.06 tons/acre/yr on the BLM inventoried portion of the watershed. Assuming erosion from roads as being the major nonnatural erosional process in the analysis area, total sediment yield is 0.12 tons/acre/yr. The estimated total sediment yield was compared to figures on sediment yield measured at the BLM's water monitoring station on

Shotgun Creek, a major tributary into the Mohawk River. The sediment yield from Shotgun Creek for the period of 1986 to 1990 ranged from 0.05 to 0.27 tons/acre/year. This comparison indicates the total sediment yield estimated by the analysis procedures falls within the range of measured sediment figures for the area.

Although analysis indicates erosion from roads has increased sediment production over natural levels, stream habitat inventories in the uplands do not indicate degradation of aquatic habitats by excessive sediment levels as a widespread problem within the watershed analysis area. This is consistent with the results of the stream channel assessment describing the Mohawk/McGowan watershed as dominated by moderately confined transport reaches, resulting in the watershed having a high capacity for transport of materials through and out of the watershed. Excessive sediment is not known to be a concern for domestic water supplies.

Water Quality

Present Water Quality Conditions - All numerical water quality standards are being met in the Mohawk/McGowan Watershed.

The beneficial uses that have been identified in this watershed are: Public-domestic water supply, Private Domestic, Irrigation, Livestock, Anadromous Fish Rearing, Salmonid Fish Passage, Resident Fish and Aquatic Life, Wildlife and Hunting, Fishing, Boating, Water Contact Recreation, and Aesthetic Quality. Six water quality parameters have been identified as not fully supporting these beneficial uses - nutrients, debris, erosion, turbidity, suspended sediment, and temperature. There are no other known water quality problems in the watershed.

Nutrients - The 1988 State Water Quality Assessment identified a moderate problem with nutrients in the reach of the Mohawk River below McGowan Creek. This problem was identified by observation that has not been confirmed by any measurements. Given the large acreage in agriculture and pasture, it is likely that a nutrient problem exists.

Debris - The 1988 State Water quality Assessment identifies a moderate problem with excessive debris accumulations on the reach of the Mohawk River below McGowan Creek. This problem was identified by observation but has not been verified. An extensive survey of this reach in 1995 did not find excessive debris.

Erosion - Turbidity - Suspended Sediment - These parameters are discussed in the Sediment routing section.

Temperature - Various studies and monitoring reports show that summer water temperatures are too high to support salmonids and some other aquatic organisms. When water temperatures are greater than 58^{o} F., the State standards place limitations on activities that cause temperature increases. Temperatures needed for salmonids are shown in the Table below.

Table: Stream Temperatures for Salmonid Fishes

Species	Preferred Temperature Range	Optimum Temperature	Upper Lethal Temperature
Chinook	45 - 58	54	78
Steelhead/Rainbow	45 -58	50	75 - 76
Cutthroat	49 - 55	----	73 - 74

Some of the 1986 recorded maximum summer temperatures are shown in the following Table.

Table: Maximum Summer Stream Temperatures

Location	Temp. (^oC-^OF)
Mohawk River near the mouth	25 - 77
Mohawk River above McGowan Creek	24 - 76
Mill Creek near mouth	25 - 77
Mohawk River above Marcola	22 - 72
Shotgun Creek at the Park	18 - 64
Mohawk River above Log Creek	20 - 68

Past Water Quality Conditions - There have been major changes in land use since European settlement that may have led to changes in water quality.

> Nutrients and other pollutants - The development of the Mohawk Valley and commercial forestry practices in the rest of the watershed have increased the likelihood of pollutants entering the surface waters. These pollutants include such things as petroleum products, man-made chemicals, and wastes. Pre-European waters were free from these pollutants except for arsenic that is natural in this basin, and the dissolved nutrients (nitrogen, phosphorous, etc.), which occurred after large fires.
>
> Debris - Changes in the amount of debris are discussed in the channel morphology section.
>
> Erosion - Turbidity - Suspended Sediment - These parameters are discussed in the Sediment routing sections.

Stream Flow

Average Flows (Water Yield): Average annual precipitation in the Mohawk Watershed is approximately 60 inches. Of this 40.19 inches leaves the watershed as stream flow. This amount equals 379,300 acre-feet or 524 cfs. The Mohawk River has lower flows than other rivers in the McKenzie Basin. For example the annual yield per Mi^2 is 47 percent greater for Gate Creek than for the Mohawk River. The Row River water yield is about the same as the Mohawk River.

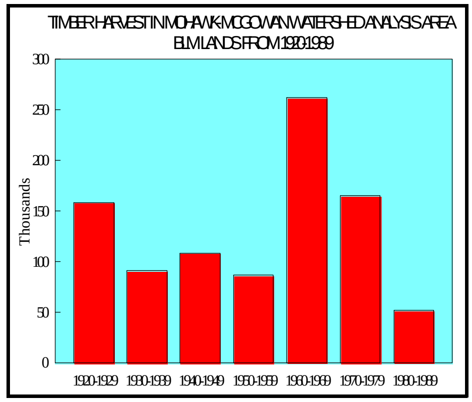
There is a large variation in precipitation rates (24-hour amounts) within the watershed, ranging between 4.5 inches and 7.5 inches. For this reason there is a large variation in water yield for the various creeks. For example Shotgun Creek averages 20 percent more water per acre than the Mohawk River. The Mohawk Watershed is about 14 percent of the McKenzie Watershed and it contributes about 10 percent of the water.

Appendix XXX contains several tables and graphs of the water yield from the watersheds mentioned above.

<u>Minimum Flows (Base Flow)</u>: Since 1936 base flows for the Mohawk River have ranged between 10 and 34 cfs. The average base flow for the period was 19 cfs. A minimum flow of 20 cfs is required to be released from the Mohawk River for aquatic habitat and for downstream users. There are 139 water rights in the Mohawk Watershed and the river is over appropriated. No water rights have ever been shut off due to lack of water; however, most years the low flow comes close to the minimum flow required.

The base flow for the Mohawk River is low when compared to most other rivers. The AVERAGE base flow of several rivers are compared in the graph. The rivers have different periods of record; therefore, the numbers are not exactly comparable.

<u>Peak Flows (Floods)</u>: The largest flow recorded for the Mohawk River was 13,000 cfs on December 22, 1964. In 1977 the largest flood was 1200 cfs. Appendix has graphs of the other large floods.



Because the natural variation in peak flows is several orders of magnitude, this analysis will discuss peak flows in terms of exceedance probability, which is the likelihood of a flood of a given size, or larger, occurring within a year. The exceedance probability is expressed as a percent. For example a 50 percent or larger flood has a 50 percent chance of happening in any year. Exceedance probability is also expressed as the recurrence interval. For example a storm with an exceedance probability of 50 percent has a recurrence interval of 2 years.

PEAK FLOWS									
		MOHAWK RIVER				ShotgunCreek			
EP[3]	RI[4]	CFS[5]	CFSM[6]	CFS	CFSM	CFS	CFSM	CFS	CFSM
80%	1.25	4,260	24					20300	22
50%	2	6,180	35	8,864	50	1,049	65	29200	31
20%	5	8,740	49	13,343	75	1,549	96	41500	45
10%	10	10,400	59	16,187	91	1,885	117	49500	53
4%	25	12,300	69	20,081	113	2,345	145	59500	64
2%	50	13,700	77	23,132	131	2,706	167	66800	72
1%	100	15,100	85	26,222	148	3,073	190	74100	80

1. Calculated from stream flow data
2. Calculated from equations developed by the USGS
3. Exceedance probability
4. Recurrence interval
5. Cubic Feet per Second
6. Cubic Feet per Second per Square Mile

Channel Morphology

Stream geomorphology reflects and integrates processes operating in a watershed because material eroded from hillsides ultimately is delivered to and routed through the channel network. The shape of the land through which a stream flows ultimately determines the potential for the input of sediment, water, and wood to the channel, relative to the ability of the channel to either transport or store these products. This information combined with geology, hydrology, historical mass wasting modules, vegetation age, and roading patterns should enable us to better understand the capabilities of a given stream, stream segment, or drainage. Using this information we should be able to predict responses to various activities (both natural and management based) that may affect aquatic resources either positively or negatively. We should also be able to identify locations in the watershed that may be particularly vulnerable or especially resilient to certain treatments/events.

Gradient is a surrogate for stream energy, the dominant control on channel morphology. Confinement controls aspects of potential response and reflects the long-term history of a valley where past events, such as glaciation, leave an imprint. Gradient and confinement together can, therefore, be used as general indicators of transport capacity.

There were a total of 445.4 stream miles and 1,887 stream segments in the assessed portion of the Mohawk/McGowan watershed. The 4 major basins, McGowan, Parsons, Cash, and Shotgun creeks, accounted for 51 percent (228.5 miles/1,024 segments: McGowan = 71.1/352; Shotgun = 70.8/345; Parsons = 58.9/232; Cash = 27.7/95). The majority of the basin was moderately confined in the 8-20 percent gradient range, and 25 percent was unconfined (Table 4-1). A surprising amount of unconfined channel was found in the 8-20 percent gradient range (49 miles/167 segments). Only 13 percent of channels in the watershed were tightly confined.

Source/Transport/Response - A simple method for categorizing channel response potential in terms of gradient and confinement was developed by Washington Forest Practices Board (1993) (see Table 4-2). Lacking more detailed information about channels, we may expect those with similar gradient and confinement to respond similarly to changes in input variables. Segment types represent the "potential" of the stream and provide constraints on the probable form that the channel can have, and thus the nature and degree of response possible.

Classification of segments into source, transport, and response reaches using gradient criteria of >20 percent for source, 3-20 percent for transport, and <3 percent for response reaches reveals general patterns of sediment (or other material) transport characteristics. Source reaches are likely to be storage sites for colluvium and are subject to debris flows and mass wasting events. Transport reaches are likely to act as conduits for rapid sediment transport and delivery to downstream reaches. Response reaches are depositional areas that are continually readjusting in response to changes in sediment/material supply.

The Mohawk/McGowan watershed analysis area was dominated by transport reaches (314.5 miles/1,252 segments/70.6%). Source areas comprised 18 percent (78.7 miles/395 segments) and there were few response reaches (52.3 miles/239 segments/12%). The 4 major basins showed the same pattern except that Cash Creek had slightly more response than source reaches (Table 4-*3).

The high capacity of the Mohawk/McGowan watershed for material transport indicates that valuable nutrients, structural materials, etc. may be limiting biological processes. Because confinement can affect or mitigate the rate of transport, the confinement condition for transport reaches across the watershed was evaluated. Throughout the watershed, and in all 4 of the major basins, the majority of the transport reaches were moderately confined. Parsons Creek was somewhat unique in that more segments (85) were moderately confined, but more stream miles (20.1) were unconfined. This system probably retains material more readily than the other basins in the watershed. There were approximately 20 percent more source than response reaches basinwide. Most source reaches were moderately confined (66%) and most response reaches were unconfined (56%). We may assume that in tightly confined areas material has no opportunity to be deposited onto a flood plain and, therefore, continues to move through the system. However, in narrow streams large objects such as wood and boulders may become wedged between canyon walls creating jams. Unconfined channels have ample opportunity for materials to deposit and these areas (when combined with low gradients) are the ecological "connectivity zones" where most biological production takes place. Unconfined reaches having a high gradient could lose material at a very high rate. Moderately confined reaches fall somewhere in between.

The distribution of source, transport, and response reaches governs the distribution of potential impacts and influences recovery times in the channel network as well as the composition and structure of the biologic communities inhabiting the stream channel. Thus identification of these potential response zones in a watershed reveals spatial linkages between upstream inputs and downstream response (Map 15).

The Shotgun Creek Basin appears to have more source areas than the other 3 major basins and the headwaters have several high gradient/unconfined segments that could be problematic. However, much of the mainstem is low gradient/unconfined, so materials from upslope should have a reasonably long residence time in the basin. A good deal of biological productivity should be expected in this basin.

Parsons Creek has very few source segments. Although most of the mainstem is comprised of transport reaches, these are generally unconfined. A variety of conditions are possible here. We may expect coarse sediment and debris flow deposition but also frequent channel scouring (degree would depend upon geology/rainfall), bank erosion, wood loss, and debris flows. In other words the area may behave unpredictably to disturbance. Most of the unconfined/response areas are located on private pasture land, precluding the biological productivity and diversity we could expect here under natural conditions.

Most of the McGowan Creek Basin is in moderately confined transport reaches with some unconfined transport. Very little source area was identified in this basin. Depending on geology, this basin has the potential for a variety of conditions. It has a fair amount of slightly lower gradient channel in the headwaters, indicating some possible depositional areas within the transport zone. These could be ecological "nick points" and should be evaluated more thoroughly.

Cash Creek is the only basin with a substantial amount of tightly confined channel. It is also almost entirely in a transport condition. There is a potential for log jams, debris flows, and coarse sediment deposition. A fair amount of unconfined transport is also present. These areas probably act as sources for material as there are almost no source reaches in this basin. This system could be flashy and unpredictable. Because of the lack of unconfined/low gradient areas, biological production and diversity is probably low. However, the formation of log jams could change this potential considerably.

Table 4-1 - Confinement and Gradient for Mohawk/McGowan Watershed. Stream miles/segments for major basins and total watershed are given (total includes basins other than those listed)

Valley Gradient and Typical Channel Bed Morphology	Streams	Pool-Riffle	Pool-Riffle, Plane-Bed	Plane-Bed Forced Pool-Riffle	Step-Pool	Cascade	Colluvial
VW > 4CW Unconfined	McGowan Shotgun Parsons Cash Total	1.2/7 2.2/7 1.6/3 --- 35.7/99	1.2/6 0.7/4 2/7 0.3/1 9.7/35	1.4/5 0.4/2 2.8/7 0.1/1 10.4/30	4.7/21 0.4/2 4.8/11 1/4 21.6/60	8.4/32 5.3/23 12.5/38 4.9/16 49/167	1.6/7 4.3/24 2.8/10 0.2/1 14.5/67
2CW < VW < 4CW Moderately confined	McGowan Shotgun Parsons Cash Total	0.3/10 1.8/22 0.1/7 0.2/2 4.0/86	--- 0.8/6 --- 0.8/1 2.5/16	0.6/8 2.6/17 0.1/4 1.4/3 9.2/52	9/51 6.3/31 0.8/9 3.1/13 32.3/169	24.9/113 18.9/94 16.9/72 10.1/35 136.3/594	9.4/51 14.3/75 7/38 0.3/2 47.8/252
VW < 2CW Confined	McGowan Shotgun Parsons Cash Total	--- --- --- --- ---	--- --- --- 0.1/1 0.4/3	0.2/2 --- 0.4/1 0.2/1 2.7/8	1.3/6 1.6/6 0.4/2 2.3/7 13.3/45	3.5/16 5.8/17 5.4/16 2.4/4 39.7/127	3.5/13 3.8/15 1.2/6 0.4/1 16.4/66
		< 1.0%	1.0 - 2.0%	2.0 - 4.0%	4.0 - 8.0%	8.0 - 20.0%	> 20.0%

Table 4-2 - Channel Segment Characteristics (from Washington Forest Practices Board (1993))

Valley Gradient and Typical Channel Bed Morphology	Pool-Riffle	Pool-Riffle Plane-Bed	Plane-Bed Forced Pool-Riffle	Step-Pool	Cascade	Colluvial
VW > 4CW Unconfined	FS BE WA	WL SF FS BE	DB DFD BE CS SF WL	DFS/DFD DB WL	DFS	DFS
2CW < VW < 4CW Moderately confined	FS BE WA	CS BE SD WL FS	CS BE DB SD DFD WL SF	DFS/DFD DB SF WL	DFS	DFS
VW < 2CW Confined	FS BE WA	CS WL	CS SD WL DFD DB	DFS/SDF DB SF WL	DFS	DFS
	< 1.0%	1.0 - 2.0%	2.0 - 4.0%	4.0 - 8.0%	8.0 - 20.0%	> 20.0%

<u>Sediment</u>

FS - Fine Sediment Deposition
CS - Coarse Sediment Deposition

<u>Discharge</u>

SD - Scour Depth
SF - Scour Frequency
BE - Bank Erosion

<u>Wood</u>

WL - Wood Loss
WA - Wood Accumulation

<u>Catastrophic Events</u>

DFS - Debris Flow Scour
DFD - Debris Flow Deposition
DB - Dam Break Flood

Table 4-3 - Source, Transport, Response Matrix by confinement class (miles/segments) for major basins and Total Mohawk/McGowan Watershed (total includes basins other than those listed).

Reach Type	Streams	Response (<3%)	Transport (3-20%)	Source (>20%)
VW > 4CW Unconfined	McGowan	2.4/13	14.5/58	1.6/7
	Shotgun	2.9/11	6.1/27	4.3/24
	Parsons	2.6/10	20.1/56	2.8/10
	Cash	---	6/21	0.2/1
	Total	45.4/135	81/257	14.5/67
2CW < VW < 4CW Moderately Confined	McGowan	0.3/10	34.5/172	8.7/48
	Shotgun	2.6/28	27.8/142	14.3/75
	Parsons	0.1/7	25/85	7/38
	Cash	1/3	14.7/51	0.3/2
	Total	6.5/102	177.8/815	47.8/262
VW < 2CW Confined	McGowan	---	5/24	3.5/13
	Shotgun	---	7.4/23	3.8/15
	Parsons	---	6.2/19	1.2/6
	Cash	0.1/1	4.9/12	0.4/1
	Total	0.4/3	55.7/180	16.4/66

Fisheries

The McKenzie River and its tributaries, including the Mohawk River, support both warm and cool water fish species (Table 4-4). Native resident cutthroat trout (Onchoryhnchus clarkii) are the most abundant and widely distributed salmonid fish species in the Mohawk watershed. Cutthroat occupy all the fish-bearing streams in the watershed (Map 16). Native resident rainbow trout (O. mykiss) also inhabit larger streams in the Mohawk Basin, but are less abundant. Most of the resident rainbow trout using the system today are believed to spend the majority of their lives in the McKenzie River, entering smaller streams to spawn (J. Ziller, pers. comm. 1994). Historically they were thought to be more abundant in the Mohawk. Spring chinook (O. tshawytscha) were also present historically, but adults have been observed only rarely in the Mohawk Basin since 1910. The capture of juvenile chinook in 1993 by the ODFW during salmonid tagging studies in the lower Mohawk River suggests successful reproduction for this species may continue to a limited degree. An alternative explanation is that these juvenile chinook were merely using the Mohawk River for winter rearing habitat, but had actually originated from adults that spawned elsewhere in the McKenzie River system (M. Wade, ODFW, pers. comm. 1994). Bull trout (Salvelinus confluentus) are native to the McKenzie system but are not known to occur in the Mohawk watershed (Howell et al. 1988).

Table 4-4: Fish Species Occurring in the McKenzie Sub-basin (Compiled by Carl E. Bond and ODF&W; modified from Howell, Hutchison, and Hooton 1988)

Common Name	Scientific Name
Catfish Brown bullhead	Family Ictaluridae Ictalurus nebulosus
Lampreys Pacific brook lamprey Western brook lamprey Pacific lamprey	Family Petromyzontidae Lampetra pacifica Lampetra richardsoni Lampetra tridentata
Minnows Chiselmouth Peamouth Northern squawfish Longnose dace Speckled dace Redside shiner	Family Cyprinidae Acrocheilus alutaceus Mylocheilus caurinus Ptychoceilus oregonensis Rhinichthys cataracta Rhinichthys asculus Richardsonius balteatus
Sculpins Paiute sculpin Shorthead sculpin Reticulate sculpin	Family Cottidae Cottus beldingi Cottus confusus Cottus perplexus
Stickleback Threespine stickleback	Family Gasterosteidae Gasterosteus aculeatus
Sturgeons White sturgeon	Family Acipenseridae Acipenser transmontonus
Suckers Largescale sucker	Family Catostomidae Catostomus macrocheilus
Sunfishes Bluegill** Largemouth bass** White crappie**	Family Centrarchidae Lepomis macrochirus Micropterus salmoides Pomoxis annularis
Trouts Coho salmon Chinook salmon Mountain whitefish Cutthroat trout Rainbow trout (resident and steelhead)** Bull trout Brook trout**	Family Salmonidae Oncorhynchus kisutch Oncorhynchus tshawytscha Prosopium williamsoni Oncorhynchus clarki Onchorhynchus mykiss Salvelinus confluentus Salvelinus fontinalis
Troutperch Sand roller	Family Percopsidae Percopsis transmontana

** Introduced

Of the nonsalmonid species listed in Table 4-4, several occur within the study area. Most nonsalmonid fishes, except sculpins (Cottus spp.) and dace (Rhinichthys spp.), are restricted essentially to the Mohawk River and their distribution has not been fully described. Several nonsalmonid fish species, such as the centrarchids and catfish, have been introduced into the Willamette River Basin. Some of these have resided in the Mohawk Basin, although little information is available on their numbers or distribution. Most probably remain in the mainstem Mohawk River.

Nonnative salmonids that have been introduced into the Mohawk in the past include coho (O. kisutch), summer and winter steelhead (O. mykiss), and hatchery-bred rainbow trout. Coho were introduced unsuccessfully into the Mohawk and its tributaries from 1962 through 1976. Adult coho returned to the Mohawk Basin, but the numbers were insufficient to maintain a self-reproducing run of coho. Some descendants of these fish may persist in the basin, judging by the few outmigrants captured during trapping operations in 1993 (Ziller et al. in press). Summer steelhead were first introduced into the Willamette Basin in 1968 and have since established in the McKenzie sub-basin. In addition over 100,000 smolts are released into the McKenzie River each year. The presence of steelhead smolts in samples of outmigrants in 1993 suggests a few stray adults or a naturalized run continues to produce offspring from the Mohawk River (Ziller et al. in press). Winter steelhead were stocked in the McKenzie Basin as early as 1911 (Wallis 1961), but the history of stocking has been poorly documented (Howell et al. 1988). Despite reports of winter steelhead being caught in the Mohawk River basin, no information could be obtained to verify hatchery fish were stocked there or that a self-sustaining population exists there today.

Nonnative hatchery rainbow trout were also stocked in the Mohawk Basin until 1988, but these are not believed to have established a self-sustaining population (J. Ziller, ODFW, pers. comm. 1994). As a result of a decision by the Oregon Fish and Wildlife Commission to manage only for native fishes in the lower McKenzie River, including the Mohawk, fish are no longer being stocked. For the remainder of this report, resident cutthroat, resident rainbow trout, and spring chinook (native salmonids) will be the principal focus of the analysis.

Nonfish aquatic organisms using the Mohawk Basin are poorly known. Among the mollusk species present are freshwater mussels and fingernail clams. Invertebrates sampled by BLM in Shotgun Creek had an average biomass of about 1.5 g/m^2, and a good diversity index of about 16. Most of the taxa present were associated with clean water and stable substrate conditions (Mangum 1991).

For a review of information on the pertinent life history of Mohawk River salmonids, see Appendix F-2.

Aquatic Habitat Conditions

The Mohawk/McGowan Watershed contains 13 tributaries classified by ODFW as Class I streams in addition to the North Fork and South Fork of the Mohawk River. The following summary is based upon stream surveys (habitat inventories) conducted from 1983-1986, primarily on BLM lands, and may not represent current conditions. Shotgun, Crooked, Seely, and Owl creeks have seen extensive instream restoration during 1993-94 and should be resurveyed to obtain current habitat information.

Of the 14 tributaries (3rd order or larger) in the Mohawk/McGowan watershed, habitat inventories were completed on portions of 8 tributaries. Inventories were primarily on streams with potential anadromous salmonid use. Information has been collected in a nonsystematic manner on other tributaries, and above inventoried areas on other streams. Based upon this information it appears that overall habitat was well below potential for both adult and juvenile salmonids and probably for other aquatic species as well, although these were not specifically investigated. Inventories were conducted on Public Lands, primarily in the lower reaches.

The size and gradient of the streams influenced the size of pools and substrates, although the presence of structural features was the most important factor in the quality of habitat present. Less than 30 percent of the habitats available were pools, only 12 percent of these were rated as being of good or excellent quality, and more than half were small (0-300 sq. ft.) (Table 4-5). A pool is considered excellent habitat when width:depth ratio corresponds to measurements where every 3 foot width is matched with 1 foot depth. Less than 10 percent of habitats had any type of cover. Quality juvenile rearing habitat, in the form of side channel, backwater, slough, or alcove pools, was available in only 2.6 percent of the 500+ habitats inventoried for the basin (Table 4-6). It should be noted that while pool habitats are used as the primary focus for evaluating stream quality in this report, trout, especially rainbow trout, also use riffles and rapids extensively during the first year of life.

Table 4-5: Pool habitat comparison for Mohawk River tributaries surveyed from 1983-1986. (values are percent of pools in listed condition)

STREAM	% POOL HABITAT	WIDTH:DEPTH RATIO				POOL SIZE (sq.ft.)[1]			
		Excel (<3:1)	Good (3:1-5:1)	Fair (5:1-10:1)	Poor (>10:1)	0-300	400-600	700-5000	5100+
McGOWAN	35	4	9	53	35	82	12	6	0
S. FORK McGOWAN	22	4	0	40	56	100	0	0	0
CASH	12	0	10	45	34	74	13	13	0
SHOTGUN	24	2	13	41	44	41	14	40	5
CROOKED	40	0	5	23	66	52	28	20	0
SEELY	52	2	6	30	53	59	15	26	0
OWL	43	0	27	31	42	98	2	0	0
LOG	82	10	14	38	38	67	12	21	0
TOTAL MEAN	28	2	10	41	44	53	14	21	2

Table 4-6: Comparison of cover, juvenile rearing habitat, and Large Woody Debris (LWD) abundances for Mohawk River tributaries surveyed from 1983-1986. (Juvenile rearing habitat includes side channel, backwater, alcove and slough pools)

STREAM	% HABITAT W/ COVER	% REARING HABITAT	LWD - PC/MI (>2'X 50')
McGOWAN	5.7	8.8	1.7
S. FORK MCGOWAN	14	0	0
CASH	10	1	0
SHOTGUN	7.7	2.4	1
CROOKED	9.6	3.6	0
SEELY	7.5	5	0
OWL	12	0	0
LOG	6.4	0	3.3

TOTAL MEAN	9.1	2.6	0.7

Large Woody Debris (LWD) was almost nonexistent with only McGowan, Shotgun, and Log creeks having any instream wood at least 24" x 50'; the basin average was 0.7 pieces of LWD per mile (Table 4-6). With the exception of a lack of large boulders, substrate types were represented fairly evenly, although not usually evenly distributed in the respective drainages (Table 4-7). Little gravel was noted and it is unknown whether the gravels found were aggregated or mixed in with other substrate types, thus being unusable for spawning. Additionally, almost 20 percent of substrates recorded were silt (Table 4-7). Silt was most common in pools and other depositional areas, and was not considered a problem in areas with suitable spawning gravels.

Table 4-7: Substrate composition of Mohawk River tributaries surveyed between 1983 and 1986 (Percentages are given)

STREAM	Bedrock	Large Boulder	Small Boulder	Cobble	Rubble	Large Gravel	Small Gravel	Sand	Silt	Organ-ics
McGowan	4.0	0.7	5.7	16.0	16.6	13.5	12.5	24.5	4.4	2.2
S. Fork McGowan	0	1.0	5.5	19.1	22.4	15.9	13.8	12.2	8.3	1.9
Cash	7.4	2.6	15.6	28.3	25.0	9.3	5.1	4.0	1.1	1.6
Shotgun	12.6	0.4	9.4	18.6	18.9	15.3	10.9	8.8	3.9	0.9
Crooked	13.6	0.1	3.4	18.0	22.2	12.4	8.0	8.3	9.4	4.6
Seely	7.0	0.1	1.3	10.3	10.6	6.9	6.8	9.1	38.2	9.6
Owl	7.0	2.0	4.1	4.3	2.9	4.7	4.8	9.1	23.0	37.2
Log	0	0	0	0.2	0.2	0.1	0.1	8.6	63.0	27.8
TOTAL MEAN	11.7	0.6	7.9	17.0	17.5	13.1	10.0	10.8	18.2	10.5

There are approximately 185 miles of potential fish habitat in the watershed. However, 35 miles of this is located above known fish passage barriers (culverts or natural waterfalls). This loss of habitat affects cutthroat trout and some rainbow/steelhead trout. Potential chinook salmon habitat is not impacted.

For a more detailed description of certain sub-watersheds, see Appendix S.

TERRESTRIAL ECOSYSTEM

Soil Productivity and Resiliency

Maintenance of soil productivity is essential to ecosystem health. Most forest uses ultimately depend on a productive soil resource. In addition to serving as a medium for plant growth and biological activity, soils also function in the storage and movement of water through a landscape. Long-term soil productivity is the capability of the soil to sustain the inherent, natural growth potential of plants and plant communities over time. Just as soils in a landscape differ in their natural productivity, they also behave differently to various land use practices. Soils in the Mohawk/McGowan watershed analysis unit were analyzed in terms of their productivity and sensitivity to natural and human caused disturbance using the Resiliency Unit concept.

The Resiliency unit concept is a stratification of soils into Low, Moderate, or High resiliency categories across the landscape according to physical properties and processes that have evolved over time in response to climate, geology, geomorphology, and the biotic community. Resiliency units for Mohawk/McGowan watershed were created by combining soil map units listed by SCS in the Soil Surveys for Lane and Linn Counties, Oregon. Each Resiliency Unit has soils with similar properties. Resiliency Units are based on such factors as soil temperature and moisture regimes, soil drainage, soil depth, soil coarse fragment content, texture, water holding capacity, organic matter content, nutrient capital, and permeability. Soils in the High resiliency category are generally the most productive areas. They can sustain substantial manipulation and still maintain nutrient capital, inherent physical and chemical capabilities, hydrologic function, and natural rates of erosion. Soils in the Low resiliency category are the least productive. In general, they require protection and offer minimal opportunities for manipulating the surface vegetation without impairing inherent properties and processes, and accelerating the frequency and magnitude of erosional events. Map 8 shows the locations of the soil resiliency categories in the Mohawk/McGowan analysis area. The Table below is a summary of the resiliency categories for this area.

Table: Soil Resiliency Unit Summary

Unit No.	Resiliency Category	Acres	Percent of Watershed Analysis Area
UNIT 1	N/A	85	<1
UNIT 2	LOW	1,574	2
UNIT 3	LOW	1,724	2
UNIT 4	LOW	214	<1
UNIT 5	MODERATE	8,260	9
UNIT 6	MODERATE	9,970	11
UNIT 7	MODERATE	3,254	4
UNIT 8	HIGH	16,134	18
UNIT 9	HIGH	44,653	51
UNIT 10	N/A	1,721	2

The Mohawk/McGowan landscape is dominated by soils in the high and moderate resiliency categories. Soils in the high resiliency categories, Units 8 and 9, represent the most productive areas and occupy 69 percent of the watershed. These soils generally occupy gentle to moderate topography, are deep (>40 inches), well-drained and highly permeable reddish-brown silty clay loams, with high levels of nutrients and plant available water.

Soils in the moderate resiliency categories occupy 24 percent of the watershed. In comparison, these areas are less productive and less resilient because soils are moderately deep (20-40 inches); they occupy moderate to steep topography or drier low elevation sites, or have a higher coarse fragment content.

Soils in the low resiliency categories, Units 2, 3, and 4, occupy less than 5 percent of the watershed area. These areas generally occur on steep slopes and have shallow (<20 Inches), rocky soils associated with scattered rock outcroppings. For soils in this category, nutrients and water are limiting factors; they are drought prone and, therefore, the least productive areas.

Alterations of the soils and associated vegetative cover have occurred from historic conditions. Land use in the landscape has been dominated by forest management activities with conversion of lands to agricultural, urban, or domestic use occurring primarily in the Mohawk River Valley and along some of the major tributaries to the river. These land use practices have affected the soils resource in several ways. Timber harvesting and broadcast burning have changed the amount of organic matter added to the system and how this material is cycled. Urban and road developments have resulted in soil removal and displacement, and higher levels of compaction than under naturally occurring conditions. Roads and compacted areas have also influenced water storage and movement and the ability of the soil to support vegetation and biological activities.

Botanical Resources

Special Status Species

Special Status plant species identified in Mohawk/McGowan Watershed include species classified as Federal Candidate for listing as Threatened or Endangered, State Proposed Threatened, State Candidate for listing as Threatened or Endangered, and BLM Tracking species. In addition to those species classified as Special Status plant species, there are other uncommon plants within the watershed that are being reviewed by the Eugene District Botany Program and/or the Lane County (Emerald) Chapter of The Native Plant Society. These species are discussed under the Chapter on Floristic Diversity. The Botany Appendix contains information on sites of Special Status plants, and maps (1:50,000 scale) stored in the map cabinet in the McKenzie conference room show locations. The Botany Appendix also lists Special Status plants suspected in the watershed.

At this time 3,504.7 acres have been inventoried within Mohawk/McGowan Watershed for Special Status plant species (map stored in McKenzie conference room map cabinet; 1:50,000 scale). These surveys have primarily been botanical clearance activities in support of other resource programs such as timber management, wildlife enhancement, recreation projects, etc. Some species specific inventories for Aster vialis and Cimicifuga elata have also been implemented under Challenge Cost Share Projects in cooperation with the Oregon Department of Agriculture.

<u>Current Land Use Allocations for Special Status Plants</u> - See SSP GIS Map (1:50,000 scale; stored in the McKenzie conference room map cabinet)for botanical reserve areas established).

Land use allocations were made in the Eugene District's Proposed RMP for Federal Candidate plant species Aster vialis and Cimicifuga elata sites found within the watershed. Botanical reserve areas have been established for the protection and management of these species; 45.5 acres have been reserved for Aster vialis within Mohawk/McGowan Watershed and 30.4 acres are reserved for Cimicifuga elata. All actions proposed for these areas must be consistent with the protection and management of these species.

SEIS Survey And Manage Species - Under the ROD, implementation of the standards and guidelines for Survey and Manage species (Table C-3 of ROD) will be required. Under this requirement there are 4 provisions that will be implemented. These include: (1) Management of known sites; (2) Survey prior to ground-disturbing activities; (3) Extensive surveys; and (4) General regional surveys.

The primary Survey and Manage species of concern known to occur within the watershed at this time are Aster vialis, Cypripedium montanum, and Choiromyces venosus because they fall into Component 1 of the FSEIS/ROD Standards and Guidelines (for site locations, see Known Sites for survey and manage species map stored in the map cabinet in McKenzie conference room).

Federal Candidate 2 plant species, Aster vialis, and BLM Tracking species, Cypripedium montanum are also considered Special Status plant species and are covered above. The third species identified under Component 1 of Survey and Manage that is known to occur within the watershed is Choiromyces venosus, rare truffle -Mohawk ACEC/RNA, T. 16 S., R. 2 W., Sec. 29.

<u>Inventory for Survey and Manage Species on BLM lands</u> - Standards and guidelines for survey protocols and implementation of these surveys will be under the direction of the Regional Ecosystem Office. A botanical survey implemented under a cost-share project with Oregon State University for lichens is in progress. Surveys will be completed at Horse Rock Ridge ACEC/RNA, Mohawk ACEC/RNA-McGowan EEA, and Grassy Mountain ACEC to provide baseline information on lichen communities. Bryophyte or fungi surveys have not been implemented in the Mohawk/McGowan watershed.

For those species that are also Special Status plant species (Aster vialis and Cypripedium montanum), surveys have been in progress for many years.

Land Use Allocations for Survey and Manage species - In the 1994 Proposed RMP direction for the Survey and Manage species Choiromyces venosus is that the BLM establish a 160-acre reserve area for this rare truffle. See SSP GIS map (1:50,000 scale, stored in McKenzie conference room map cabinet) for reserve design for truffle and other vascular plants.

Choiromyces venosus is a large truffle of broad European distribution. The only known North American site is at Mohawk ACEC/RNA. Information in Appendix J2 of the SEIS/ROD suggests that clear cutting may negatively impact this species and calls for continued protection of the Mohawk site; survey of suitable habitat adjacent to known site; and establishment of protective buffers for populations located and monitoring and tracking the species found.

Survey and Manage Species Suspected in the Watershed - The lack of information about the Survey and Manage species and their distribution, abundance, and habitat preferences, makes it difficult to predict the potential occurrence of these species in the watershed. Information provided that describes potential habitat for these species is likely to change as more information is available. It is likely that there will be habitat within the McGowan/Mohawk Watershed to support several of these species. Survey and manage species suspected in the watershed along with habitats that support these species are identified in the Botany Appendix.

A list of species is being prepared by the REO (Terrestrial Module Team) that identifies species, which must be considered on an individual basis if riparian buffer widths are to vary from the standard widths identified in the FSEIS. This list is found within the Botany Appendix. This list should be considered DRAFT at this time as the Terrestrial Module has not been completed.

Floristic Diversity Within The Watershed - See Botany Appendix; Vascular/Nonvascular plant/fungi species known from the Watershed. Botany Module, Mohawk/McGowan Watershed, January, 1995.

Plant community information is lacking to describe the watershed. This type of information is a critical missing link in being able to describe, track, and compare the diversity of plant communities that occur in and between watersheds and in being able to assess the distribution and abundance of plants, fungi, and animals that depend on these plant associations.

It has been documented that low elevation old growth forests adjacent to the Willamette Valley are rare. Because plant communities below 3,000 feet have not been adequately described, it is probable that these low elevation climax plant communities are rare within the watershed. This is complicated by the fact that many of these forests were probably "perturbation-dependent" plant communities driven by anthropogenic fire regimes. Species richness within this watershed can be assessed as follows. A total of 480 native species have been identified to occur within this watershed on BLM lands. The number of noxious or exotic species known in the watershed totals 111 species on BLM lands. This list will most likely become more complete as botanical inventories continue within this watershed. Little information is available on fungal species. The following numbers of species have been identified:

Number of Native Species Known to occur in the watershed on BLM Lands:

Tree/Shrub Species	65
Grass Species	25
Sedge/Rush Species	26
Forb Species	282
Moss Species	19
Fern/Fern allies	18
Lichen Species	45

Fungi Species - Information too limited to quantify

Number of Noxious/Exotic Species Known to occur in the watershed on BLM Lands:

Tree/Shrub Species	6
Forb Species	77
Grass Species	28

Some species of interest have been identified in the watershed on BLM lands (see Botany Appendix). These are of ecological interest because of scattered distributions (often found in small populations) and/or because they are found at a geographical extreme of their range or in a completely disjunct area. Populations of these types may have unique genotypic characteristics important for long-term species viability. It is likely that over time additional species may be added to this list.

Noxious Weeds Within the Mohawk/McGowan Watershed

Noxious weeds are defined in Noxious Weed Strategy for Oregon and Washington (BLM/OR/WA/PT-94+4220.9) as "Plant species designated by federal or state law as generally possessing one or more of the characteristics of being aggressive and difficult to manage, parasitic, a carrier or host of serious insects or disease, and being nonnative, new to, or not common to the United States."

BLM Manual 9220 - Provides guidance for implementing integrated pest management on lands administered by the Bureau. The objective is to ensure optimal pest management with respect to environmental concerns, biological effectiveness, and economic efficiency while achieving resource objectives.

The Oregon Department of Agriculture (ODA) has determined which plant species are legally designated as noxious weeds.

There is evidence to suggest that roads are a primary medium for the establishment and expansion of some noxious weed species on forest land in the Mohawk/McGowan Watershed. Contaminated gravel and fill, spread of weed seed by road maintenance activities, altered micro-climatic and hydrological conditions, and introduction of new weed species by recreational vehicles and equestrians are factors in the relationship of roads and noxious weeds.

In 1988 the Oregon Department of Agriculture conducted a roadside survey for noxious weeds on part of the watershed. Approximately 275 acres of right-of way were surveyed and the following populations of noxious weeds were delineated:

Species	Common Name	% Cover Survey Area
Cytisus scoparius	Scotch broom	29
Senecio jacobaea	tansy	<1
Hypericum perforatum	St.-John's-wort	<1
Centaurea diffusa	diffuse knapweed	<1
Centaurea maculata	spotted knapweed	<1
Centaurea pratensis	meadow knapweed	<1

Additional noxious weed species known in the watershed, but not included in this survey, are the following: Cirsium arvense (Canada thistle) and Cirsium vulgare (bull thistle). An infestation of Centaurea solstitialis (yellow star thistle) is known from just north of the watershed. An infestation of Lythrum salicaria (purple loosestrife) is known from just south of the watershed.

Special Areas

Special Areas are defined as Areas of Critical Environmental Concern (ACEC), Research Natural Areas (RNA), Outstanding Natural Areas (ONA), or Environmental Education Areas (EEA). These areas contain qualities that make them fragile, sensitive, rare, unique, or endangered and thus are critical components for preserving biodiversity. Within the ACEC program, special areas that are designated RNA have also been designated within the Mohawk/McGowan Watershed. The RNA program is a cooperative interagency program implemented to preserve diversity by establishing and protecting representative examples of natural ecosystems. This system of preserves represents regional concerns and interests in identifying and protecting areas of significant natural ecosystems for various biological reasons, including use in comparisons with systems already influenced by humans, providing educational and research areas for ecological and environmental studies, and for preserving gene pools for typical as well as rare species. These natural areas provide important linkages for the elements of biodiversity at larger spatial scales.

<u>Site Descriptions</u>:

Mohawk ACEC/RNA (290 Acres)	T16S R02W Sec.19
McGowan Creek EEA (79 Acres)	T16S R02W Sec.19
Horse Rock Ridge ACEC/RNA (378 Acres/122 out of Watershed)	T15S R02W Sec.1
Grassy Mountain ACEC (75 Acres)	T15S R01W Sec.11
Relict Forest Island ACEC (1 Acre)	T15S R02W Sec.9

See the Botany Appendix for a more complete description of these Special Areas.

Vegetation

Current Conditions - The vegetation pattern that exists (as of 1993) within the Mohawk/McGowan Watershed has largely been the result of several decades of timber management and the checkerboard ownership pattern.

Table 4-8 is a summary of the seral stage classification (see Appendix W, Seral Stage Classification) for the entire watershed by acres for BLM and other owners of age classes of that type within the Mohawk/McGowan Watershed.

Table 4-8: Current Seral Stage Classes - All Lands

Current Seral Classes (years)	Percent of Watershed	BLM Acres	BLM Percent of Age Class	Other Owners Acres	Others Percent of Age Class	All Acres in Class
0-5	12.9	1,365	12.0	9,972	88	11,337
6-15	13.2	978	8.4	10,623	91.6	11,601
16-45	28.7	9,558	37.9	15,666	62.1	25,224
46-80	32.0	9,354	33.2	18,770	66.8	28,124
81-195	2.0	486	27.6	1,272	72.4	1,758
196+	0.9	750	94.8	41	5.2	791
Agriculture	9.4	0	0	8,261	100.0	8,261
Non Forest	0.9	272	34.0	519	65.6	791
Total		22,763	25.9	65,124	74.1	87,887

The Mohawk/McGowan Watershed has been an area of timber harvest activity for the past 100 years and within the past 50 years approximately 60 percent of the forested lands within the watershed have been harvested. BLM also has harvested almost 60 percent of their holdings during this period.

Mature forest areas are scarce remnants scattered throughout the watershed, almost entirely on BLM holdings

(Map 17). The largest single patch of old forest (196+ yrs.) in the Mohawk/McGowan Basin is 178 acres and this is on BLM land. The hardwood areas are generally associated with streams and riparian areas of 3rd order and larger streams. The nonforested agricultural and pasture areas are generally located in the valley bottoms of the Mohawk River in close proximity to the more heavily developed and populated areas of Marcola and Mohawk. The nonforested lands are mostly on nonfederal lands while 95 percent of the old forest occurs on federal (BLM) lands.

Land Use Allocations - There are 4 different Land Use Allocations (LUA) within the Mohawk/McGowan Watershed: General Forest Management Areas (GFMA), Connectivity (CON), District Designated Sites (DDR), and Late-Successional Reserves (LSR).

General Forest Management Areas (GFMA) and Connectivity (CON) are combined to form the land base for the Matrix LUA.

General Forest Management Areas account for approximately 83 percent of the BLM holdings and Connectivity, 14 percent within the watershed. These 2 Matrix Land Use Areas comprise 25 percent of the entire watershed basin.

Matrix: (Connectivity/Diversity Blocks and General Forest Management Area) as described in the Eugene District's PRMP/FEIS (12/94)

The lands in the Matrix are expected to

- produce a sustainable supply of timber and other forest commodities.
- provide connectivity (along with other allocations such as Riparian Reserves) between Late-Successional Reserves.
- provide habitat for a variety of organisms associated with late-successional and younger forests.
- provide important ecological functions, such as dispersal of organisms, carryover of some species from one stand to the next, and maintenance of ecologically valuable structural components (e.g., down logs, snags, and large trees).
- provide early-successional habitat.

In the Matrix the General Forest Management Area and Connectivity/Diversity Blocks vary in size and are distributed throughout the Matrix. Timber harvest and other silvicultural activities will be conducted in that portion of the Matrix with suitable forest lands.

Timber harvest will be conducted to provide a renewable supply of large down logs well distributed across the Matrix landscape in a manner that meets the needs of species and provides for ecological functions. Down logs would reflect the species mix of the original stand.

Green trees and snags will be retained throughout the General Forest Management Area, including 6 to 8 green conifer trees per acre in regeneration harvest units. Snags will be retained within a timber harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels. In addition green trees will be retained for snag recruitment in timber harvest units where there is an identified, near-term (less than 3 decades) snag deficit. These trees do not count toward green-tree retention requirements. The PRMP provides for Connectivity/Diversity Blocks as currently spaced, that are managed on 150-year rotation. When an area is cut, 12 to 18 green trees per acre will be retained. There would be 25 to 30 percent of each block in late-successional forest at any given time. Riparian Reserves and other allocations with late-successional forest contribute toward this percentage.

Late-Successional Reserves : Objective is to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old growth forest-related species including the northern spotted owl. These reserves include 2.5 percent of BLM holdings and 0.7 percent of the Mohawk/McGowan Basin.

District Designated Reserves : The types of administratively withdrawn areas, also known as DDR's, are Relict Forest Islands and Bald Eagle Habitat.

Past Conditions - For a description of past vegetation patterns of the watershed, see Appendix V.

Wildlife

Forests in western Oregon were dominated by large interconnected blocks of mature and older conifer forest prior to European settlement. Forest habitats within this landscape were both structurally and vegetatively very complex. Early seral habitats now dominate the landscape, interspersed with small, isolated patches of older forest, which are often fragmented by roads and young conifer plantations. Nearly all habitats have been simplified both vegetatively and structurally. Forest practices and land ownership patterns have created sharp habitat boundaries, providing conspicuous contrast between adjacent habitats. These habitat alterations have substantially reduced the populations of many wildlife species associated with riparian and old forest habitats.

Landscape Pattern

Seral Stage : Mature and older forests dominated the Mohawk/McGowan Watershed during the mid-1800s and early 1900s. Based on survey notes and plats, the 1852-1872 vegetation map (Map 18) classified approximately 80 percent of the watershed as heavily timbered that, after review of the 1936 type map (Map 20), appears to have been primarily mature and old forest habitats. The 1914 type map (Map 19) classified 77 percent of the watershed as merchantable timber, which again corresponds to the mature and old forest habitats of the 1936 type map. These forest conditions were generally uniform across the watershed aside from the southwestern portion of the watershed, which was composed of a prairie/savannah habitat type surrounded by an oak woodland habitat component. This prairie/savannah habitat is reclassified as agriculture land today. There were also a few small, irregular shaped burns within the conifer forest landscape in the 1800s and early 1900s. Therefore, the watershed was characterized as a large block of dense, contiguous old forest interspersed with relatively few patches of young forest, shrublands, and openings. By 1936 the watershed contained approximately 45 percent old forest habitat and by 1993 (Map 17), the watershed was highly fragmented, with only a small percent of the landscape remaining in mature and old forest condition. The majority of the watershed today is composed of plantations and young forest, especially the eastern portion of the watershed that is predominately private timberlands.

Patch size: The unmanaged landscape of the mid-1800s and early 1900s was dominated by very large contiguous blocks of older forest habitat. Within this large forest medium, fire was the primary large scale disturbance factor (Agee 1991), creating predominately moderate to large scale patches of early seral habitats. The fire initiated early seral habitats typically contained an abundance of snags and sometimes scattered remnant older trees. In contrast plantations established following clear cutting are structurally simpler. Although the quantity of mature and old forest habitats was reduced almost 50 percent by 1936, the landscape pattern was still characterized by medium to large contiguous blocks. It was in the last 30 years that the dramatic changes in forest patch size occurred within the watershed. Timber sales were laid out through the forest to support development of a road system to facilitate forest management and fire control. These practices created a highly fragmented landscape, dominated by conifer plantations and young forests. Within this basin, small isolated patches of mature and old forest remain, most all on public lands in the central and western portion of the watershed.

Edge: The increase in the amount of old forest habitat influenced by edge is one of the major effects of fragmentation. Microclimate changes along patch edges alter the conditions for interior plant and animal species (Lehmkuhl and Ruggiero 1991), reducing the amount of interior old forest habitat. Along these edges, the habitat usually becomes drier and receives much more light, increasing the abundance and vigor of early seral vegetation and the probability of their establishment within patch interiors (Lehmkuhl and Ruggiero 1991). Current estimates in Pacific Northwest forests by Lehmkuhl and Ruggiero suggest that microclimatic effects extend up to approximately 525 ft. in from the patch edge. Based on these estimates, patches of old forests 25 acres or smaller are effectively all edge and have lost the essential attributes of the old growth condition (Lehmkuhl and Ruggiero). Within the Mohawk/McGowan Watershed there are 32 patches of mature (81-195 yrs) and 24 patches of old growth (196+) forests. Eight of the old growth patches are believed to still maintain the functions of an old growth forest. The role of the smaller patches to some of the plants and less mobile animals and invertebrates is not completely known. Management practices have not only increased the amount of habitat affected by edge, but also changed the character of edges and patch shapes. In unmanaged forests, natural disturbance processes such as fire, disease, and wind create irregularly shaped patches. The location of patch borders in natural landscapes is strongly influenced by aspect and topography, with openings occurring primarily on the ridge tops gradually changing into the more dense forests, which remain along the streams. Clear cut logging practices have substantially altered this pattern. Within the Mohawk/McGowan and Coburg Hills Fringe, these patterns are typically geometrically shaped with linear boundaries following ridge lines or property boundaries. Nearly all vegetation is removed within these boundaries, creating a landscape with very narrow, sharp patch edges and dramatic contrast between adjacent habitats.

Impacts to Wildlife: Wildlife populations are impacted by forest fragmentation in many ways. The quantitative loss of habitat is the most obvious affect. Of the 70,086 acres of mature and old forest habitat present in the Mohawk/McGowan watershed in the mid-1800s to early 1900s, about 2,549 acres remain in small patches scattered throughout a heavily fragmented landscape. The species most directly affected by habitat loss through fragmentation include those with large home range requirements, very specific micro-habitat requirements, and poor dispersal abilities (Faaborg et al. 1993). Although species with small home range requirements may be able to survive and reproduce, population size will be limited by the available habitat, increasing the chance of local extinction for populations in small isolated forest remnants (Saunders et al. 1991). Species such as the fisher and American marten, which historically may have occurred in the watershed, are now strongly believed to be absent as a result of habitat loss and fragmentation.

Forest fragmentation has also reduced the ability of mature and old forests associated wildlife species to maintain genetic interchange and colonize forest, which are developing late seral characteristics. Narrow bands of unsuitable habitat may serve as a barrier to movement between forest patches for species with limited dispersal capabilities, such as salamanders and rodents. However, species with small home range requirements are often capable of persisting in small refugia for extended periods of time, allowing then to colonize surrounding habitats if future conditions become suitable at a later time (Lehmkuhl and Ruggiero 1991).

Movement and dispersal of species associated with mature and older forests were much easier in the natural forests of the watershed that occurred in the 1800s and early 1900s than in the present landscape. When catastrophic events such as fire transformed a portion of mature forest displacing the resident wildlife, large healthy populations remained nearby in the old forest matrix, available to recolonize the new patch when environmental conditions again became favorable. In contrast the small isolated patches of old forest habitat in a heavily fragmented landscape, support much smaller and less resilient wildlife populations (Faaborg et al. 1993). Forest management practices of the past 3 decades have also reduced the structural and vegetative complexity of early seral habitats (Spies and Franklin 1991), eliminating many habitat components such as down logs and snags, which facilitate the dispersal of wildlife species.

Increased intra-specific competition from edge associated and generalist species that benefit from increased forest fragmentation provide additional complications to wildlife species dependent on interior habitat conditions (Lehmkuhl and Ruggiero 1991) and (Saunders et al. 1991). Road corridors often function as edge or young forest habitats that support populations of edge associated wildlife species within the core of larger old forest patches, increasing the proportion of old forest species affected by intra-specific competition. Additionally, many edge associated and generalist species are nest parasites or predators, capable of affecting the survival and reproductive success of species far inside habitat patches (Faaborg et al. 1993).

The fragments of old forest that remain provide key habitats for many wildlife species. They serve as refugia where small populations of older forest species may persist, and are a source for recolonizing nearby habitats following disturbance or local extinctions. However, these small, isolated populations are extremely vulnerable to local extinction (Lehmkuhl and Ruggiero 1991), making it important to maintain as many of the existing refugia as possible, and manage the surrounding landscape to minimize the external influences on these remaining patches (Saunders et al.). In the short-term, forest management practices in the watershed should center on maintaining the integrity of refugia by minimizing edge effects through avoidance of further fragmentation, maintaining existing forest buffers around habitat patches, and promoting the rapid revegetation of adjacent early seral habitats, including unnecessary roads.

In addition to maintaining the integrity of refugia, it is important to provide for genetic exchange between these habitats by facilitating the opportunities for successful movement and dispersal of wildlife species between habitat patches. The Riparian Reserves established, based on the FEMAT (1993) recommendations, may serve as an important link providing part of the connectivity between habitat patches, especially for wildlife species closely associated with aquatic and riparian needs.

Habitat Components - Snags and Coarse Woody Debris

Snags: Snags are an important structural component in forest communities. Species of wildlife that frequently use snags for foraging, nesting, or perching are selective as to size, decomposition stage, and abundance of snags (Brown et al. 1985). Nearly 100 species of wildlife, including at least 53 species (39 birds and 14 mammals) are cavity-dependent. Brown et al. has defined a snag as . . . any dead, partially-dead, or defective (cull) tree at least 10 inches in diameter at breast height (dbh) and at least 6 feet tall.

Snags are also used by wildlife as loafing sites, dens, lookout posts, overwintering sites, plucking posts, communication sites, and food caches. Research has shown that the greatest number of wildlife is present when large diameter snags are available as compared to animals where few or no large diameter snags are present. The number of snags in all sizes in Douglas-fir stands in western Oregon and western Washington is about 70/acre in young stands (30-80 yrs), 50/acre in mature stands (80-200 yrs), and 24/acre in old growth stands (>200 yrs). When only large snags (20" dbh and 16' tall) are considered, then there are 6/acre in old growth stands, 4/acre in young stands, and 3/acre in mature stands (Maser et al. 1988). The use of snags by wildlife is also influenced by the snag's stage of deterioration. Soft and rotten snags are most used by cavity-nesting wildlife; however, woodpeckers in western Oregon often selected "hard-remnant snags" for nesting while the chestnut-backed chickadee used "soft-remnant snags." The importance in managing for the requirements of all snag-dependant species is incumbent in the management of all snag deterioration stages.

Over 90 percent of the forested lands in the Mohawk/McGowan Watershed have been harvested with the majority of the stands being managed on a second rotation and some acres being managed for a third rotation. Recent timber harvest units (final regeneration or commercial thinned stands) during the past 20-30 years have retained few if any snags and very few green trees were retained in these harvest units to serve as future snag recruitment. During the Fall of 1994, 50 snags were created on the uplands of the Showalter and Cash Creek drainages. These snags were created in timber stands that had been commercially thinned within the past 5 years and are 50 to 70 years of age. There were very few natural snags in these areas prior to project initiation. Of the 50 green trees treated for snag development in 1994, all but 2 trees were 19 inches or greater in diameter.
The following table from Maser et al. shows the estimated age for various snag stage deterioration. (Please refer to Appendix for explanation of snag deterioration stages.)

Estimated age snags reach a given stage of deterioration	Stage of Deterioration				
	1	2	3	4	5
1-18" dbh	0-4 yrs	5-8 yrs	9-17 yrs	>17 yrs	Fallen
8-19" dbh	0-5 yrs	6-13 yrs	14-29 yrs	30-60 yrs	>60 yrs
>19" dbh	0-6 yrs	7-18 yrs	19-50 yrs	51-125 yrs	>125 yrs

Snags - Existing Condition: At least 36 wildlife species require standing dead trees for one or more life needs in the Eugene District (Eugene District PRMP, 1994). The Eugene District Resource Management Plan requires that snags and green trees, 15 inches dbh or greater, be retained at levels sufficient to support species of cavity nesting birds at 40 percent of potential population levels.

The following table shows the primary cavity-nesting birds that occur in the McGowan/Mohawk Watershed:

Table: Snag Requirements for Woodpeckers Found in the McGowan/Mohawk Watershed
(This table assumes 40 percent population levels. Numbers of snags per 100 acres are shown in parentheses. Snag densities shown here refer to densities through time.) (Adapted from Brown et al. 1985)

Snag diameter class (inches dbh)	Snag Decay Stage		Total Snags by Diameter Class
	Hard 2-3	Soft 4-5	
11+	Downy Woodpecker (3)	Downy Woodpecker (3)	(6)
15+	Red-breasted Sapsucker (18)	Hairy Woodpecker (77)	(95)
17+	Northern Flicker (9.5) Red-breasted Nuthatch (31) Acorn Woodpecker (28)**	Northern Flicker (9.5)	(78)
25+	Pileated Woodpecker (2)		(2)
Total snags by decay class	(90.5)	(89.5)	(181)

** Acorn woodpeckers occur primarily on oak woodland habitats of which very little is managed by BLM. From BLM's standpoint the total number of snags needed to ensure 40 percent cavity nesting requirements, as predicted by the model, would be reduced by 28 per 100 acres.

Within the Upper Mohawk/McGowan Watershed spotted owl habitat analysis data in spotted owl home ranges (Appendix WL) was gathered from McGowan and Parson creeks. Data was also collected at sites immediately adjacent to the Upper Mohawk/McGowan Watershed at East and West Brush creeks. Tables 4-9 (and S-2 Appendix WL) show the results of this data for the 2 locations immediately in this watershed as well as the sites just outside the watershed boundaries. Table 4-9 lists the averages for the various forest age classes as they pertain to the RMP requirement of retaining snags at least 15 inches in diameter in future timber management activities. The smallest snag size used by woodpeckers for nesting in the watershed is 11 inches and, upon review of data in Tables S-2 and S-4 in Appendix WL, there were no snags recorded in the 11" to 15" diameter range within the watershed and very few snags in the entire study area that fell within this range. Snags less than 11" are, however, important to woodpeckers as foraging habitat.

Table 4-9: Averages of snag data by forest age class from spotted owl habitat analysis (Mohawk/McGowan Watershed) .

Age Class (years)	Snags/Acre		Average DBH (inches)		Average Height (feet)	
	<15"	>15"	<15"	>15"	<15"	>15"
21-40	45.8	1.3	6	63	35	18
41-80	60.5	3.4	7	40	41	44
81-150	26.1	6.5	7	36	38	23
150+	20.2	20.2	7	47	29	30

Tables 4-10 and 4-11 reveal how the number of snags found in the spotted owl habitat analysis study compares to research done in 1988 by Spies and others on snags found in Douglas-fir stands that originated after wildfires in the Oregon Cascade Range (Spies et al. 1988).

Table 4-10: Comparisons of snag density, dbh, and height for snags SMALLER THAN 20" dbh (In stands regenerated after fire (Spies) versus those in the spotted owl habitat analysis study completed in the Mohawk/McGowan Watershed and for the entire study area.)

Age Class (years)	Snags/Acre - <20"			Average DBH - (inches)		
	Spies et al.	M&M Watershed	Entire Study Area	Spies et al.	M&M Watershed	Entire Study
<80	71	106	100	13	6	6
81-199	38	46	54	13	7	8
>200	14	0	0	-	0	0

Table 4-11: Comparisons of snag density, dbh, and height for snags GREATER THAN 20" dbh (In stands regenerated after fire (Spies) versus those in the spotted owl habitat analysis study completed in the Mohawk/McGowan Watershed and for the entire study area.)

Age Class (yrs)	Snags/Acre - >20"			Average DBH - (inches)		
	Spies et al.	M&M Watershed	Entire Study Area	Spies et al.	M&M Watershed	Entire Study
<80	11	5	7	-	52	43
81-199	6	7	8	-	36	38
>200	11	0	0	22	0	0

The number of snags found in the study suggest that the watershed contains snags reminiscent of what you would find in fire regenerated stands, at least for the <80 and 81-199 age classes. However, this data is biased towards areas being used by spotted owls in the watershed, of which there are very few, and does not reflect the intensive timber management activities that has occurred over the past 3 decades. Over _ percent of the watershed has been harvested in the past 3 decades and the eastern 1/3 of the watershed, which is under private ownership, contains very few snags across the landscape. Also field observations for other project work tend to suggest an overall lack of snags occurring on the public lands and other private land throughout the rest of the watershed boundary. There were no stands in the owl study area that were over 200 years of age. Overall, the Mohawk/McGowan Watershed is lacking snags that are of large diameter (>20") and tall (>50').

Table 4-12 presents the snag decay class for snags measured in the spotted owl habitat analysis study in the Mohawk/McGowan Watershed. Of the 522 total snags measured in and immediately next to the Mohawk/McGowan Watershed, only 12 percent were larger than 15 inches. Looking at these snags under the >15" heading in Table 4-12, 6 percent of the snags are in the 1st decay class; 24 percent are in the 2nd decay class; 22 percent are in the 3rd decay class; 14 percent in the 4th decay class; and 34 percent in the 5th decay class.

Table 4-12: Decay class information for actual snags inventoried in Mohawk/McGowan Watershed

Age Class (years)	<15"					>15"				
	1	2	3	4	5	1	2	3	4	5
21-40	7	7	1	1	0	0	0	0	0	2
41-80	133	196	56	13	2	2	3	3	5	6
81-150	7	7	9	5	3	1	5	1	3	14
150+	5	4	0	1	0	1	8	10	1	0
Totals	152	214	66	20	5	4	16	14	9	22

As mentioned above, some woodpecker species are dependent upon the later decay stages (4-5) to meet their biological needs. Safety issues and logging activities could eliminate over 70 percent of the snags in a stand. This potentially would include all snags in the 3rd decay class and later.

Because it takes anywhere between 19-50 years for a snag (>19" dbh) to reach the 3rd decay class and 51-125 years for a snag (>19" dbh) to reach the 4th decay class, and over 125 years for this same snag to reach the 5th decay class, it seems highly unlikely this snag condition will be maintained sufficiently or persist for any length of time across the Matrix landscape given the short rotation age for the forest landscape.

Therefore, the best opportunity to maintain snags in the later decay class will fall upon the Riparian Reserves and some of the few administrative outs scattered throughout the watershed.

Coarse Woody Debris: Coarse Woody Debris (CWD) is important in many ecological and physical processes in forest and stream ecosystems. The amount, structure, and dynamics of CWD in forests can influence species composition, nutrient cycling, productivity, and geomorphology for centuries and millennia (Spies et al. 1988). Large logs typically persist for very long periods - up to several centuries for some species, such as Douglas-fir and western red cedar(Ruggiero et al. 1991). Down logs represent major long-term sources of energy and nutrients as well as sites for nitrogen fixation. Down logs provide essential habitat for many plants and animal species. There are 150 terrestrial wildlife species known to utilize dead and down woody materials in the forests west of the Cascade crest in Oregon/Washington. This habitat component provides cover and serve as sites for feeding, reproducing, and resting for many wildlife species.

When a fallen tree decomposes, unique habitats are created within its body as the outer and inner bark, sapwood, and heartwood decompose at different rates (Maser et al. 1988). Tree size influences both internal and external habitats. Habitats provided by the death of young trees in a young forest are short lived and rapidly changing. In contrast, the less frequent more irregular mortality of large trees in old forests creates long lived, stable habitats. Just as snags can be a limiting factor for some wildlife populations in western forests, so too can down woody material be a limiting factor (Brown et al. 1985).

Large quantities of down logs are an important component of many streams. The most productive habitats for salmonid fish are small streams associated with mature and old growth coniferous forests where large organic debris and fallen trees greatly influence the physical and biological characteristics of such streams(Maser et al. 1988). Large amounts of woody debris, regardless of the bed material, were contained in the channels of both high-and low-gradient rivers. Down woody debris influences the form and structure of a channel by affecting the profile of a stream, pool formation, and channel pattern and position (FSEIS). This debris also affects the formation and distribution of habitat, provides cover and complexity, and acts as a substrate for biological activity. Down woody debris in streams comes directly from the adjacent riparian area, from tributaries that may not be inhabited by fish, and from hillslopes (FSEIS).

In 1st and 2nd order streams, large woody debris is common and covers as much as 50 percent of the channel. Large woody debris usually covers less than 25 percent of the channel in 3rd and 4th order streams; 1st and 2nd order streams feed 3rd and 4th order streams, the amount of which becomes progressively smaller as stream order increases. Small streams derive much food for invertebrates (Maser et al. 1988).

Coarse Woody Debris - Existing Condition: Approximately 1/3 of the plots measured within the spotted owl home ranges contained enough down logs to meet the RMP requirements of trees >20" dbh, 20 feet long and 240 linear feet/acre (Table 4-13). Again, the areas containing down logs were biased to areas with owl use. This study is showing a strong correlation between snags and down logs to use areas preferred by spotted owls. Also, timber harvesting activities over the past 3 decades have left little of this habitat component behind on timber sale units. The amount of down logs on the eastern portion of the watershed is unknown; however, given that this land is managed by private timber interests for maximum commodity production, it is safe to say that very little large down woody material can be found on the ground. Throughout the rest of the watershed, down logs meeting RMP requirements may be found in forests that were logged prior to 1960 when logging activities were not as "clean." However, based on field observations for a variety of project work done in the watershed, it appears that there is an insufficient amount of the down woody habitat component across much of the landscape.

In Table 4-13, the total number of plots fully meeting RMP requirements for the various forest age classes is labeled as "R-plots." Some plots met only a portion of the RMP requirements and, therefore, are not shown in the following table. The number of sites pertains to the actual on-the-ground areas where habitat plot sites were measured for the various forest age classes; plots refers to the total number of habitat plots measured for all sites by forest age class.

Table 4-13: Down logs meeting RMP requirements by forest age class in the Mohawk/McGowan Watershed.

Age Class/Number of sites; plots; R-plots/Age Class	# of logs measured in R-plots	Avg. Log Diameter (inches)	Linear ft./Acre
21-40 (4;10;1)	1	43	239
41-80 (19;54;22)	61	32	405
81-150 (5;15;0)	-	-	-
150+ (1;4;4)	10	40	501

In the Mohawk/McGowan Watershed where over 80 percent of the forest lands have been converted to managed forests and agricultural fields, habitat complexity has been significantly reduced, which has impacted many species of wildlife, especially those associated with old growth forests. Approximately 74 percent of these lands are privately owned and will continue to be managed primarily for commercial production of agricultural and forest commodities. These lands will provide only simplified, early seral habitats with limited value to a variety of wildlife, particularly those wildlife species associated with older, more complex habitats. As a result, to meet the objective of maintaining long-term ecosystem health outlined by FEMAT (1993), management of the 22,850 acres of BLM administered lands should focus on emulating the complex vegetative and structural conditions present in natural forests. Given that this watershed is to be managed primarily for timber production, the value of riparian buffers and some administrative withdrawn areas becomes increasingly valuable to wildlife species associated with older forest habitats. Habitat management practices in these areas should be targeted at developing the patchy, complex canopies typical of natural forests instead of plantations with uniform tree size, height, and spacing. These practices should be consistent with strategies identified in the ROD/RMP for these areas. Additional studies should be conducted to determine the numbers, sizes, conditions, and distribution of snags and down logs present in natural forests for all seral stages and forest types found in the watershed. Management prescriptions should protect existing snag and down log habitat and provide mechanisms for future recruitment to ensure adequate numbers, sizes, and conditions of these structures are continually available and well distributed throughout the landscape. The effectiveness of Riparian Reserve widths should be evaluated as to their effectiveness in maintaining habitat for older forest dependent species occurring in the watershed, and their ability to provide connectivity across the landscape.

Riparian Vegetation

Current riparian vegetation cover types (Map 21) were determined by aerial photo interpretation for 3rd order and larger streams covering Log Creek and the drainages entering the Mohawk River below Log Creek (Table 4-14 summarizes the results). Hardwood categories (see Table 4-14, below) occur along 63.2 miles (58%) of the streams inventoried. About 43 percent (27 miles) of the hardwood area is mixed with scattered conifers. Young hardwoods occur along 9.4 miles (15% of hardwood area) of streams, while old hardwood stands (deteriorating condition with openings and large dominant trees) occupy approximately 42 percent (26.6 miles). About 13.4 miles of the total hardwood area are along the Mohawk River and appear as older trees. About 19.7 (31%) miles of the hardwood stands occur on BLM lands.

Conifer cover types occur along 28.6 miles (26%) of the streams inventoried. Conifer stands with DBH less than 30 inches occur along 24.8 miles (87% of conifer area) of inventoried streams; BLM administers 13.7 of

these miles. About 3.8 miles (13% of conifer area) have conifer stands with DBH greater than 30 inches; BLM administers 2.0 of these miles.

Pasture, agriculture, and residential uses occur along 17.4 miles of the streams inventoried.

H:\RES\WP\CHAPT'4.M&M

Chapter 5
Ecosystem Interrelationships, Functions, and Processes Important to Major Values/Issues

Innumerable processes have interacted to develop the Mohawk/McGowan Watershed to the state it is today. Man's interaction with these processes has had an impact on some of the processes. This chapter will explore some of the processes and interactions that are relevant to the Key Issues (Chapter 3).

Value/Issue: Water Quality and Quantity

Stream Flow

This assessment describes the physical attributes and processes of stream related resources in the Mohawk River Watershed. It is designed to understand interrelationships between these attributes and the rest of the ecosystem. Specifically it is designed to look at relationships with the biologic communities and other physical properties, e.g., geomorphology. It can also be used to relate the Mohawk River Watershed to the McKenzie River Basin as a whole, e.g., downstream effects. The descriptions include stream flow and water quality. Ground water was not listed as an issue for the McKenzie Watershed. An understanding of the climate, mass wasting erosion, road related erosion, and hill slope related erosion assessments are useful in understanding this assessment.

Hydrologic Function: Water enters the watershed as precipitation, primarily as rain during winter storms. A small amount enters in the form of fog drip, a process of fog capture by vegetation that drips to the forest floor. Eighty-two percent of the precipitation occurs from October through March. From 10 to 30 percent of this water is captured by vegetation and evaporates. A small portion of the precipitation falls directly into streams (about 0.2%) or flows overland to streams (about 0.2%). As much as 98 percent of the precipitation that reaches the ground infiltrates into the soil to become ground water. A small percent of the ground water enters the bedrock and flows slowly to the creeks and rivers where it emerges as stream flow. An insignificant portion of this flow will leave the watershed as groundwater and surface in the McKenzie River.

The vast majority of the water enters the soil where it becomes part of the soil ecosystem that is comprised of a diverse group of flora and fauna. The water becomes part of the aboveground ecosystem as it moves through mycorrhiza and roots into plants. It moves into, through, and out of the O horizon or duff layer. It moves as part of animals, and moves out of the soil ecosystem by transpiration of plants, or evaporation from exposed soil surfaces. Most of the water is not available to the soil ecosystem because there is little biological activity in the winter, and because the soils are very permeable allowing the water to flow downhill. For these reasons there is a summer drought.

Water that falls after soil field capacity has been reached, along with water that enters the soil near creeks without riparian areas, joins the surface runoff and the antecedent water in the creeks to become part of the storm peak flow. Peak flows or floods are one of the most important disturbances to the ecosystem and are discussed below.

The hydrologic relationship between the creek, the riparian area, and the flood plain are so interrelated and complex that it is difficult to separate them. Water that is not lost to evapotransporation or flood runoff moves slowly downhill until it reaches a stream channel or flood plain. Flood plains and their associated riparian vegetation are a critical part of the hydrologic functioning of a watershed. Hydrologically, riparian areas connect and are part of the terrestrial and the aquatic systems. Flood plain soils are deep alluvial soils that store the water from the uplands and in periods of high flow store water from the creek. This water is slowly released in the summer resulting in greater soil moisture in the riparian area and greater base flow in the creek. The higher soil moisture in riparian areas produces a greater diversity and abundance of flora and fauna than in the uplands. The increased vegetation produces denser root masses and more litter and dead wood, all of which helps store water. The increased shade and evapotransporation of the riparian area and the creek creates a micro climate that has higher humidities and more moderate temperatures than the surrounding uplands. At one location, the humidity was 26 percent on an upland clear cut, and 48 percent in the undisturbed riparian zone. The temperature on the clear cut was 94^{o}F. and 75^{o}F. in the riparian zone. The change in microclimate in turn changes habitat for the biologic community, which changes soil water movement and microclimate.

Water flows from the creek in the winter and spring and flows to the creek in the summer and fall. The structure, composition, morphology and, therefore, the functioning of physical and biological processes of riparian areas are created largely by the creek. Likewise the structure, composition, morphology and, therefore, the functioning of physical and biological processes of creeks are created largely by the riparian area.

Peak Flows

Changes in peak flow can be caused by many physical or biological processes such as the following:

1. Storm events, of course, are the principal factor in determining peak flow. A large storm will drop 3 inches of precipitation in 24 hours at Springfield and 4.75 inches at the higher elevations of the watershed. Appendix XXX contains isopluvail maps that show precipitation intensity. The time of year, the duration of the storm, and the form of the precipitation all play a large part in determining peak flows. These aspects of precipitation will be discussed later.

2. Topography is another factor affecting peak flows. Both steep slopes and highly dissected topography cause the rainfall to reach the channels faster (more efficiently); therefore, the creeks in steep highly dissected terrain are expected to have higher peak flows and the floods will last a shorter time (flash floods).

3. Smaller watersheds are flashier than large watersheds.

4. Vegetation interacts with stream flows in many ways. In the Pacific Northwest transpiration does not play the major role in stream flow that it does in other places. Fall storms will have smaller peak flows in fully vegetated watersheds because much of the precipitation will be used for soil water recharge after a summer of depletion by transpiration. During the winter there is little transpiration and the soil is at field capacity or saturated. Openings in the canopy of forests affect peak flows by creating areas of snow accumulation many times the amount under the canopy. At higher elevations the effect is to delay runoff until the spring or summer and to moderate magnitude of the peaks. At lower elevations warm rains will melt the snow during a storm and can greatly increase the magnitude of peak flows. Rain-on-snow is usually associated with large storms (25-year) and greater return periods. The 1964 floods were a result of a rain-on-snow event. In this watershed the rain-on-snow zone is assumed to be between the 1,500 and 3,500 foot elevation (Map 14), although rain-on-snow can occur at any elevation.

5. There are 2 soil factors affecting peak flows that are of concern. Compaction affects peak flows by delivering water to the streams more efficiently, therefore causing larger peak flows. Compaction can be roads, landings, residential or urban areas, and some farms or pastures. Roads can have a second affect on peak flows. When a road cut intercepts groundwater and delivers it to a stream via a ditch, the ditch becomes in effect a stream. This also makes for more efficient water movement and, therefore, larger peak flows.

6. Riparian areas and channel morphology decreases the magnitude of peak flows when streams are allowed to reach their flood plain, streams meander (decreasing gradient), riparian vegetation slows stream velocity, and when flood plains store a large amount of water.

Creeks in the upper portion of the watershed (Shotgun and Log creeks) are expected to be flashier and have relatively larger peak flows than the main stem of the Mohawk or the lower portion (Parsons and McGowan creeks). The creeks in the upper portion of the watershed receive more precipitation, have more area in the rain-on-snow zone, and have steeper slopes.

Land use practices have increased peak flows since Euro-American Settlement. The following table gives the exceedance probability for the various magnitude floods, shown in the second column, as conditions are now and as conditions may have been without Euro-American settlement. The differences will be due to processes that overlap and, therefore, the results cannot be added.

PC. Present Condition from USGS gauging station at the mouth of the Mohawk River.
I. There is a full forest canopy in the transient snow zone.
II. There is no soil compaction in the watershed.
III. There is no Euro-American development in the valley.
IV. No logging practices, including road building, have been done in the watershed.
V. None of the roads extended the stream network.
VI. Channels and riparian areas are in pristine condition and are fully functioning.

Table:

PRESENT CONDITION			SCENARIO					
			I	II	III	IV	V	VI
RECURRENCE INTERVAL	FLOW CFS	EXCEEDANCE PROBABILITY						
1.25 year	4,260	80%	67%	74%	*	33%	*	64%
2 year	6,180	.50%	42%	46%	*	22%	*	40%
5 year	8,740	20%	16%	18%	*	8%	*	15%
10 year	10,400	10%	8%	8%	*	3%	*	7%
25 year	12,300	4%	3%	3%	*	.0.6%	*	2.5%
50 year	13,700	2%	1.3%	1.7%	*	0.3%	*	1.1%
100 year	15,100	1%	0.6%	0.8%	*	0.15%	*	0.5%

Confidence:

PC. USGS calculations, 100% accurate but may change year to year.
I. Modified Washington TFW methods. Changes from PC may not be real for floods with a recurrence interval less than 25 years. The difference between scenario I and present condition could be 50% greater or 500% less than shown.
II. Empirically developed relationship. The difference between scenario II and present condition could be off by +/- 200%.
III. There is no method to calculate this scenario. A significant portion of the differences in peak flows shown in scenarios II, IV, and VI are due to development of the valley.
IV. Summary of various research papers. The difference between scenario IV and present condition could be 15% greater or an order of magnitude less than shown.
V. There is no method to calculate this scenario. A significant portion of the differences in peak flows shown in scenarios II could be due to ground water interception instead of compaction.
VI. Estimated by a newly developed methodology with many assumptions. The difference between scenario II and present condition could be off by an order of magnitude.

Peak flows cause the creeks to overflow their banks and inundate the flood plain. These floods can cause the following to occur:

1. If there is not adequate structure in the creek and/or riparian area, the channel bottom will erode and the stream will down cut. This will drain the riparian area and much of the riparian hydrologic functions will be lost. Down cutting and/or unusually high peaks will cause the stream to straighten its course. This means that the stream will drop in a shorter distance, which will increase velocity and further increase down cutting. Channelized creeks move water more efficiently with less flooding of developed lands; however, the same process increases downstream flooding.

2. Adequate structure including the riparian vegetation will decrease stream velocity. This will result in deposition of sediments, which will result in a buildup of the flood plain and channel bottom. In-stream structure will divert the flow, which will cause bank cutting and meandering. The result will be:

   - Deeper flood plain soils for water storage and plant growth.

   - Raised channels that reach the flood plain more often and transfer water to the riparian area more efficiently.

   - Greater sinuosity that results in more creek/riparian contact, greater riparian area, and slower velocities.

   - Changes of channel location that create back waters and other aquatic habitats.

   - More and deeper pools.

   - Disturbance of the riparian area for young serial stage organisms.

   - Higher base flows and less damage from future peak flows.

   - More frequent flooding of the valley and less frequent downstream flooding.

In summary, increases in peak flows will benefit aquatic and riparian values if the channel and riparian areas have enough structure to handle the increase. If the increases overwhelm the system, larger peak flows will degrade aquatic and riparian habitats. In the developed flood plain of the Mohawk Valley, increased peak flows degrade the river and will cause an increase the amount of flood damage.

Minimum Flows (Base Flow) - In western Oregon, base flows often last from late spring through fall. This makes the impact of any change in base flow very important. Base flow directly affects all beneficial uses including aquatic and riparian organisms (flora and fauna). Any changes in base flow will change the area that is under water in the summer, a change that directly affects the survival of macro and micro aquatic organisms. Indirectly, base flows determine the ground water regimes and, therefore, the communities of riparian areas. The size, shape, and number of pools, riffles, and other fish habitat features are determined by the base flows in the summer. The base flow affects physical properties of the water including temperature, dissolved oxygen, and concentrations of dissolved and suspended solids.

Many natural occurrences and land management practices can affect base flows. Removal of vegetation will increase base flows by decreasing evapotransporation. Increases of 100 percent have been reported in the Coast Range during the first year after clear cutting 100 percent of a drainage; however, these increases are short-lived. Large fires are expected to have similar effects. Compaction and very hot fire can decrease base flows especially at the end of the summer. This decrease happens because the water runs off faster in the spring, leaving less water available for base flows.

Changes in riparian vegetation and channel morphology from natural conditions can also decrease base flows. There have not been any studies in this region on the effects of riparian vegetation on flows. However, in more arid areas, studies have shown significant decreases in base flow after removal of riparian vegetation, even the drying up of creeks. Although these studies do not apply on the "westside", some processes do happen here. Of most significance is the property of riparian areas to act like a sponge, holding water in winter and releasing it in summer. When channels down cut they become disconnected from the riparian area. This drains the riparian area earlier in the season. Because streams in the Mohawk Watershed can only down cut a few feet before reaching bedrock (see channel morphology section), the large effects experienced in other places do not occur. The magnitude of any decrease in base flow cannot be calculated.

Streams that down cut and straighten have another effect. These streams are more efficient moving water out of the basin, leaving less water for base flow. This amount could be calculated; however, it would be extremely expensive. Decreases in base flows cannot be calculated; however, changes in riparian condition and channel morphology can give an indirect indication of the likelihood of decreases (see channel morphology section).

Water Quality

Water temperature, specifically maximum summer temperature, is the only water quality parameter that will be discussed in this section. Other parameters were not an identified issue or they will be discussed in other portions of this chapter.

The initial temperature of stream water is determined by the elevation of the place where the water leaves the ground. A rule of thumb is that ground water temperature equals the average annual air temperature. The Mohawk Basin is low elevation and, therefore, has relatively high initial temperatures. The water temperature in the streams and rivers almost always increases as the water flows downstream and picks up energy. The net energy gain and resulting temperature is a function of complex interactions. A <u>few</u> of the factors that effect stream temperature are:

- The vast majority of the energy that warms the water is from direct solar radiation. Within a climatic region, the factor that has the greatest effect on water quality is shade from direct solar radiation. Although topography, distant tall trees, and dead materials provide some shade, the vast majority is provided by riparian vegetation. The Mohawk drainage has an estimated 80 percent shade on the perennial streams. If there were 100 percent shade, summer temperature at the mouth of the Mohawk River would decrease by 1.6^{o}F.

- Bedrock channels can store energy and release it during the middle of the day. The effect will be higher maximum temperatures. Although this effect is not large it could be critical to salmonids. The only bedrock channel in the Mohawk Basin is Mill Creek (not included in the M/M LAU). Mill Creek has the highest temperatures for its size of all the measured streams.

- The depth of the water effects the distribution of stream temperatures. Cooler water sinks and warmer water rises. The water at the bottom of pools has less velocity than the water at the surface and in the main current. The water becomes cooler and does not mix. These cool pools are critical to the survival of some species.

- Flow, velocity, and surface area all affect water temperature by affecting the amount of solar radiation striking the surface each second for each cubic foot of water.

- Channel morphology indirectly affects water temperature by affecting riparian vegetation, bedrock exposure, pools, flow, velocity, and surface area.

Maximum summer water temperature indirectly affects the aquatic flora and fauna by affecting dissolved oxygen in 2 ways. First, more O_2 can be dissolved in warm water, which often results in lower saturation. Secondly, higher temperatures increase biological activity and increase the biological oxygen demand by the decay process of organic matter (logs, leaf litter, sticks etc.), which can then compete with the needs of the aquatic organisms.

The greatest concern with high summer maximum water temperature is the effect on salmonids. These cold water fish are adversely affected by high temperatures in many ways. Direct mortality occurs if temperatures are too high (>68% F.). Diseases increase dramatically in warmer temperatures. Eggs and fry will only develop in cold waters. Anadromous fish will not migrate up streams if the temperature is too high.

It is believed that a run of spring chinook salmon has been lost from the Mohawk Watershed because the temperature during the migration season (June through August) has increased due to land management practices that have affected the factors described above. Other aquatic resources have probably suffered due to water temperature increases in the Mohawk Valley.

Sediment Routing - The deposition of sediment into streams and its subsequent routing through a watershed is a natural disturbance process influencing channel morphology, aquatic habitat, and water quality for other beneficial uses of water. Of particular concern is the contribution of fine sediment generated by human activities resulting in degradation of aquatic habitat and water quality.

Much of the Mohawk/McGowan Watershed Analysis area is underlain by pyroclastic rock material. Soils subsequently formed from this material are fine-grained in texture. Hillslope and road-related erosion from these soils will provide largely finer sediments to streams. Less area, generally ridge tops, is occupied by harder rock types (basalt and andesite), and are the source of larger gravels, cobbles, and boulders vital to aquatic habitats. The stream assessment categorized streams into channel response segments based on whether they function as source, transport, or deposition areas. The Mohawk/McGowan Watershed Analysis area is dominated by moderately confined transport reaches, giving the watershed a high capacity for transporting materials. It can be assumed much of the sediment entering streams will be transported through the stream channel network to the Mohawk River and beyond.

What sediment remains within the deposition areas is dependent on the size of flows (storms), whether or not stream structures such as large woody debris are present to retain the sediment, and whether the stream is channelized. Larger storms, for instance those with a 25-year or greater return interval, may result in much of the sediment being moved through the channel network, but may also allow for flooding and deposition of sediment on flood plains. Very large storms, with greater than 100-year return interval, have the potential for reaching broader flood plain reaches and depositing larger amounts of sediment in these locations there. Channelization of streams affects the ability of streams to flood, i.e. a larger storm is required for flooding to occur. This in turn reduces the amount of sediment deposited in flood plains, resulting in relatively more sediment being moved out of the channel network.

Limited fish habitat surveys in the uplands indicate excessive sediment problems are localized, but not a widespread problem affecting aquatic habitats in the watershed. There are no documented reports of excessive sediment problems affecting domestic water rights or other water users. Even though human activities, such as roads, are increasing sediment contribution to streams above natural levels, the nature of flows and the distribution of channel response types, allow for continued transport of much of the sediment reaching streams. However, where excessive, sediment levels can be a serious problem to aquatic habitats and an impediment to fish populations.

Value/Issue: Aquatic Habitat

Quality habitat is influenced by numerous past and current activities as well as natural conditions.

Large Woody Debris - Many of the streams in the watershed are deficient of large woody debris due to past management activities such as splash damming, stream "cleaning," and reduction of old growth forests. This wood affects a wide array of stream ecosystem functions including the occurrence and morphology of pools and gravel deposits, sediment storage and routing, bank stability, and overall channel complexity. Along stream corridors and areas adjacent to streams, large wood also serves as local regeneration sites for conifers. Of the 109 miles of 3rd order and larger streams in the western 2/3 of the watershed, 1/3 (36 miles) are managed on public lands. On these lands, 13.7 miles (38%; cover types C1, C2, C3 in Table 4-14) of the riparian overstory condition is composed of young conifer stands and 12.3 miles (34%; cover types H1, H2 in Table 4-14) is comprised of young hardwood or mixed hardwood stands with young conifers emerging. Therefore, a total of 26 miles (72%) of the riparian overstory on public lands contains a young tree overstory and large woody debris input to the aquatic system will take many years to develop. On private lands in the western 2/3 of the watershed, 10.8 miles (15%) of the riparian overstory contains young conifer stands and 24.3 miles (33%) contains young hardwood or mixed hardwood stands with young conifers emerging. Therefore, on private lands, 35.1 miles (48%) of the riparian overstory contain a young tree overstory with little opportunity for near-term large wood recruitment. Large woody debris is the major habitat structure in this watershed by which the healthy aquatic communities function. Large wood provides overhead and undercut fish cover, energy breaks from high flows, organic debris supply for the benthic community, and the nutrient cycling process. It governs the storage and release of sediments and detritus that facilitates the biological processing of organic inputs from the surrounding forest (Bisson et al. 1987).

Large Boulders - Another important habitat component is also very scarce in the aquatic systems of this watershed; however, in this system it is naturally scarce. Most of the large boulders were removed during the splash dam era in which boulders were removed to facilitate log movement down stream.

Gravels - This habitat component is very important for salmonid egg development. Historically, the gravels in the streams were trapped and held back by in-stream structures (e.g., large down logs) and were well distributed. As the logs were removed from the streams, the gravels were routed through the stream system at faster rates, especially during flood events, or what remained was poorly distributed within the streams. Newly recruited gravels probably move through the stream systems faster than they did when the streams had more in-stream structure.

Land Use Practices - A variety of land use practices occur within the watershed boundaries. Timber management, grazing, farming, and urban development have played a role in impacting the riparian zones in various ways, which has led to habitat fragmentation within the aquatic systems. The removal of woody debris, compromising of riparian habitat, local increase of silt from streambank erosion, decrease in side channel habitats, stream channel confinement, increased water temperatures primarily along the lower reaches of the Mohawk River, road construction, stream barriers from culverts and agricultural practices, etc. have all played a role in habitat simplification. Providing quality habitat for aquatic communities is part of the role of public lands. Following the guidelines of the Aquatic Conservation Strategy will improve the habitat functions considerably for the native, nonmigratory biotic component. It will also provide some of the functions necessary for downstream functions and aquatic communities on private lands (i.e., large woody recruitment).

Timber Management - This has been the biggest impact to the aquatic environment within the Mohawk/McGowan Watershed. The historical impacts have been talked about earlier. Future management on private timber lands will provide for a small buffer width that will provide some habitat protection and improvement for instream aquatic organisms and habitat function. The benefits to the riparian zones and the terrestrial component associated with the aquatic environment will not fully benefit from this narrow buffer as many functions of the riparian zone will still not be adequately provided for, such as microclimate processes, shade, and vegetational complexity. Also, road building by both BLM and private landowners can have a significant impact to aquatic habitat quality if constructed incorrectly.

Barriers - Although this watershed is already heavily roaded, dirt spur roads crossing streams off main road systems will still occur. From a limited inventory in the western 2/3 of the watershed, there are existing dirt and gravel roads where identified culvert barriers have been located (Map 16). Barriers associated with the eastern 1/3 of the watershed have been located and repaired. The culverts serving as barriers tend to be impassable to fish and other organisms, effectively limiting the amount of suitable habitat that can be used both upstream or downstream. They intercept organic material moving downstream; stream substrate such as gravels are prevented from moving downstream, except during strong floods, which leads to poor distribution of this resource. Streambeds are scoured at the ouflow of the culvert due to the funneling of water, and stream banks become down cut. Dirt and gravel roads that cross headwall streams and steep/pool drainages may also be sources of accelerated sedimentation to streams. Barriers associated with homeowners and agricultural activities such as diversions and small dams are unknown.

Recreation - Off Highway Vehicle (OHV) use is a major recreational activity within the Shotgun, Cash, and Showalter creek drainages. The number of off road trails is unknown; however, in some areas within these drainages it is quite extensive. Analysis on the impact of these trails to the aquatic communities is unknown but there is strong potential for some localized impacts to habitat and instream disturbances.

A temporary dam is built during the summer months on Shotgun Creek to create a swimming hole for visitors of this heavily used park. Although most fish migration is completed by summer, this dam does restrict movement up and down this reach of stream by the local aquatic organisms. To what extent this may be impacting the aquatic species is unknown.

Special Forest Products Management - It is unknown the type of impact this program may have on the quality of aquatic habitat. There is the potential to have small, localized, negative effects to vegetation near waterways from high use collection areas.

Value/Issue: Terrestrial Habitat

Lack of Biological Data - Aside from spotted owls and bald eagles, there is very little biological data on Federal Candidate, Bureau Sensitive, ROD J2 species, and other wildlife species that are either known or have the potential to occur in the watershed. This is an important part in trying to understand and properly manage other resource programs in a way that is compatible with the biological resources and for assessing the effects of ecological functions and processes. What is the impact of OHV trails or special forest product harvesting on habitat fragmentation and effectiveness (and for what species); what is the impact of additional noise from recreational activities, or other resource management disturbances to the biological resources? In lieu of such biological information, recreation, special forest product or other resource management plans being developed can never be considered final. As we gather biological data and understand the habitat needs of these species and how they function within the ecological processes of this watershed, modifications may and should be made to existing plans in an effort to mitigate for any adverse impacts to the species.

Are our habitat rehabilitation projects providing the benefits to biological resources they were intended to benefit? Are instream structures, snag creation, and riparian stand conversions helping or harming the wildlife and which ones? Biological data is needed for designing proper project monitoring systems to evaluate the project effectiveness and ecological functions.

Are the current land use allocations for this watershed adequate to meet the wildlife species' needs they were intended to benefit? In particular:

- Are 6-8 retention trees meeting the needs of maintaining 40 percent cavity nester requirements?
- Are timber management activities in the General Forest Management Areas providing for the early successional species needs? What about for other Federal Candidate, Bureau Sensitive, or ROD J2 species' needs?
- Are Riparian Reserves providing for connectivity and biological diversity for older forest species' needs across the Matrix landscape? Are these areas meeting the needs for Federal Candidate, Bureau Sensitive, or ROD J2 species' needs?
- Is spotted owl dispersal habitat being adequately provided across the landscape with the existing LUAs?

Large Tree Dominated Stands - In the watershed there is less than 1 percent of forest lands in stands 196+ years old. There is also approximately .5 percent of the watershed in forested lands 81-195 years of age. These large tree dominated stands are very important to meeting the biological needs of the 6 spotted owl pairs using the watershed and as dispersal habitat for spotted owls. Very few of these large tree dominated stands contain portions of perennial streams. The benefit to Federal Candidate species, Bureau Sensitive species, and ROD J2 species is not fully known but, for those species that are riparian/old growth forest canopy dependant, these may serve as refugia areas for this biological diversity component. Large tree dominated stands may hold the biological seed source for a variety of species to be able to expand their ranges into future suitable habitat in time as the Riparian Reserve areas and administrative withdrawn areas get older and more vegetatively complex or, in the case of natural or human catastrophes (i.e., major wildfire, chemical spill), help recolonize suitable habitat. These large tree dominated stands are a source of later decay class of large snags and down logs, habitat components seriously lacking throughout most of the watershed. Over the next 50-100 years, assuming the role of Riparian Reserves widths approximate what is required in the Forest Plan, older forest habitat (81+ years of age) will increase to approximately 30 percent of BLM ownership.

The relationship of the existing large tree stands with adjacent watersheds is largely unknown. What, if any, connectivity habitat, migration routes, genetic interchange, etc. are being provided by these stands and for what species? What are the recreational values resulting from these few large tree stands remaining in the watershed and are there negative impacts to the biological resources? What types of uses and potential future increase from recreational activities can we expect in the future, and what impacts will there be on the biological resources and their processes during those times.

Timber harvesting on private lands has all but eliminated forest stands older than 196+ years old and less than 1 percent of the stands 81-195 years old are all that remain on private land. Future projections see the eventual elimination of a majority of the remaining older forests on private lands with no real expected growth of existing younger stands into large, older forest habitats. Since the watershed does not contain enough acres of older forests to meet the 15 percent older forest retention on 5th field watersheds, the remaining large tree dominated stands (196+ and 81-195 age class) on public lands will remain for at least the next 50 years. The current Land Use Allocation (Matrix) and private land holdings within the watershed boundaries significantly increase the value of these large tree dominated stands in this watershed. Future large tree stands that will evolve in time will be restricted to the Riparian Reserves, Connectivity Blocks, and administrative withdrawn areas. Biodiversity for older forest species are and will be restricted to these large tree stands. These older stands will over time dominate up to 40 percent of the Federal ownership but less than 11 percent of the total watershed. The retention of older forests and the benefits to a variety of resources such as recreation, wildlife, fisheries, and special forest products is strongly related to land ownership and BLM will provide for these resource values for this watershed.

Roads - The road density in the watershed is 4.9 miles of road per square mile on private timberlands in the eastern 1/3 of the watershed; 4.48 miles per square mile on public lands; 3.67 miles per square mile on private timberlands intermingled with the public lands; and 3.7 miles of road per square mile on lands managed by small private landowners and other lands. This extensive road network serves as a conduit for the introduction of exotic plant and animal species into the forest landscape. These exotic species compete with and sometimes outcompete with the native flora and fauna inhabiting the watershed. This is especially a problem in the few remaining large tree dominated stands where interior forest species are already vulnerable to reduction in numbers or to local extinction. The impact of these exotics on Federal Candidate species, Bureau Sensitive, and ROD J2 species is unknown at this time. Research with starlings in midwest United States has shown a significant impact to native songbirds' reproduction success. Starlings are just one of the exotics that do occur in the watershed.

Logging roads, whether or not gated, provide increased human access that leads to wildlife poaching (especially McGowan Creek and Shotgun Creek drainages), accidental or purposeful wildlife harassment, pollution, and provides potential access for human caused fires. On the positive side, roads do provide wildlife viewing opportunities. Logging roads impact wildlife habitat by fragmenting an already fragmented habitat especially as it pertains to the remaining large tree dominated stands. The roads also reduce the effectiveness of habitats for some species (i.e. neotropical bird nesting habitat) and alteration of habitat use by some wildlife species (i.e., big game security cover).

Fragmentation - Within the Mohawk/McGowan watershed, fragmentation of early seral stage forest habitat was not considered to be an issue. Fragmentation of the large tree dominated stands is the issue for existing and future stands within this watershed. Fragmentation from logging roads on existing stands is discussed above. The changing landscape patterns resulting from land management practices of the last century have had dramatic effects on the ecology of forests in the Mohawk/McGowan watershed. The old forest dominated landscape of the late 1800s and early 1900s was converted to a fragmented landscape of young forests, plantations, and agricultural fields in which less than 2 percent of the landscape remains in mature and old forest condition that is fragmented into small, isolated patches. The combination of small isolated patches, further dissected by the extensive road network, maximizes the effects of edge, substantially reducing the amount of effective interior old forest habitat. The existing large tree dominated stands house the remaining biological legacy (fungi, large trees, parent soils, microorganisms, etc.) for the watershed. This legacy has been eliminated in the eastern 1/3 of the watershed where intensive timber harvesting practices on private lands have eliminated all older forest habitats. The amount of fragmentation is still expected to be high in the future as the Riparian Reserves, administrative withdrawn areas, and owl core areas develop. However, spatial distribution will be better across the western 2/3 of the watershed than the current distribution of the few isolated patches that exist. For some species, such as those with limited dispersal capabilities and species with small home range requirements, this fragmentation may not be as restricting. This assumption is based on reserve widths, withdrawn areas, and owl core areas being managed as described in the RMP and ROD.

Snags and Down Logs - The ecological processes that lead to the creation of snags and down logs should be reviewed to help determine the management prescription and timing of converting retention trees in timber management units into snags and down logs.

The spatial distribution of snags and down logs across the landscape is determined by a variety of variables such as slope and aspect, and varies through time for unmanaged forests. In an effort to emulate these conditions, a strategy should be developed to address the following concerns:

Timber harvesting - snag creation and timber harvesting activities need to be coordinated so this habitat component can be distributed within a timber sale unit through time and avoid clumping all snags at the bottom or edges of sale boundaries. Also, snags and road systems need to be managed to avoid human safety concerns.

Silvicultural operations - retention of existing snags after harvest and newly created snags need to be coordinated with forest replanting needs, including prescribed fire, so that this habitat component can be well distributed within a timber sale unit through time and to avoid clumping of snags.

Recreation management - inventories for existing snags should be done to minimize safety conflicts with OHV trails and other recreational activities. A snag inventory would be extremely valuable in determining management direction needed to be taken for existing recreational use areas and future use areas.

Public safety - with the extensive road network in the watershed and OSHA requirements for public safety, quite a few existing snags adjacent to roads could be eliminated from the landscape. Currently, it is believed that the watershed contains a low amount of snags fulfilling the biological needs of the wildlife occurring in the watershed so a management strategy needs to be developed soon to avoid the future reduction of an already scarce resource.

Spotted owl dispersal habitat - there is a strong correlation between snag and down wood quantity and spotted owl use areas. BLM is responsible for providing spotted owl dispersal habitat across the landscape and research in the watershed is showing owls associated to areas containing more snags per acre than what the ROD/RMP requires (Table S-7). Since BLM is responsible for managing for spotted owl dispersal habitat, they will be applying the best available science in the areas needed to provide for dispersal habitat needs.

Value/Issue: Commodity Values

Timber Quantity - The following lists the elements that may affect the amount of timber harvesting occurring in the watershed.

15% rule - The watershed does not meet the 15 percent rule; therefore, no stands over 80 years of age will be harvested. Approximately 1,236 acres have tree stands 80 years old and over and will be available for harvest as younger reserve stands exceed 80 years in age.

Rotation - The amount of BLM operable acres with stands 40 - 50 years old is 2,384 acres. The amount of BLM operable acres 60 - 70 years old is 1,947 acres. The total amount of BLM acres available for harvesting is 4,331, which is 4.9 percent of the total watershed. For the watershed as a whole, there are 28,124 acres of 46 - 80 year old.

Land Use Allocation - Approximately 52 percent of the BLM lands is in General Forest Management Areas (GFMA). Approximately 37 percent of GFMA acres are in Riparian Reserves. The 37 percent is a low estimate because it only includes streams that are in GIS (based on our experience with recent timber sale projects, the estimate may be between 40 and 50 percent). The amount of Riparian Reserves and the potential for more will impact the amount of timber harvest. Also, the location of the Riparian Reserves may impact the amount of timber harvested. The Riparian Reserves may create isolated pockets of timber that are not accessible unless helicopter logged.

Maintaining Other Resources - Special habitats like ponds and wetlands will have a nonharvestable buffer to protect these resources for fish, wildlife, and sensitive plant resources. Also, providing the required snag retention trees and down woody material to meet wildlife and other ecosystem health needs will result in less trees harvested. Simplification of habitats over the past 200 years into plantation forests has resulted in less heterogeneity of special habitats/riparian habitat, which historically supported high species richness (Botany Appendix).

Special Forest Products - The following lists elements that influence the supply and demand for special forest products

Road Access - This area is well-roaded. Most of the watershed can be accessed by roads. For the lands intermingled with BLM lands, there are few roads that are closed to the public. This allows special forest products collectors access to the forest.

Increase In People Use - The Eugene/Springfield area's population increased by 6.8 percent and the Marcola Division's population increased by 10 percent. It is expected that the Eugene/Springfield area and the watershed area will continue to grow in population (Census Data). In 1994 the amount of greens collected increased by 65 percent and the amount of moss collected increased by 53 percent over 1993 levels. The amount of fuelwood collected decreased by 76 percent over 1993 levels. The increase in people and use of the area may impact the amount of special forest products available over time.

Timber Harvesting - Timber harvesting impacts the amount of special forest products available, such as mushrooms, ferns, mosses and greens (especially final regeneration harvesting). Moss will decrease because of the removal of vine maple and lower vegetation structures. Mushrooms tend to associate with mixed conifer stands. Removal of overstory through timber harvesting will eliminate these fungi for many years because of less habitat. Ferns will decrease because of harvesting disturbances. However, ferns will grow back quickly but may be of poor quality depending on the amount of canopy present. Salal could increase after harvesting if a canopy of 30 percent or less remains. Salal and Oregon grape will respond with partial stand removal from thinning type operation. Ground disturbance effects from harvesting will negatively effect truffle production.

Threatened and Endangered Plants - There is a potential for loss, damage, or collection of T&E plants or sites. Approximately 15.4 percent of the BLM administered lands have been surveyed for T&E plants. Since there is a lack of inventory of T&E plants, it is difficult to protect plants against loss, damage, or collection.

Special Areas - Special areas such as ACECs and RNAs do not allow special forest products collection. There are 823 acres of special areas in the watershed.

Personal Use & Traditional Use - There is no traditional use/cultural values recorded for this watershed. Some special forest products are collected for personal use as well as commercial use. Some special products collectors perceive collecting forest products as a recreational venture.

Recreation - Recreation activities have economic benefits to businesses within the watershed. Businesses such as grocery stores, restaurants, shooting range, golf course, and horse stables earn money from the recreation use in the area.

Recreation Activities and Events - Recreation events increase the amount people in the watershed. These events increase the amount of foot traffic at local businesses. Events draw visitors to the area from outside the State. A money trail follows these nonlocal visitors. The various recreation activities such as hang gliding, horseback riding, dirt bike riding, mountain bike riding, and scenic viewing occur year around. There is no data that states the amount of people use this area receives. Recreationists visiting the watershed probably spend money at the local businesses.

Hunting, Fishing and Motorcycle Permits - Hunting and fishing both require a permit to participate in either activity. The economic benefit of selling permits is at the State level. A percentage of the money collected at the State level is returned to the local level. Hunting and fishing brings people to the watershed who may stop at local businesses.

Motorcycle riders are required to obtain a permit for their motorcycles. The money collected goes into a fund that is partially allocated to improve recreational riding opportunities. There is a local benefit associated with these dollars when we obtain funds for improving recreational riding opportunities. Riders are attracted to the area and spend money.

Shotgun Park - Shotgun Park received over 88,000 visits in 1990 (RMP pp 3-108), 87,073 visits in 1991, 85,015 visits in 1992, 92,226 visits in 1993, and approximately 80,000 visits in 1994. Shotgun Park visitors may stop at some of the local businesses on their way to or from Shotgun Park.

Accessibility - Most of the analysis area where BLM lands intermingle with private lands is accessible to the public. Since there are roads throughout the watershed, people have access to land for a variety of recreation activity. Three of the five major entry points are paved and, therefore, highly accessible. These roads pretty well cut through the heart of the area. The watershed is also within close proximity to the Eugene/Springfield area. The road system and proximity to Eugene/Springfield area makes this watershed accessible to recreationists, providing customers to the local businesses.

Value/Issue: Public Use

Where People Live and Demographics - People have lived in this watershed since 1850. Most of the residential areas are along the Mohawk River, and Parson and Wendling creeks. Four percent of the Mohawk Drainage is zoned residential (Schaffner). One percent of the people live on farms. The population increased 10 percent in the Marcola Division over the 1980 level (census data).

Forest Land and Scenic Quality - There are many reasons why people live in rural areas. One is that some people like to live out in the forest, and another is the scenic quality of living in a forested and open field environment. The main reason is probably the quality of life of which the above mentioned reasons are a subset. Some people have strong concerns about how a forest is managed that is adjacent to their property. Neighbors may influence how BLM harvests timber next to their property. This may affect timber quantity.

Movement of Animals and Plants - Increased human habitation over the past 200 years has resulted in the conversion of special status and native plant community into agricultural, residential lands, road building, etc. (Botany Report). The same could be said regarding terrestrial species.

Aquatic habitat - People may impact aquatic habitat by impacting the streams. Impacts can be such things as cleaning debris from stream banks, placing fish barriers in streams or increasing the amount of sedimentation into streams. In the watershed, sedimentation is not a problem except possibly in some areas. Having adequate stream structures and the presence of fish barriers is a problem in the watershed. The identified fish barriers have mostly been culverts on BLM lands. The increase in population and residential dwelling may impact water quality depending on if and where drainfields are built (Schaffner, p.73).

Recreation

Accessibility - The proximity to the Eugene/Springfield area and road access within the watershed promotes use of the watershed for recreation. Unique topographical features is another reason this watershed area attracts recreation use.

Ownership - BLM administered lands is only 26 percent of the watershed. The ownership pattern and amount of BLM lands has impacted the quality of the recreation experience. It has also impacted the recreationist access to sites, reduced opportunities, and increased conflicts. The ability to plan and designate recreation use has been made more complex because of the ownership pattern. Since recreation activities have occurred to some extent regardless of ownership patterns, the private landowners are concerned about recreation use and impact to their lands.

Aquatics - There is some soil movement from recreation activities. However, we do not know how much and what impacts are occurring. We do know that sedimentation is not a problem at the watershed level. Sedimentation problems are localized. Stream crossing by recreationists may cause short-term impacts. However, we do not know for sure because of lack of monitoring.

Terrestrial Species, T&E Species, and Special Areas - T&E plants may have their natural communities or plant size impacted by recreation activities. Some special habitats such as meadows, ponds, and special areas have been impacted by recreation use.

H:\RES\WP\CHAPT'5.M&M

Chapter 6
Future Conditions

Land Use And Ownership

The future condition for the Mohawk/McGowan Watershed is influenced by landownership. The lower elevations are dominated by agricultural and residential uses. It is anticipated that residential use will increase. Native riparian vegetation on the lower portion of Mohawk River and McGowan and Parsons creeks is lacking and probably will remain so in the foreseeable future. Approximately 52 percent of the watershed is in industrial forest management, which is anticipated to continue into the future. It is assumed that these industrial lands will be managed for maximum timber production while abiding by the Oregon Forest Practice Rules; a 45-year rotation age is assumed for these industrial lands. BLM managed lands are about 26 percent of the watershed and are divided into 4 major categories of general land management objectives (Late-Successional Reserves, Matrix, Riparian Reserves, and Administrative Outs). For BLM administered lands, these categories are the dominant factors determining the course of future conditions. Each category and a possible future scenario based on the distribution of these categories in the Mohawk/McGowan Watershed will be discussed.

Late-Successional Reserves

These areas are identified to protect and enhance conditions of late-successional and old growth forest ecosystems that serve as habitat for late-successional and old growth forest related species, including the northern spotted owl (ROD, p. A-4)). Since few acres of this allocation occur in the watershed, vegetation on areas with this designation will simply age into the future. Vegetation on about half of the acres in this allocation is greater than 80 years old. Unless a major disturbance occurs, the vegetation in 50 years will be 80 years or older.

Matrix

Primary objectives of lands in this category are:

1. Produce a sustainable supply of timber and other forest commodities to provide jobs and contribute to community stability;

2. Provide connectivity (along with other allocations such as Riparian Reserves) between Late-Successional Reserves;

3. Provide habitat for a variety of organisms associated with both late-successional and younger forests;

4. Provide important ecological functions such as dispersal of organisms; carryover of some species from one stand to the next; and maintenance of ecologically valuable structural components such as down logs, snags, and large trees; and

5. Provide early-successional habitat.

To meet these objectives, this land use allocation is divided into 2 categories: General Forest Management Area (GFMA) and Connectivity/Diversity Blocks. The GFMA concentrates on objectives 1, 4, and 5, above. Regeneration harvests on GFMA areas in this watershed may occur at about 70-year intervals. Therefore, the GFMA vegetation may never reach late-successional or old growth conditions, but will provide a sustainable supply of timber. Due to the amount of private industrial lands (assumed to have a 45-year rotation) and GFMA, the majority of this watershed will remain in the younger seral stages into the future.

Management of the Connectivity/Diversity Blocks concentrates on objectives 2, 3, and 4, above. This category occupies 3,252 acres of the watershed. For the future scenario, it was assumed that lands in this category are on a 150-year rotation. Therefore, for the next 50 years very few acres will be regeneration harvested. However, between 50 and 100 years from now, almost half of the acreage (not including Riparian Reserves) may have vegetation less than 15 years old.

Riparian Reserves

Riparian Reserves are a key element of the Aquatic Conservation Strategy (ACS). They provide an area where riparian-dependent resources receive primary emphasis. Riparian Reserves are also important to the terrestrial ecosystem (e.g., dispersal habitat for northern spotted owl). The Riparian Reserves are a vital link for late-successional and old growth habitats in the Mohawk/McGowan Watershed. Riparian Reserve areas comprise about 9,492 acres (using ROD interim widths for BLM and 20-foot widths for private timberlands). In the western 2/3 of the watershed, 58 percent (55% on public lands) of the 3rd order and larger streams' riparian overstory is hardwood dominated and 26 percent (44% on public lands) is conifer dominated. The Oregon Forest Practice Act provides for a 20-foot buffer area along streams on private forest lands that will not be harvested. Depending on stream type and size, an additional 30 to 80-foot buffer will be left and actively managed to provide recruitment of large woody debris, snags, and existing down wood. This additional management buffer will be based on square feet of basal area per 1,000 feet of stream, each side. Vegetation in this buffer will progress through the seral stages into the future.

No final regeneration timber harvesting is assumed for the Riparian Reserves on BLM administered lands. Therefore, vegetation in these reserves will age into the future. We assume that within 50 years the younger hardwood stands will be maturing and naturally succeeding into young conifer stands. At 100 years out, a mixed conifer and hardwood stand could be dominating areas that are in young hardwoods. The reserve areas dominated by old hardwoods will age and pass through the seral stages over the next 50 years, and will probably be dominated by conifers 100 years from now. In 50 years, when about 1/3 of BLM Riparian Reserve vegetation will be greater than 80 years old and 100 years out, almost all will be between 120 and 195 years old. Objectives for BLM Riparian Reserves may create opportunities to use vegetation management practices on existing vegetation to create late-successional and old growth characteristics sooner than would happen naturally.

Administratively Withdrawn Areas - Administratively withdrawn areas (1,020 acres in Mohawk/McGowan Watershed and 1,290 in the Coburg Fringe area) include ACECs, Research Natural Areas, recreation site (Shotgun Creek), Relic Forest Islands, and T&E outs (bald eagle). Each area will be managed for the resources for which it was reserved, and allowed to age into the future.

Major Values/Issues

This section will address the effects of assumed management (addressed above) of private and BLM lands on the major ecosystem elements involved with the concerns/issues identified in Chapter 3.

Terrestrial Habitat

On public lands within the Mohawk/McGowan Watershed, forests will be predominately managed under a short-rotation (60-80 year) prescription. The uplands will encompass forests in the early seral stages. This landscape will contain snags (decay classes 1-3) and down woody material meeting RMP/ROD Standards and Guidelines. The vegetational component will include species representative of what would naturally occur. Vegetational structure and complexity will remain fairly simple within uplands. Tree diameters will range between 20"-30" dbh. Wildlife species associated with early seral habitats such as bluebirds, coyote, pocket gophers, and deer and elk foraging habitat will benefit from this management prescription.

To meet the new State Forest Practices rules on private commercial forest lands 2 green trees or snags per acre will be left on the uplands after timber harvesting for units >10 acres. Although the trees are encouraged to be distributed across the harvest unit, they can be distributed along riparian buffers, sensitive sites, or along the edge of a unit. Also 2 down logs/acre 16" dbh (large end) and 16' long are to be left in harvest units (>10 acres). At least 50 percent of these logs need to be conifer species. Trees on the upslope will be predominately Douglas-fir with little diversity of other conifer/ hardwood trees or shrubs. The forest structure and complexity will be very simple. Tree diameters will be small (20" dbh). It is assumed that forest rotation will be 40-50 years.

Within the watershed, Riparian Reserves, spotted owl core areas and other administratively withdrawn areas on public lands will be the areas in the watershed where large tree dominated stands will occur. Many of these areas are in a young seral age class and over the next 100 years will become mature forest stands. The existing older forest stands are small, isolated, and fragmented. Many are not functioning as old growth forests, at least not for the species where research has been conducted. Very few of the existing large tree dominated stands are adjacent to or encompass riparian areas. The riparian management areas, as described in the Forest Plan and State Forest Practices Act, will encompass approximately 37 percent (based only on GIS estimate) of the public lands and 10 percent of the total watershed acres (Map 4). The 72 percent of the riparian area that is in the young seral habitat condition will, within a 100 years, become mature forest providing structural and vegetational complexities and begin providing habitat for species associated with older forest conditions (brown creeper, deer and elk thermal cover, silver-haired bats). Also, these riparian areas will be important in the retention of both large and small diameter snags and down logs in the later decay classes. Species that prefer this habitat component (woodland salamanders and hairy woodpeckers) would benefit. As these reserves grow older, they will begin to compliment the existing older stands from owl core areas and administrative withdrawn areas, provide for connectivity with these older stands, and also provide travel corridors across the landscape for many mobile and less mobile special status, ROD J2, and other wildlife species that exist or potentially exist in the watershed. The Riparian Reserves will be the land use allocation by which the maintenance of biological diversity and its processes (gene flow, species richness, community and landscape level interactions) and habitat for older forest dependent species will be provided in an otherwise early seral forest landscape. Leave trees in the Matrix will also provide some maintenance of biodiversity.

Water Quality And Quantity

Peak Flows - BLM activities will not have a significant effect on peak flows in the watershed. The affect of all owners and land uses will probably not have a net effect on the present exceedance probability of peak flows for the Mohawk River.

There will be short-term increases and decreases in the exceedance probability of the various subwatersheds due to timber harvest in the rain-on-snow zone. These changes are expected to even out throughout the watershed. Variations in magnitude of peak flows will be insignificant compared to natural variations due to precipitation. Short-term is less than 25 years. Using the cutting patterns assumed in developing the future scenarios, Log Creek will have lower exceedance probability (greater magnitude peak flows) in 10 years while Parsons and McGowan creeks will have lower exceedance probabilities in 50 years due to rain-on-snow effect.

Compacted areas and roaded areas in the watershed are not expected to increase significantly in the foreseeable future. An increase of 1,000 acres compacted (equivalent to 185 miles of road) could increase the magnitude of peak flows up to 2 percent.

Improvements in riparian and aquatic habitats will probably have some affect on peak flows; however, there is no method to estimate the amount.

Base Flows - Base flows will hopefully increase in the future due to increased awareness of the value of riparian and stream ecosystems; improved BMPs, forest practices, and agricultural practices; stricter forest practice rules; and stream and riparian enhancement projects. The increases cannot be estimated; however, even a couple percent increase would have tremendous benefits.

Temperature - In the future, maximum summer temperatures in the lower Mohawk River are not expected to change significantly from the present ranges. Improvements in riparian and aquatic habitats (e.g., addition of in-stream structure, pool formation, decrease in stream bedrock exposure, etc.) have the potential to lower maximum temperatures. Conversely, eliminating vegetation providing shade to the stream will increase temperatures.

Sediment Routing - Since the watershed is mostly roaded and the majority of sediment above background levels is produced by roads, the sediment rates in the future should not significantly increase. Strategically planned road projects (e.g., modified road drainage, road decommissioning, etc.) could actually decrease the amount of sediment produced by the road system .

Aquatic Habitat

Structure Recruitment: Large woody debris is the predominate habitat component providing aquatic structure in this watershed so this section will focus on this element.

As mentioned in the previous chapter, within the western 2/3 of the watershed, 72 percent of the 3rd order and larger streams on public lands and 48 percent of the private lands contain riparian overstory stands that are too young to provide immediate large wood recruitment to the aquatic environment. Looking at it another way, 26 percent (9.4 miles) of public land and 26 percent (19.2 miles) of private lands contain riparian overstory conditions of mature, old growth, or old hardwood stands that have the potential for immediate recruitment of large down logs. The older hardwood stands will convert to conifer overstory over the next 50-100 years. This analysis is based on aerial photo interpretation of riparian overstory conditions within 100 feet each side of 3rd order and larger streams. Based on the new State of Oregon Forest Practice Water Protection Rules that went into effect in 1994, streamside habitat protection can be expected to provide for large woody debris recruitment for streams on private lands. On the eastern 1/3 of the watershed, the Upper Mohawk Watershed Analysis (completed by Weyerhaeuser) concluded that an additional 3.5 miles of stream provides good potential for large woody recruitment and an additional 1.5 miles contains poor potential for large down wood recruitment. Most of the middle to lower sections of the Mohawk River contain an old aged hardwood stand. The density of this overstory condition varies significantly along this reach; however, and may not provide adequate large wood recruitment for this system. Also, the probability of large logs being retained in this predominately agricultural environment is highly unlikely since logs would capture upstream debris, reroute the river channel, and cause localized flooding.

Long-term recruitment of large woody debris will come from stand manipulation of the young conifer and red alder hardwood dominated stands. This action may expedite the riparian zones' return to older, mature conifers with scattered hardwoods. To capture over 90 percent of the potential large woody debris recruitment within the stream channels, riparian buffer widths for perennial streams need to be maintained at 100 feet on public lands.

Short-term recruitment of large down logs will have to be brought in from off-site (i.e., road right-of-ways) or by treating trees within older conifer stands adjacent to streams.

Public Use and Commodity Values

Recreation - The future scenario is to have an inventory of trails and people use, and to have designated trails. There will be more partnerships with clubs, recreationists, and private landowners. There will be more people wanting to recreate. The management issue will be trying to accommodate the increase in recreationists and maintain a quality recreation experience. Through the use of design, law enforcement, and education current conflicts will be addressed and the quality of the recreation experience can be maintained even with an increase in use.

Where People Live and Demographics - The future scenario is that there will continue to be an increase in population. Approximately 25 percent of the residential zoned land in the Mohawk Basin is considered vacant and approximately 87 percent of the vacant lands can be developed.

Residential development potential lies near the Mohawk River and its tributaries (Schaffer, p 73). The Marcola community is where the most potential for expansion exists; however, the community will need to expand water and sewage treatment facilities to reach maximum build-out potential (Schaffer, p. 73). If the Marcola community expands its water and treatment facilities, the maximum number of dwellings that could be built in the Mohawk Basin is 753; if the Marcola community does not expand the maximum number of dwellings that could be built is 421. The table below shows the dwelling and population increases. Current population in the Mohawk Basin is 3,080 people (Schaffner, p. 17).

Maximum Potential New Dwellings	Maximum Mohawk Basin Dwellings	Population Increase	% Change in Population
753	1,780	1,807	58
421	1,448	1,010	33

Assumption: 2.4 persons per dwelling
Source: McKenzie Basin Residential Land Use Pilot Analysis

Considering the above information, the future scenario is more residential dwellings along the Mohawk River, and Parsons, Wendling and Log creeks. Also, the Marcola community would receive an increase in population. There will probably be an increase in population not only within the watershed but also in the Eugene/Springfield area. Therefore, the area will probably have an increase in use.

Commodity Values - Timber and special forest products will continue to be harvested. The amount of timber available may be cyclic since a large percentage of the watershed is in younger seral stages. According to projections (based on gross assumptions), the amount of BLM acres in the 46-80 age class is expected to drop over the next decade. In 50 years the amount of BLM acres in the 46-80 age class may be more than double that estimated for 10 years from now. In 100 years the amount of BLM acres in the 46-80 age class may be close to the current amount. Again these estimates are based on a gross estimate and do not consider spatial distribution and other factors.

H:\RES\WP\CHAPT'6.M&M

Chapter 7
Opportunities

Some opportunities to help meet the objectives of the various BLM land use allocations in this watershed are discussed in this chapter. These opportunities are arranged by the values/issues presented in Chapter 3. Some relate to more than one issue and may be found under 2 or more issues. Cooperative projects on multiple land ownerships are most effective in meeting watershed objectives. Cooperative efforts are feasible in this watershed since it contains several large landowners (i.e., Weyerhaeuser, Willamette Industries, Hancock), small landowners who could be represented by the McKenzie Watershed Council, and Federal interests (BLM and National Resources Conservation Service).

Water Quality and Quantity

The elements of stream water temperature (as it affects salmonids), sediment, and flow were addressed in Chapters 4 and 5. The interaction of maximum temperature and minimum flow on the salmonid (especially spring chinook) population is of most concern for this watershed. Sediment is probably not a concern on the overall watershed but may be a concern in specific areas.

Stream Water Temperature - Cooperative efforts (small private, large private, BLM) to help lower stream water temperatures on the lower reaches of the Mohawk River. A combined effort by all landowners could possibly lower summer temperatures 1-2^{o}F.

Flow

- Decommission roads that are significantly affecting water flow regimes. It is doubtful that decommissioning a few miles of road on BLM lands alone will have any impact.
- Cooperatively manage road density, construction, and drainage to minimize influence on peak flows.
- Manage large wood material, reduce compacted area, increase streams' access to flood plains, and manage for "healthy" riparian areas with the objective to increase base stream flow. Changes in base may not be measurable, but the benefits to the aquatic ecosystem would be substantial.

Sediment

- Develop a road management plan including an updated road inventory and an assessment of erosion input locations.
- Decommission roads where this treatment will reduce erosion.
- Inventory and assess sediment contribution from recreational bike trails. Support cooperative efforts with users to manage the trails to avoid or ameliorate sediment production.

Riparian Reserves

Riparian Reserves are important for meeting the Aquatic Conservation Strategy objectives and providing dispersal corridors for terrestrial species. The vegetation in the Riparian Reserves is generally too young to provide the structure and functions necessary to meet these objectives. Shade to the stream is important to minimize effects on water temperature. Large woody debris for riparian area and in-stream structure is lacking. The following list of opportunities should help manage the Riparian Reserves to meet the objectives mentioned above and provide for riparian structure and function that may be missing.

Riparian Reserves Management

- Manipulate the hardwood dominated Riparian Reserve vegetation to become conifer dominated stands with the ultimate long-term goals of producing large woody materials for the aquatic ecosystem; and creating late-successional and old growth characteristics sooner than would occur naturally. Use fisheries and stream geomorphology to help prioritize areas.

- To meet short-term large down woody material needs, logs from Late-Successional Reserves and road right-of-ways should be used.

- Manipulate (e.g., PCT, CT) the conifer dominated Riparian Reserve vegetation for large wood material recruitment and to create late-successional and old growth characteristics sooner than would occur naturally. Use fisheries and stream geomorphology to help prioritize areas.

- Manage Riparian Reserve vegetation to encourage large snag and down wood development.

- Work with ODFW in beaver management for relocation to improve riparian ecosystems. Beaver activities would raise the water table, improve water storage, enhance riparian vegetation, and create aquatic and riparian habitats important to other wildlife species. When considering management activities designed to encourage beaver, the potential affects to adjacent landowners should be carefully considered.

- At the project level, assess affects (consider impacts to water quality and aquatic and terrestrial habitats) of building roads through Riparian Reserves. For the Mohawk/McGowan Watershed, large woody debris (both in riparian area and in-stream), stream water temperature, habitat fragmentation, and barriers to fish passage should receive particular attention when assessing affects. Design and build road crossings to maintain or enhance aquatic habitats up and down stream. Road crossings create a control point for the stream. This is a point where the stream is set in space, both vertically and horizontally. Stream crossings can create wetlands, agrade stream beds, add sinuosity, and create diverse habitats.

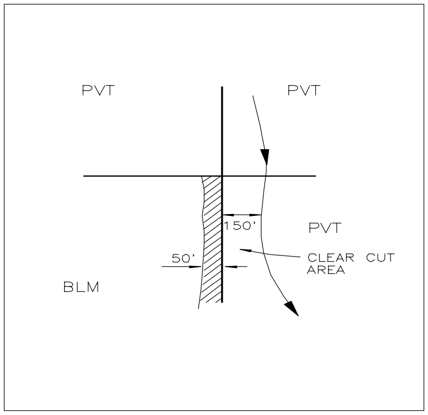
- At the project level, assess affects (consider impacts to water quality and aquatic and terrestrial habitats) of creating openings (e.g., yarding corridors) in the Riparian Reserve vegetation. Large woody debris, stream water temperature, and habitat fragmentation should receive particular attention when assessing affects.

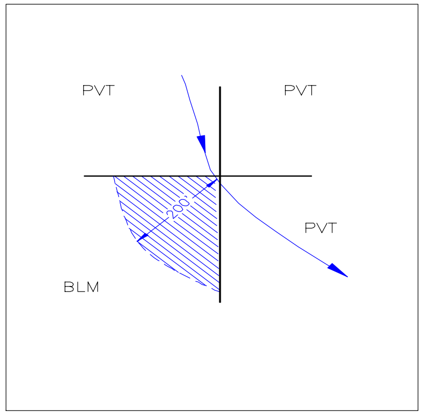
Riparian Reserves Width

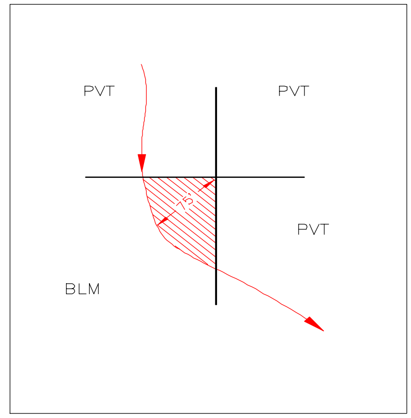
As referenced in the ROD (p. B-23), watershed analysis provides the basis for managers to set appropriate boundaries for Riparian Reserves. Watershed analysis can provide the ecological and geomorphic basis for changing the interim widths of Riparian Reserves necessary to meet the Aquatic Conservation Strategy objectives. Critical hillslope, riparian, and channel processes must be evaluated in watershed analysis in order to delineate Riparian Reserves that assure protection of riparian and aquatic functions (ROD, p. B-13). Watershed analysis addresses the ecosystem interactions, functions, and processes important to riparian areas. Following watershed analysis, a site-specific analysis should be conducted and described, and the rationale for final Riparian Reserve boundaries should be presented through the appropriate NEPA decision-making process. Until this process is completed, the interim prescribed widths apply.

<u>Perennial and/or Fish Bearing Streams</u> - Riparian Reserve widths for perennial and/or fish bearing streams should approximate the interim widths specified in the ROD (p. C-30). The general lack of information about the numerous plant and animal species (especially species in the J-2 Appendix of the SEIS/ROD) that inhabit and use riparian areas in the Mohawk/McGowan Watershed provides no basis for modifying the interim widths. However, due to the checkerboard ownership pattern of BLM and private lands, occasional disjoined reserve areas may occur (see Figure 1). Also, small isolated Riparian Reserves (see Figures 2 and 3) may occur due to the checkerboard ownership. These disjoined and isolated areas should be evaluated at the project level and assessed for the overall watershed effectiveness of that particular Riparian Reserve area to meet the intent of the Aquatic Conservation Strategy.

Figure 1. Disjoined Riparian Reserve. Figure 2. Isolated Riparian Reserve.   Figure 3.Isolated Riparian Reserve







Intermittent Streams - For intermittent streams, Riparian Reserve widths should be established considering the geomorphic, hydrologic, and riparian-dependent species conditions as well as benefits (especially dispersal) for nonriparian dependent species. Riparian Reserve widths on intermittent streams and wetlands necessary to meet the Aquatic Conservation Strategy objectives can be determined by using the Figure B-1 in the ROD (p. B-15). This Figure shows the estimated size of Riparian Reserves needed to protect the "ecological integrity" of intermittent streams with different slope and rock types. "Ecological integrity" in this case included erosion (excluding slope stability), soil productivity, habitat for riparian-dependent species, the ability of streams to transmit damage downstream, and the role of streams in the distribution of large wood (ROD, p. B-15).

Three steps or "screens" can be used to evaluate pertinent ecosystem processes and determine appropriate Riparian Reserve boundaries for intermittent streams. In essence, Figure B-1 in the ROD can be used to estimate Riparian Reserve widths needed to meet the objectives of the Aquatic Conservation Strategy (including riparian-dependent species but excluding slope stability). This figure should be used as the first step or "screen" in a process to recommend Riparian Reserve widths for intermittent streams. At the project level, slope and rock type should be determined and used to estimate minimum width of the Riparian Reserve for that project area. Rock types for the Mohawk/McGowan watershed fit into the Figure B-1 categories of unconsolidated, intermediate sediment, other resistant, or weak rock. Depending on slope and these rock types, Figure B-1 indicates Riparian Reserve widths of approximately 60-175 feet to meet the Aquatic Conservation Strategy for streams in the Mohawk/McGowan Watershed.

The second step or "screen" in the evaluation process to estimate Riparian Reserve widths contains the following criteria/elements that need to be addressed:

1. At the project level identify and include in the reserve the extent of unstable and potentially unstable areas;

2. At the project level determine reserve widths necessary to yield no net long-term increase in stream water temperature;

3. At the project level identify and include the 100-year flood plain if it is greater than the widths required in the first "screen" above (from ROD Figure B-1, p. B-15) (for maintenance of base flow and sediment routing); and

4. At the project level include the 100-year flood plain plus an area of 100 feet on each side of the flood plain (for recruitment of large woody material).

The third "screen" in the process involves assessing Riparian Reserve objectives for nonriparian dependent species. Criteria/elements to address in this step are:

1. Effects on microclimate: Data are needed to assess the effects of various Riparian Reserve widths on microclimate and species (plant and animal) in the riparian area. Until these data are available, the 6 parameters (e.g., soil moisture, radiation, relative humidity, etc.) listed in Figure V-13 in FEMAT (p. V-27) should be used to evaluate the needed Riparian Reserve width at the project level. The project Interdisciplinary Team should evaluate the microclimate effects and carry the recommended Riparian Reserve widths through the Environmental Assessment and NEPA process. If effects (within the context of the watershed) cannot be addressed adequately, the Riparian Reserve widths listed in the ROD (p. C-31) should be used.

2. Effects on nonriparian dependent wildlife: At the project level assess effectiveness of interim Riparian Reserve width to meet the needs (e.g., dispersal) of nonriparian dependent wildlife. If needs/effectiveness (within the context of the watershed) cannot be adequately addressed, the Riparian Reserve widths listed in the ROD (p. C-31) should be used.

3. At the project level assess effectiveness of interim Riparian Reserve width to meet the needs (e.g., dispersal) of fungi, bryophytes, lichens, and vascular plants. If needs/effectiveness (within the context of the watershed) cannot be adequately addressed, the Riparian Reserve widths listed in the ROD (p. C-31) should be used.

Aquatic Habitat

Most streams in the watershed lack in-stream structure. Also, the area of fish distribution has been affected by barriers created by unnatural situations. The items listed under Riparian Reserves (above), and the following opportunities will enhance aquatic habitat.

In-Stream Habitat

- Eliminate fish barriers created by unnatural situations.

- Install in-stream structures (large wood, boulders) to create aquatic habitat diversity. These structures should span the time between now and a period in the future when large woody material will be supplied by the Riparian Reserve vegetation. The large wood can be brought in from Late-Successional Reserves and road right-of ways.

Terrestrial Habitat

The Mohawk/McGowan Watershed has few acres of late-successional and old growth stands. Snags and downed, large woody debris are also at low amounts. The watershed is predominantly Douglas-fir stands less than 80 years old. Therefore, concerns for this watershed relate to fragmentation of the remaining large tree dominated stands, providing "connectedness" of large tree dominated stands (Connectivity and Riparian Reserve LUAs), and enhancing the amount of snags and downed, woody debris.

Landscape Pattern

- Minimize the impacts to remaining large tree dominated stands within the watershed. Retain as many large tree dominated stands as possible, well distributed throughout the landscape, to protect remnant populations of older forest associated species, and facilitate their recolonization of recovering habitats in Riparian Reserves, LSRs, and Administrative Withdrawn Areas. Using an interdisciplinary team, identify and prioritize the large tree dominated stands within the watershed that function as key refugia for special status, ROD J2, or other species; provide essential connectivity to other habitat patches; or provide large intact blocks of interior old forest habitat.

- Establish a network of forest patches and riparian corridors to provide connectivity between refugia, mature and old forest habitats throughout the western 2/3 of the watershed and adjacent watersheds. Existing Connectivity Blocks and Riparian Reserves established by FEMAT should provide the core of the network. However, where Aquatic Conservation strategies can be met by narrower reserves and opportunities exist to enhance connectivity of key habitats elsewhere, consideration should be given to this concept.

- Manage large tree dominated stands to reduce edge effects. Minimize the microclimate effects of edge on remaining large tree stands, maximizing effective interior habitat. Avoid additional near-term harvest within or near remanent large tree stands, and manipulate adjacent stands to provide maximum protection from windthrow, increased light availability, and drying. Decommission interior and border roads where possible to promote revegetation of these corridors.

- Manage stands within LSRs that are less than 80 years old where appropriate to speed old growth characteristics.

- Concentrate leave trees at "sensitive" areas (e.g., remaining old growth stands, raptor nests, areas of environmental concern, etc.)

- Study impact of exotic species on Federal Candidate, Bureau Sensitive, and ROD J2 species.

- Study impact of exotic species on the remaining large tree dominated stands to help determine the ability of these patches to function as an old growth forest.

- Determine how important existing large tree dominated stands are in providing biological connectivity to large tree dominated stands in adjacent watersheds.

- Apply spotted owl research data in the management of spotted owl dispersal habitat.

- Develop a management strategy for snags to avoid further reduction of this scarce resource and minimize human safety concerns.

Temporal and Spatial Pattern Relationships - Develop long-term landscape plans that consider vegetational patterns and how these patterns should change through long periods (include private land management). These plans should prescribe target landscape patterns and specify how these patterns will be modified through multiple rotations, identifying the type, sequence, and timing of all major treatments throughout the subbasin, and in relation to adjacent watersheds. Forest management should focus on more closely emulating the spatial and temporal patterns created by the dynamic processes of natural forests. To the extent possible, this would include mimicking as close as possible the vegetation, structural characteristics, patch size, and disturbance frequencies of the natural ecosystem.

Road Management

- Develop a road management plan and address impacts to wildlife, fisheries, and botanical resources from poaching, pollution, human caused fires, illegal plant collecting, recreational trespass, etc. In the road management plan consider decommissioning roads where densities are considered to negatively affect above mentioned resources.

- Complete inventory of all road systems on public lands to determine barriers to aquatic habitat functions. Work with adjacent landowners to locate and correct barriers on private lands.

Enhancement of Native Biodiversity

- Acquire land at the margins of the lower Mohawk Valley, and manage for oak/fir/pine community. This plant community was present before settlement of the valley.

- Create ponds and off-channel habitat for riparian dependent species (e.g., frogs, turtles, etc).

- Manage Riparian Reserve vegetation to encourage large snag and down wood development.

- Control exotic species (plants and animals) that are harmful to native biota.

- Create snags in the greater than 200-year size class.

- Control access to areas with special status species.

- Evaluate and determine the opportunity to reintroduce species that are currently or suspected to be extinct in the watershed (i.e., pacific fisher, yellow-legged frog).

Public Use

Because of its proximity to the Eugene/Springfield area, the watershed is extensively used for recreational purposes. As the population increases, the recreational demand on the watershed will probably increase. Following are some opportunities that may help manage the resources to facilitate recreational uses.

- Continually update and improve methods to involve publics for recreation planning.

- Establish cooperative efforts to provide recreational uses and controls.

- Obtain private land where launch sites (for hang gliders and remote control gliding) are located or develop launch sites on BLM lands.

* Develop designated trail system for dirt bikes, mountain bikes, and horses.

- Reduce the amount of dumping, vandalism, and other illegal activities.

- Continue working with other agencies to promote bicycling events.
- Promote tourism opportunities.
- Promote recreational events.
- Educate the public about recreation impacts and ways to reduce them.
- Increase collaboration activities with groups, clubs, and other organizations.
- See the Recreation Appendix (Mohawk Planning Update) for more opportunities.

Commodities - Use intensive forest management practices and investments to maintain a high level of sustainable timber production while maintaining long-term site productivity, biological legacies, and a biologically diverse forest matrix (FSEIS B-11).

H:\RES\WP\CHAPT'7.M&M

Chapter 8
Data Needs and Monitoring

During the course of this watershed analysis, various elements, which needed more data to make conclusions about processes/interactions, were identified. Also identified were monitoring needs to determine the effectiveness of resource projects in meeting their objectives and to help fill in information needs about the processes/interactions occurring in this watershed. This chapter lists some of those data and monitoring needs.

Data Needs

Aquatic Habitat

- Inventory of riparian systems/habitats along the lower Mohawk River and in the agricultural and residential areas (cooperative with NRCS).
- Collect data to characterize channel bed morphology.
- Inventory of fish habitat along the lower Mohawk River and in the agricultural and residential areas (cooperative with ODFW).
- An inventory of aquatic invertebrates including J2 species.
- Data to evaluate impacts on microclimate (e.g., data for microclimate parameters (FEMAT, p. V-27).
- Need riparian ground water data for any riparian or aquatic inventory.

Water Quality and Quantity

- Need data on stream nutrient levels
- Need stream water temperature data for major tributaries other than Shotgun Creek.
- Need ongoing water temperature at the mouth of the Mohawk River.
- Sediment rates for streams.
- Analyze water quality data that has been collected for Shotgun Creek.
- Road surfacing for private roads.
- Dirt bike trail erosion analysis.

Public Use

- Inventory of bike (bicycle and dirt bike), OHV, and horse trails and determine heavily impacted areas.
- Inventory of highly used shooting areas
- Determine heavily impacted areas from recreation uses.
- Obtain information on visitation/use days

Terrestrial Habitat

- Need baseline data for Federal Candidate, Bureau Sensitive, and J2 species and other wildlife species.
- Need botany survey of Coburg Fringe.
- Habitat differences due to physical variation in the watershed (e.g., soil, climate, elevation, etc.).
- Effects of special forest product harvest.

Monitoring

Terrestrial Habitat

- Monitor the 1.5 snags/acre standard to determine if it is adequate (also monitor distribution effectiveness) to meet the requirements for 40 percent cavity nesters.
- Monitor Connectivity and Riparian LUAs to determine if they are adequate for spotted owl dispersal.
- Monitor effectiveness of Connectivity and Riparian LUAs in providing habitat, connectivity, and distribution for older forest dependent species across the landscape.
- Determine effectiveness of Riparian Reserves for "old growth" species.
- Monitor effectiveness of rehabilitation projects (e.g., snag creation, minor species planting, etc.)

Water Quality and Quantity

- Collect and maintain water temperature and sediment data at the USGS station. This should be done cooperatively with Weyerhaeuser, USGS, and McKenzie River Council, if possible. Needs to be done by BLM if we cannot get cooperators.
- Monitor changes in stream flow, groundwater, micro/climate channel structure and channel morphology. This monitoring would be done to evaluate the impacts of land management practices and restoration projects. This monitoring need not be very expensive, but must be well planned.
- Monitor McGowan Creek flows to determine the effect of logging in the rain on snow zone.
- Monitor sediment rates from different road surface types and uses.

Commodities - Monitor impacts of special forest products harvesting on biological resources.

Aquatic Habitat

- Monitor effectiveness of stream and riparian rehabilitation projects.
- Stream flow needs to be included in any aquatic habitat monitoring plan.

H:\RES\WP\CHAPT'8.M&M

REFERENCES

Agee, J.K. 1993. Fire Ecology of Pacific Northwest Forest. Island Press, Washington, D.C.: pp. 493.

Allely, Steven. 1975. A Clovis Point from the Mohawk River Valley, Western Oregon. In Archaeological Studies in the Willamette Valley, Oregon, edited by C. Melvin Aikens. University of Oregon Anthropological Papers 8:549-552.

Beckham, Stephen Dow. 1976. Indian Distribution in Oregon. In Atlas of Oregon, edited by William G. Loy, pp. 6-7. University of Oregon Books, Eugene.

Beckham, Stephen Dow, Rick Minor, and Kathryn Anne Toepel. 1981. Prehistory and History of BLM Lands in West-Central Oregon: A Cultural Resource Overview. University of Oregon Anthropological Papers 25.

Brown, E.R., tech. ed. 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. Part 1 - Chapter narratives, 332 p. Part 2 - Appendices, 302 p. Publ. R6-F&WL-192-1985. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

Collier, C.M. 1896. Cadastral Survey Notes, T. 17S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

Connolly, Thomas. 1983. Modeling Prehistoric Cultural Systems in the Willamette Valley: A Demonstration of Regional Diversity. In Contributions to the Archaeology of Oregon 1981-1982, edited by Don E. Dumond. Association of Oregon Archaeologists Occasional Papers 2:27-39.

Faaborg, J; M. Brittingham; T. Donovan; J. Blake. 1993. Habitat fragmentation in the temperate zone: A perspective for managers. In: Finch, D.M.; Stangel, P.W. editors. Status and management of neotropical migratory birds. Gen. Tech. Rep. RM-229. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 331-338.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment.

Freeman, J. 1853a. Cadastral Survey Notes, T. 15S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1853b. Cadastral Survey Notes, T. 16S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1853c. Cadastral Survey Notes, T. 17S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1853d. Cadastral Survey Notes, T. 17S., R. 3W., W.M. Microfiche BLM Archives, Eugene.

Howell, P., J. Hutchison and R. Hooton. 1988. McKenzie sub-basin fish management plan. Oregon Department of Fish and Wildlife. 109 pp.

Hunt, W.L. 1980. Wild trout inventory, 1980. Northwest Region. Oregon Department of Fish and Wildlife. 46 pp.

Hyde, J. 1852a. Cadastral Survey Notes, T. 15S., R. 1E., W.M. Microfiche BLM Archives, Eugene.

1852b. Cadastral Survey Notes, T. 15S., R. 1W., W.M. Microfiche BLM Archives, Eugene.

1852c. Cadastral Survey Notes, T. 15S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

Interagency Watershed Analysis Coordination Team. 1994. FY 1994-96 Watershed Analysis Guidelines. Regional Ecosystem Office, June.

Latshaw, J. 1853. Cadastral Survey Notes, T. 17S., R. 3W., W.M. Microfiche BLM Archives, Eugene.

Lehmkuhl, J.F.; L.F. Ruggiero. 1991. Forest fragmentation in the Pacific Northwest and its potential effects on wildlife. In: Ruggiero, L.F.; K.B. Aubry; A.B. Carey; M.M. Huff, tech. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. General Technical Report PNW-GTR-285. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 35-46.

Light, J., and J. Stark. 1994. Upper Mohawk River Watershed Analysis: Fish Habitat Assessment. Weyerhaeuser Company. Tacoma.

Magnum, F.A. 1991. Aquatic Ecosystem Inventory: Macroinvertebrate Analysis (for BLM Eugene District). USDA Forest Service Intermountain Region, Brigham Young University, Provo Ut.

Maser, Chris; Robert F. Tarrant; James M. Trappe; Jerry F. Franklin, tech eds. 1988. From the forest to the sea: a story of fallen trees. Gen. Tech. Rep. PNW-6TR-229, 159 p.

McClung, J.H. 1873a. Cadastral Survey Notes, T. 15S., R. 1E., W.M. Microfiche BLM Archives, Eugene.

1873b. Cadastral Survey Notes, T. 15S., R. 1W., W.M. Microfiche BLM Archives, Eugene.

McClung, J.H. and W. Pengra. 1871. Cadastral Survey Notes, T. 16S., R. 1W., W.M. Microfiche BLM Archives, Eugene.

Minor, Rick and Kathryn Anne Toepel. 1982. The Halverson Site: A Late Prehistoric Campsite in the Upper Willamette Valley, Oregon. Tebiwa 19:1-14.

Moring, J.R., and C. Youker. 1979. Oregon rainbow and cutthroat trout evaluation. Oregon Department of Fish and Wildlife, Final Report, F-94-R. 65 pp.

Murphy, D. W. and M. O'C. Murphy. 1854. Field Notes, Survey of T. 17 S., R. 2 W., W.M. BLM microfiche file, Eugene District Office.

Murphy, D.W. and M. O'C. 1854a. Cadastral Survey Notes, T. 15S., R. 1W., W.M. Microfiche BLM Archives, Eugene.

1854b. Cadastral Survey Notes, T. 15S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1854c. Cadastral Survey Notes, T. 16S., R. 1W., W.M. Microfiche BLM Archives, Eugene.

1854d. Cadastral Survey Notes, T. 16S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1854e. Cadastral Survey Notes, T. 17S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

Nicholas, J.W. 1978. A review of literature and unpublished information on cutthroat trout (Oncorhynchus clarki clarki) of the Willamette watershed. Oregon Department of Fish and Wildlife, Upper Willamette District. 13 pp.

Oregon Department of Forestry, Oregon State Forestry Annual Reports from 1960 to 1993

Orr, Elizabeth L., et al. 1992. Geology of Oregon, Fourth Edition, Kendall/Hunt Publishing Company, pp. 141-165, 203-223.

Polley, Louis E. 1984. A History of the Mohawk Valley and Early Lumbering. Polley Publishing, Marcola.

Regional Ecosystem Office. 1994. A Federal Guide for Pilot Watershed Analysis. January. Portland, OR.

Saunders, D.A.; R.J. Hobbs; C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: A review. Conservation Biology 5: 18-32.

Schaffner, Larry; McKenzie Basin Residential Land Use Pilot Analysis: The Mohawk River Subbasin, June 1994.

Sharp, E. 1891. Cadastral Survey Notes, T. 15S., R. 2E., W.M. Microfiche BLM Archives, Eugene.

Southard, Michael D. 1977. Horse Rock Shelter Test Excavation (35LIN92). Report on file at the Eugene District Office, Bureau of Land Management.

1981. Bissel's Corner Test Excavation (35LA488). Report on file at the Eugene District Office, Bureau of Land Management.

1991a. An Archaeological Evaluation of the Mill Creek No. 6 Site (35LA365), Lane County, Oregon. In Archaeological Investigations on the Western Flank of the South-Central Cascades, Lane and Douglas Counties, Oregon, edited by Michael D. Southard, pp. 1-22. USDI Bureau of Land Management, Portland, Oregon, Cultural Resource Series No.7.

1991b. An Archaeological Evaluation of the Crack Shot Site (35LA848), Lane County, Oregon. In Archaeological Investigations on the Western Flank of the South-Central Cascades, Lane and Douglas Counties, Oregon, edited by Michael D. Southard, pp. 88-101. USDI Bureau of Land Management, Portland, Oregon, Cultural Resource Series No.7.

1991c. An Archaeological Evaluation of the Mill King Site (35LA805), Lane County, Oregon. In Archaeological Investigations on the Western Flank of the South-Central Cascades, Lane and Douglas Counties, Oregon, edited by Michael D. Southard, pp. 46-61. USDI Bureau of Land Management, Portland, Oregon, Cultural Resource Series No.7.

1991d. An Archaeological Evaluation of the Vacuum Site (35LA875), Lane County, Oregon. In Archaeological Investigations on the Western Flank of the South-Central Cascades, Lane and Douglas Counties, Oregon, edited by Michael D. Southard, pp. 46-61. USDI Bureau of Land Management, Portland, Oregon, Cultural Resource Series No.7.

1991e. An Archaeological Evaluation of the Scant Site (35LA945), Lane County, Oregon. Report of the Bureau of Land Management, Eugene District to the Oregon State Historic Preservation Office.

1991f. An Analysis of Test Excavations Conducted at the Watson Site (35LA878), Lane County, Oregon. Report of the Bureau of Land Management, Eugene District.

Spies, T.A.; J.F. Franklin. 1991. The structure of natural young, mature, and old-growth Douglas-fir forests in Oregon and Washington. In: Ruggiero, L.F.; K.B. Aubry; A.B. Carey; M.M. Huff, tech. coords. Wildlife and vegetation of unmanaged Douglas-fir forests. General Technical Report PNW-GTR-285. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 91-110.

Spies, T.A.; J.F. Franklin; T.B. Thomas. 1988. Coarse woody debris in Douglas-fir forests of Western Oregon and Washington. Ecology 69:1689-1702.

Toepel, Kathryn Anne and Stephen Dow Beckham. 1981. Ethnographic Overview. In Prehistory and History of BLM Lands in West-Central Oregon: A Cultural Resources Overview, by Stephen Dow Beckham, Rick Minor and Kathryn Anne Toepel, pp. 41-115. University of Oregon Anthropological Papers 25.

Toepel, Kathryn Anne and Stephen Dow Beckham. 1991. Cultural Resource Investigations for the Eugene Water and Electric Board Relicensing Project, Lane County, Oregon. Heritage Research Associates Report No. 102.

Toepel, Kathryn Anne and Richard L. Bland. 1991. Archaeological Investigations at the EWEB Walterville Storage Pond (35LA951), Lane County, Oregon. Heritage Research Associates Report No. 103.

U.S Census - 1980 and 1990

USDA, Forest Service and USDI, BLM. 1994. "Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Fores related Species Within the Range of the Northern Spotted Owl." April. p. B-20.

US Forest Service, Draft North Fork Siuslaw Watershed Analysis, October 1994, Appendix C, "Demographics, Employment and Economy of Lane County and the area surrounding the North Fork Siuslaw Watershed.

Walker, George W., and Robert A. Duncan. 1989. "Geologic Map of the Salem 1° x 2° Quadrangle, Western Oregon", U.S., Geological Survey.

Walker, George W., and Norman S. MacLeod. 1991. "Geologic Map of Oregon", U.S. Geological Survey.

Wallis, J. 1961. An evaluation of the McKenzie River Salmon Hatchery. Fish Commission of Oregon. Clackamas.

Wilkins, J. 1872b. Cadastral Survey Notes, T. 15S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

1872b. Cadastral Survey Notes, T. 16S., R. 2W., W.M. Microfiche BLM Archives, Eugene.

Wyatt, B. 1959. Observations on the movement and reproduction of the Cascade form of cutthroat trout. M.S. Theses. Oregon State College, Corvallis.

Zenk, Henry B. 1976. Contributions to Tualatin Ethnography: Subsistence and Ethnobiology. Unpublished M.A. Thesis in Anthropology, Portland State University.

Ziller, J.M., M. Wade, and D. Irish. 1994. Mohawk River trout study 1992-93. Unpublished report, Oregon Department of Fish and Wildlife, Upper Willamette District. 13 pp.

Aleman, Liz; Recreation Management Data Module, October 1994, BLM
Miles, Saundra; Communication
Kellerman, Vicki; Communication

Conversations with John Hegg, Special Forest Products specialist
Conversations with Liz Aleman, Recreation Planner
Botany Report
Eugene District ROD/RMP, May 1995

H:\RES\WP\REFER.M&M

APPENDICES

All Appendices are not complete and are not included in this report at this time. As each Appendix is completed, it will be added to this section.

APPENDIX A

Cultural Resources/Watershed History

Beginning in 1975 cultural resource surveys were conducted in advance of all potentially surface disturbing projects throughout the Eugene District. In 1977 a program of post-harvest survey was initiated. The post-harvest cultural resource survey program was not designed to cover all harvested BLM acres within the District; however, within the area under consideration approximately 30 percent of the final harvest acreage has been surveyed since 1978. Between October 1975 and the present a total of 5,760 acres within the Mohawk/McGowan watershed were surveyed for cultural resources in advance of surface disturbing projects and an additional 1,400 acres of post-harvest cultural resource surveys were conducted. This effort with some contract survey work conducted on private lands has resulted in the location and recordation of an additional 72 prehistoric archaeological sites in the Mohawk River, Camp Creek, and lower McKenzie River drainages. The majority of these sites were discovered by BLM personnel and are located on BLM administered lands.

A Class III literature review and synopsis of existing data for lands within the Eugene District, including those within the lower McKenzie River drainage, was conducted by Heritage Research Associates during 1980-81. The results were published in the University of Oregon Anthropological Papers series (Beckham, Minor, Toepel 1981). Those interested in an explanation of topics such as the cultural sequence employed in the Willamette Basin, aboriginal settlement patterns of the area, or information concerning the ethnographic lifeways of the aboriginal inhabitants should consult this reference.

Prehistoric Period

Three sites in the watershed have been extensively excavated. The Halverson site (35LA261) is a Late Archaic Period campsite excavated by a University of Oregon Department of Anthropology field school crew during the summer of 1977 (Minor and Toepel 1982). The Mill Creek #6 site (35LA365), a dense lithic scatter with a variety of tool forms is assigned to the Early Archaic/Middle Archaic transitional period on the basis of temporally sensitive tool forms (Southard 1991a) and the Log Site (35LA1023), a very low density lithic scatter assigned to the Middle Archaic period based on the recovery of a single broad-necked projectile point fragment (Southard, in progress), were excavated by BLM personnel and volunteers.

An additional 13 sites within the area have been the object of some subsurface testing.

Horse Rock Shelter(35LIN92) (Southard 1977)
Bissel's Corner(35LA488) (Southard 1981)
Crackshot (35LA848) (Southard 1991b)
Mill King(35LA805) (Southard 1991c)
Vacuum(35LA875) (Southard 1991d)
Scant (35LA945) (Southard 1991e)
Watson (35LA878) (Southard 1991f)
Lalone Ranger (35LA874)
Marksman (35LA1098)
Walterville Overlook (35LA654) (Southard, in progress)
(35LA951) (Toepel and Bland 1991)
(35LA952 and 35LA953) (Toepel and Beckham 1991)

The Walterville Overlook site is assigned to the Early Archaic period on the basis of temporally sensitive tool types. The Marksman site has produced projectile point types identified with the Early, Middle, and Late Archaic periods. The Mill King and Watson sites have yielded projectile point types identified with the Middle and Late

Archaic periods. Crack Shot, Vacuum, Lalone Ranger, and site 35LA951 are assigned to the Late Archaic period solely based on the recovery of narrow-necked projectile points. The Scant site, Bissel's Corner, and sites 35LA952 and 35LA953 did not yield temporally sensitive artifacts and are not assigned to a specific prehistoric period.

Surface collections from 24 of the remaining 65 sites have yielded temporally sensitive tool forms and have components assignable to one or more cultural periods between the Early Archaic and the Early Historic. Forty-one sites have not yielded temporally sensitive tool forms and are not assigned to a specific prehistoric period.

In addition to the 72 recorded sites, the locations of 86 isolated artifacts have been recorded in the watershed. Approximately 25 percent of these isolates consisted of temporally sensitive artifact forms and can contribute to our understanding of the aboriginal use of the area through time.

Given the number of sites in the lower McKenzie drainage with components that can be assigned to a specific developmental period within the Willamette Basin cultural sequence, and the distribution of these sites across a variety of ecological zones, there is excellent potential for developing information on settlement patterns for Middle and Late Archaic period occupations within the drainage. This should be particularly true for the Late Archaic period because we know that portion of the lower McKenzie drainage, which included the Mohawk River and Camp Creek, was within the territory of a single ethnographically known band, the Mohawk or Pe'u band of the Kalapuya (Beckham 1976). The only serious gap identified in the data necessary for the conduct of such a study relates to winter village sites. No locations identified as winter village sites have been excavated or discovered in this watershed area.

Connolly (1983) utilized site size and locational data from recorded sites in the Mohawk Valley in a comparative study of aboriginal settlement patterns within 3 of the sub-basins of the southern Willamette Basin. Connolly's study did not consider site age, was completed during a time when the number of recorded sites in the Mohawk Valley was approximately one-half the present number, and was conducted prior to the initiation of the site testing program conducted in the Mohawk and Camp Creek drainages. The use of site age and the additional information gained from the site testing program could contribute valuable information to future studies similar to the one carried out by Connolly.

Ethnographic Period

Ethnographic information on the Native American inhabitants of the Willamette Valley is rather scant and much of what is known relates to Kalapuya bands who resided in the northern part of the valley. Each band, actually a residential group set off from its neighbors by language differences at the dialect level, occupied a portion of the main Willamette Valley or the valley of a major tributary stream (Zenk 1976). Each territory contained the requisite ecological diversity to permit the occupants to practice a subsistence economy based on the exploitation of seasonally available food resources within the territory. In order to be successful the band members relied on a high degree of residential mobility and careful scheduling that placed some or all members of the primary food-producing unit (usually the nuclear family or a minimal expression of the extended family) at the location of harvestable resource at the time when the resource could yield the best return for the effort expended in the harvest activity.

Each territory contained one or more winter village sites to which band members repaired with the coming of the rains and colder weather of late fall. These winter village locations contained the only permanent structures utilized by the Kalapuya. During the remainder of the year, whether occupying base camps or small extractive stations, they erected temporary windbreaks or camped in the open.

Ethnographic research with Kalapuya informants did not begin until the third decade of the Twentieth Century and was conducted using informants on the Grand Ronde reservation who traced their ancestry to Kalapuya bands inhabiting the central and northern portions of the valley. Henry Zenk (1976) has reviewed and synthesized this earlier ethnographic work. The following synopsis of the Kalapuyan lifestyle is based in large part on Zenk's work.

The Kalapuya practiced a subsistence economy based on hunting and gathering following a scheduled seasonal round that placed members of the band at locations of seasonally abundant wild foods within the territory occupied by the band. Each band appears to have occupied all or a portion of a major drainage that gave them access to a wide variety of upland and valley floor resources. The settlement pattern of each band was a response to the seasonal round as it was followed within the band's territory. The year began and ended in the winter village, a collection of multi-family houses constructed of poles and matting or bark erected over a shallow pit. Earth was banked up around the base of the structures to further insulate them. Winter village sites were located in well drained locations, such as natural levees or the leading margins of terraces beyond the reach of annual flooding, on the floor of the Willamette Valley or the valley of a larger tributary stream. Much of what was eaten while in the winter village consisted of stored foods gathered and preserved during the other seasons of the year. As early as March people began leaving the winter villages to gather the few vegetable foods available at this the leanest season of the year when stored provisions were scarce or entirely depleted. This marked the beginning of a period of high mobility during which no permanent shelters were used and work groups erected lean-tos or brush wind breaks beneath the branches of large fir trees for temporary shelter.

Camas (*Camassia quamash* and *Camassia leichtlinii)*, a member of the lily family with edible bulbs was a staple of the Kalapuya. The bulbs were dug beginning as soon as the first shoots appeared above ground in the early spring, although the greatest number were collected in June when large amounts were collected, baked in earth ovens, and pressed into cakes and stored for winter use. Tarweed seeds were also collected in large amounts during the late summer. The seeds were toasted and ground to a coarse meal and stored for winter use. Berries were also gathered and dried for storage. Much of the gathering of plant foods was the work of the women while the men hunted for game, using deerskins with the head attached as disguises to enable them to approach close enough for a shot. They also used drives and surrounds employing many people in order to kill a number of animals at a single time. Men fished using hook and line, spears, and willow basket traps. At the onset of the rainy season in late fall the various family groups who had been gathering and preserving provisions for the winter returned to the winter village to refurbish the huts for another long winter (Toepel and Beckham 1981:63-70).

All Native American groups inhabiting the Willamette Valley and the valley of the lower Columbia River suffered devastating population losses from introduced epidemic diseases during the late 1700s and early 1800s. One estimate places the population of the Willamette Valley prior to Euro-American contact at 10,000 individuals. By the late 1830s the native population had dwindled to 600 individuals. Following the signing of the Dayton Treaty in 1855 most of the remaining Native American inhabitants of the Willamette Valley were moved to the Grand Ronde Reservation in 1856 (Toepel and Beckham 1981: 80-81).

<u>Management Objectives</u> - There are 13 aboriginally generated archaeological sites located on BLM administered lands within the Mohawk/McGowan LAU. The following table lists those sites and their management categories.

TABLE___. Management Objectives for Archaeological Sites in the Mohawk/McGowan LAU

SITE	OBJECTIVE
OR-09-027	Discharged from management
OR-09-054	Discharged from management
OR-09-081	Manage for scientific use
OR-09-125	Manage for scientific use

OR-09-142	Discharged from management. This site has been formally determined **not eligible for listing on the National Register**.
OR-09-143	Manage for scientific use
OR-09-150	Manage for scientific use
OR-09-162	Manage for scientific use
OR-09-169	Manage for scientific use
OR-09-185	Discharged from management
OR-09-189	Manage for scientic use. This site may be eligible for listing on the National Register. A request for a formal determination of eligibility will be made to the Oregon SHPO.
OR-09-190	Manage for scientific use
OR-09-191	Manage for scientific use

Euro-American Settlement

When deputy surveyors from the Surveyor General's Office arrived to survey townships 15S., 16S., and 17S. of ranges 1 and 2 west between 1853 and 1855, 17 settlers lived within the boundaries of the Mohawk/McGowan LAU. These were established settlers with tilled fields, albeit small, and well constructed dwellings who had staked claims on the natural prairies and oak savannah portions of the Mohawk River Valley as far upstream as the vicinity of present day Marcola. That some of these settlers had been here for a number of years is evident from notations on the township map for T. 15 S., R. 1 W. identifying a trail running N-S through the center of the township as the "Pack Trail to the Calapooya Mills." Settlers had been in the area long enough to establish a trail to grist mills where flour for domestic use could be ground. However, by 1854 William Simmons had "a sawmill in operation and a flouring mill in course of erection" along the Mohawk River in T. 17 S., R. 2 W. (Daniel and Matthew O'C. Murphy 1854).

The earliest settlers sought land for the purpose of developing farms and staked their claims on natural prairies or savannahs, which were easily cleared and quickly cultivated. Of course, these settlers needed some timber for building cabins, barns, fences, and fuel. However, there was no real demand for lumber other than for local domestic purposes; consequently there was no strong move to file claims on heavily forested tracts. This changed as markets for lumber developed and transportation systems evolved to haul lumber to markets in the midwest and east. Once the transportation infrastructure was in place around 1898, a flood of fraudulent claims were filed by individuals who turned over the claims to big lumber companies for a fee. The timber was quickly harvested and the land forgotten or sold.

APPENDIX C

Mass Movement Assessment - Purpose, Assumptions and Methodology

Purpose & Key Questions - This assessment will identify the potentially unstable mass movement areas in the Mohawk/McGowan Watershed Analysis area. The following key question will be addressed by this assessment:

WS1 What mass wasting processes are active, and where is there evidence of, or potential for, mass wasting in the watershed (what areas are sensitive)?

Assumptions

- Identification of existing mass movement features can be used to predict the likelihood of future instability. Areas prone to these processes can be mapped based on physical characteristics, as interpreted from aerial photographs, topographic maps, and geologic and soils maps.

- Results from research, inventories, and models can be used to help predict the likelihood of future instability.

- It is feasible to extrapolate from one sub-basin to another having similar characteristics.

Methodology - A mass movement potential map was constructed using GIS with topography (slope steepness), stream location, and timber Productivity Capability Classification (TPCC)(field identified unstable areas) themes, and aerial photo inventory of rotational slump areas. Three categories of relative potential for mass movement were mapped using the following criteria:

High
- Mass movement features are common and/or there is significant potential for mass wasting
- Mapped FGNW and FPNW areas in TPCC
- Stream adjacent (within 100ft. of streams) sideslopes >75%
- Steep (>75%) and convergent slopes

Moderate
- Mass movemnt features and potential for mass wasting are intermediate and do not fit into the High or Low categories
- Stream adjacent sideslopes with 55-75% slopes
- Slopes >100ft. from streams with slopes >65%
- Moderate (55-75%) and convergent slopes
- Mapped FPR and FGR areas in TPCC
- Landslide geomorphic units determined through aerial photograph interpretation

Low
- Mass movement features are few to nonexistent and factors contributing to slope instability are practically absent
- Stream adjacent sideslopes <55%
- Planar slopes >100ft. from streams <65%
- Convergent slopes <55%

Slope criteria mentioned above are based on limited data from surveys of known failure sites conducted by the BLM in areas similar to the analysis area.

APPENDIX E

Hillslope Erosion Assessment - Purpose, Assumptions, and Methodology

Purpose & Key Questions - The purpose of this assessment is to identify the existing and potential hillslope related surface erosion areas that contribute sediment to stream channels. The following key question will be addressed by this assessment:

WS2 What is the hillslope erosion potential, i.e. what areas are sensitive?

Assumtions

- Sheet erosion of hillslopes is influenced primarily by soil type, hillslope gradient, protective cover, perticipation intensity, and human activity
- Certain soils (easily detachable) and slope conditions (steeper) are conducive to surface erosion
- On potentially erodible soils, the primary factors determining whether surface erosion occurs are exposure and compaction of mineral soil and topography. Surface erosion tends to increase as these three characteristics increase.
- Certain management practices can expose and/or compact surface mineral soil and significantly increase surface erosion. Practices that do not expose or disrupt the surface mineral soil are unlikely to increase surface erosion.
- Surface erosion may be delivered anywhere in the stream system by dry ravel or overland flow, but is fairly easily disrupted by a buffer of slash, duff, and other protective soil cover. Therefore, sediment is generally not delivered to the stream system if adequate buffers exist of the hillslopes.
- Dry ravel is primarily a function of slope gradient, hillslope storage potential, surface cover, and soil erodibility.
- Most surface erosion occurs within five years of a contributing activity.

Methodology - A soil erosion potential map (Map C) was constructed using GIS with topography (slope steepness) and soils (USDA Soil Conservation Service, K-factors) themes. Three categories of relative potential for erosion of exposed mineral soil were mapped using the following criteria:

High	Slopes >65%, K >.25 Slopes >30%, K >.40
Moderate	Slopes >65%, K <.25 Slopes 30-65%, K .25-.40 Slopes <30%, K >.40
Low	Slopes <30%, K .25-.40 Slopes <65%, K <.25

From past experience, it was decided that the use of aerial photographs would not be helpful in determining sites with existing surface erosion (i.e. gullies). Field visits were conducted for the 3 erosion potential categories to determine presence (and degree) or absence of erosion.

APPENDIX F-1

Potential habitat for Chinook salmon, steelhead/rainbow trout and cutthroat trout was identified by computer based upon stream order and gradient. The following assumptions were used.

1. Chinook salmon: Stream Order >3; Gradient <4%

2. Steelhead/rainbow trout: Stream order >2; Gradient <7%

3. Cutthroat trout: Stream Order >1; Gradient <18%

Cutthroat will sometimes use first order streams if sufficient water is present, and will be found higher up in the system than any other fish including non-salmonids.

APPENDIX F-2

Life History Characteristics Of Mohawk River Salmonids

Because little is known about the details of fish populations inhabiting the Mohawk watershed, this section will review information on the pertinent life history characteristics of upper Willammette River cutthroat and McKenzie River spring chinook and resident rainbow trout as representative of populations within the assessment area.

Resident Cutthroat Trout - Cutthroat may spawn at almost any month of the year, but reports have shown over 80% spawn January to March (Nicholas 1978, Moring and Youker 1979). Wyatt (1959) reported cutthroat spawning in small tributaries from late March to early June. Fish entering tributaries on the valley floor may spawn earlier than those entering higher elevation Cascade slope streams. Where a mixture of salmonids is present in a basin, cutthroat are known to dominate the higher gradient, small tributaries and have been found spawning in streams with flow rates as low as 0.5 to 1.00 cfs, but will spawn in any accessible stream with suitable habitat.

Fry emerge earliest in warmer streams or sections of streams (as influenced by elevation, shading and groundwater) and move downstream during summer and fall. Cutthroat that rear in cool headwater tributaries are generally smaller that fish rearing in lower elevation tributaries and mainstem reaches (Hunt 1980). Growth typically accelerates when fish move from smaller tributaries to larger waters (Nicholas 1978). Some cutthroat trout mature by age 2, most by age 3.

Cutthroat trout may move upstream from larger streams into smaller tributaries from late fall through early summer. The timing of this activity is probably influenced by local water flow and temperature. Some evidence also indicated that cutthroat will return to their natal tributary to spawn. It is poorly understood how many fish show this behavior and how much straying may occur.

There are three general life history patterns exhibited by cutthroat trout, and all three patterns are probably found within the Mohawk watershed:

1. Trout that are above impassable barriers and therefore constitute reproductively isolated populations. Any individuals that emigrate downstream past these barriers are removed from the original population.

2. Trout that are largely resident in the middle or upper sections of tributaries (including the mainstem Mohawk R.), but are not isolated above barriers. The opportunity exists for some individuals to move downstream to rear and then return to spawn with individuals that did not move.

3. Trout that are largely migratory. They emerge and rear for an undetermined length of time in small to medium sized natal tributaries, move downstream to large mainstem reaches (e.g. McKenzie River) to mature, and then return to smaller tributaries to spawn.

Resident Rainbow Trout - Rainbow trout have the same general life history as cutthroat, although they may not occupy many areas of the watershed year-round in great numbers. It appears that most of the population resides in the mainstem McKenzie and selected tributaries, while some portion of the population uses the tributaries and upper Mohawk watershed for spawning and short-term rearing. Only a scattering of juvenile rainbow trout were found during summer electrofishing surveys in the upper Mohawk mainstem (Ziller et al. in press). The lower portions of the Mohawk and other tributaries are believed to function as winter rearing areas for some of the resident rainbow trout population that inhabits the McKenzie R. mainstem (M.Wade, ODFW, pers. comm. 1994).

Spring Chinook - Adult spring chinook enter the McKenzie River from as early as April to as late as November (Howell et al. 1988). Peak migration occurs in June. Spawning largely takes place during September. Adults may therefore spend several months in the McKenzie and its tributaries prior to spawning.

Timing of chinook fry (<2in.) emergence appears to be quite variable, depending on location, but begins as early as January (Howell et al. 1988). Fry have been captured as late as August. Most juveniles presently leave the McKenzie between September and December.

APPENDIX M

Methods For Channel Morphology

Gradient and confimenent were assessed for all GIS identified streams in the Mohawk/McGowan watershed beginning at the mouth of the Mohawk River and ending at the eastern boundary of R.1.W., where BLM land becomes scarce (Figure 1). Gradient was determined by computer modeling.

Confinement (the ratio of valley floor width to stream channel width) was estimated using a 1:24000 topo map. Valley floor width was actually measured on the topo map. Stream channel width data collected in the Shotgun Creek basin in 1983 was used to obtain an estimated ratio (confinement class) for that basin. I then extraoplated these ratios across the watershed based on actual valley floor width. The confinement classes were: unconfined (VW>4CW), moderately confined (2CW<VW<4CW), and tightly confined (VW<2CW) (TFW, 1993).

Each stream in the system had been previously divided into gradient segments by the computer based on intersection with tributaries (nodes). These segments roughly corresponded to confinement designations in most areas, and so were used throught the analysis. A combination gradient/confinement map was then generated for the watershed.

The accuracy of confinement estimations was assessed in the field. I drove the four major basins (McGowan, Parsons, Cash, and Shotgun Creeks) and stopped at 58 channel crossings. At each stop I visually determined the appropriate classification. After all field checks were completed, I compared the estimated and observed confinements and found that 76% of the estimates were correct. The most common error was estimating moderate confinement when an unconfined condition was observed. I suggest that a computer model be developed for future confinement estimation. We now have information on average channel widths based upon stream order that could be used. This should improve estimation accuracy. Because of time constraints, the original, estimated confinements are used in this report.

APPENDIX R

<u>Potential Impacts of Recreation Activities</u>

The moderate climate associated with the watershed further promotes year-round public use of the area. Unlike the higher cascade areas managed by the Forest Service, the Mohawk-McGowan watershed doesn't have the luxury of a late fall - early spring reprieve from most social uses. Therefore, this area is constantly being used even when the ground is wet and more vulnerable to impacts.

- Because of the watershed's close proximity to a metropolitan area, it serves as a strong magnet to teenage and *twenty-something* youth--particularly on weekends and evenings. The culture of this age group is such that a sense of mortality is immature at best. In addition, many young individuals have not yet formed a positive relationship with the land that guides them in displaying stewardship actions. The consequences of this situation are wide ranging and include excessive driving speeds, vandalism, soil and stream damage, blatant antagonism of other visitors, violence, etc.

- The watershed is heavily impacted across the board geographically by gun shooting recreationists. A recent Connecticut court decision and lead cleanup on the Santa Fe National Forest indicate that there is substantial liability associated with small arms shooting ranges on public lands due to lead as a hazardous material. Think of the ramifications to the extensive hazardous waste situation linked to the pervasive informal shooting situation we have in the Mohawk-McGowan watershed where there is limited to no control or management of the situation.

- Much of the recreational use within the watershed is group oriented. It's common to have several dirt bike riders, 4X4s, hang gliders, plinkers, bicyclists, etc. together at any given time. This type of concentration results in visible impacts within the watershed in areas that are not "hardened" for certain types of recreational use.

- There are people who don't flinch at the idea of dumping household garbage and old car batteries on the land, creating 3' ruts with their vehicles, poaching wildlife, and littering the landscape with shooting targets. This situation appears most concentrated within the McGowan drainage, but is evidenced in notable quantity within the Drury drainage.

- An area on the "17 Road" serves as a popular hang gliding launch site. The road commonly used by the hang gliders to access this site is not maintained at a level consistent with the heavy use it sustains and shows signs of wear.

- The emphasis of Horse Rock Ridge is research and education. Recreational use of the area, however, is desired by some visitors. This type of use is not consistent with the research emphasis of the area and is a point of concern because of physical impacts to the fragile area.

- The Coburg Ridge is a natural attractant for a variety of recreational uses: partying, viewing, hang gliding, paragliding, riding, etc. These activities are impacting because, in some cases, they result in trash, drug paraphernalia, and unattended fires left behind. Likewise, some of the activities are positive in the sense that they serve a presence in the area that helps curb illicit activities (e.g., air monitoring and electronic communication).

- The Drury waterhole site located at the end of Drury Creek Road has sentimental value to some visitors, but is violated with regularity by others who target shoot in the area and leave evidence of their activity. While some degree of vehicular riding occurs northwest of the site, I'm not convinced that the use is a point source detriment to the site.

- The powerline clearing west of Marcola road receives heavy impact from various recreation activities.

- Rock pile locations within the watershed invariably serve as staging areas for motorcycle and ATV users. It is not uncommon for these areas to have an associated extensive trail network.

- The Mountain Bike Ride Guide of Lane County describes popular mountain biking routes within the watershed. Bicycling use within the watershed is year round and occurs during the night and day. It impacts the watershed because some route segments are not maintained to sustain the level of use received and become point source detriments.

- The meadow areas located on the upper part of McGowan Road northwest of the power line are taking a beating from 4 X 4 use during wet conditions. Tire tracks are readily visible.

- Horse use in the watershed may be impacting the native vegetation by and disseminating non-native invaders.

- In general, where not provided, visitors are creating their own recreational backdrops and access within the watershed. These range from social trails, to launch pads, to shooting galleries. Their placement may not be light on the land and, in some cases, should not be present at all because of fragile resource condition. Also, these visitors' created recreational sites are not maintain and they are often not designed with other resources in mind.

- Mud Lane is a mountain bike trail written up in the Mountain Bike Guide. Parts of this trail is on private land along road 15-2-23 which is receiving resource damage because of ruts in the road.

APPENDIX S

Sub-watershed Stream Information

Black Canyon (T17S R2W Sec 7 road 17-2-8)
This 4th order stream is fish bearing to the forks (Figure 1). Approximately 3/4 mile of the 2.25 mile length flows through BLM land. While a formal inventory of Black Canyon has not been done, some information was gathered in conjunction with timber sale planning in the basin. The stream has a moderate gradient, and is primarily riffle-rapid-cascade habitat types, with only limited pool area. There are several cut banks along the stream, and some sedimentation from the roads. During periods with limited rainfall, flows become quite low to intermittent. Some cutthroat trout are present.

Spores Creek
This 4th order stream is fish bearing to the middle of section 5, possibly no fish on BLM (Figure 1). When visited during a period with limited rainfall, Spores Creek on Public Lands was dry. Spores Cr. flows through less than 1/4 mile of BLM land. No habitat data are available.

Kelley Creek
This 4th order stream flows from the east and joins the Mowhawk River in section 35 (T16S R2W). It is fish bearing for much of its length, but the portion flowing through BLM land in section 25 is probably not fish bearing. No habitat data are available.

McGowan Creek and Tributaries
McGOWAN CREEK - This is a 4th order stream flowing off the Coburg Hills, with two major tributaries, South Fork McGowan Creek and Allison Creek. The 1985 inventory of McGowan Creek showed a system with relatively few small pools, most of fair or poor quality (Table @@). Little cover or juvenile rearing habitat was present, although this stream had a higher percentage of rearing habitat (8.8%) than any other surveyed stream in the basin (Table ??). Sand was the dominant substrate type (Table ##). The channel shows considerable instability during the past 15 years. A storm event about 1982 brought considerable material into the channel, much of which accumulated above the first road crossing on public lands. This material, plus the culvert, created a partial barrier to upstream movements of fish. Below this culvert, the channel shows signs of active down cutting, with the secondary incision. As a result of the lack of structural materials, McGowan in this reach lacks spawning and rearing area, although the potential is quite good. In the northwest quarter of section 29, McGowan forks; both forks have road culverts with deep drops at their lower ends that area barriers to upstream fish migration.

The two forks of McGowan are both in largely confined channels, although in their upper reaches there are a number of benches providing flatter gradients. In the flatter areas, and where beavers have worked for extended periods of time, there are some ponds and wetlands, creating good fish and wildlife habitat. The dominant riparian species is red alder, with willow abundant on the benches and conifer more abundant in the most confined reaches. The channels are stair-step, with cobble, rubble and small boulders common. Some woody debris is present, but it is mostly shorter pieces left after logging.

SOUTH FORK McGOWAN CR. - This is a 3rd order tributary of McGowan Cr. The stream is of moderate gradient, with a generally stair-step appearance. Gradient is lowest near the mouth. All of the relatively few pools in this stream, were <300 sq. ft. in area, and were of fair or poor quality (with the exception of 2 excellent pools) (Table @@). This suggests a lack of suitable habitat for adult fish. More cover was found in this stream than any other, but only 14% of habitats surveyed had cover elements and no quality juvenile habitat was present as defined in table ??, but the abundance of smaller pools, with perhaps a lack of large fish could be a benefit to juveniles. Cobble and rubble were the dominant substrates, approximately 25% of substrates were gravel and very little silt was present (Table ##). Collectively these data suggest that this segment of the drainage may have been somewhat suitable for juvenile rearing and if these gravels were aggregated (which is unknown), spawning conditions may also have been acceptable.

ALLISON CR - This is a third order tributary to McGowan Cr. The lower, more moderate gradient portion of the stream flows through open meadows on private lands. The upper portions are in timber of different age classes, with a moderate to steep channel with a stair-step appearance. A former road crossing at one time had considerable erosion, adding extensive silt to the stream. The stream is accessible to migrating fish, and has habitat for salmonids although the overall habitat quality would be rated as fair or poor.

Wade Creek
This 3rd order stream is fish bearing to the forks and does not flow through BLM land. no habitat data is available.

Parsons Creek and Tributaries
This 5th order stream flowing off the Coburg Hills, together with its four major tributaries, Whiskey, Drake, Wendy, and Small Creeks, is fish bearing for most of its length. The status of fish habitat and fish populations in the sections flowing through BLM lands are unknown (Figure 1). The stream has not been inventoried. Parsons Creek is one of the larger drainages in the Mohawk basin, and is suitable for use by resident and anadromous salmonids. Access for migrating fish to the upper reaches is blocked by a culvert on the Parsons Creek road. The majority of the basin is privately owned, with the lower half flowing through agricultural and urban areas. The stream is down-cutting in many reaches and lacks instream structure. The headwaters are steeper and are forested. Much of the forest is in second growth, although there are some remnant older forest patches. The tributaries of Parsons creek are moderate to steep gradient, stair-stepped in appearance and dominated by rocky substrates. Pools tend to be small in size. Parsons creek has considerable potential for restoration projects, if done on a basin-wide basis.

Cash Creek/Showalter Creek
CASH CREEK - This a 4th order stream with little pool habitat. What there is generally small and of fair to poor quality (Table @@). There is also little cover or quality juvenile rearing habitat (Table ??). Cobble and rubble (at greater than 50%)were the dominant substrates (Table ##). Riparian vegetation is predominantly hardwood in lower reaches, but with a greater percentage of conifer in upper reaches, possibly due in part to the loss of deposits of finer substrates. In the lower reaches, gradients are low to moderate, and the valley floor is unconfined. The majority of the stream is in a more confined valley, with gradients from moderate to steep. Except for a short section near its mouth, Cash Creek flows through timber lands, most of which are in younger age classes. Cash Creek has resident cutthroat trout, and is accessible for use by migrating trout, salmon and steelhead. The stream lacks instream structure, but has considerable potential for restoration projects.
SHOWALTER CR - This is a third order tributary to Cash Cr., entering about one mile above the mouth of Cash Creek. It is primarily moderate to steep gradient, dominated by cobble, rubble and small boulder, with a stair-step habitat sequence of rapids, cascades and some pools. It is lacking in woody structure. Streamside areas are primarily young conifers and some red alder. The stream has habitat for cutthroat trout, and is accessible for use by migrating trout and steelhead.

Shotgun Creek and Tributaries

SHOTGUN CR - This is 5th order stream flowing off the Coburg Hills near Bald Mountain and Horse Rock. It is one of the larger tributaries of the Mohawk River, with an extensive basin which, with its tributaries, flows primarily through lands managed by BLM. The lower reaches of Shotgun Creek are on the Mohawk floodplain, and have a low gradient and wide, unconfined valley floor. BLM maintains a major recreational area about one and a half miles above the mouth, which includes a swimming area formed seasonally by damming Shotgun Creek. Wastes from the campground are treated off-site.

Pools represented only 24% of the habitats surveyed, but, while they were generally of fair to poor quality, 40% were fairly large and probably provided some habitat for large fish (Table @@). There are several large, high-quality pools which receive heavy use by fish. Overall, cover or quality juvenile habitat was limited,(Table ??). Many of the larger pools contain extensive rearing habitat, and this drainage is replete with floodplain areas that probably provide quality habitat at higher flows. A variety of substrate types were present and little silt was noted (Table ##) suggesting a potential for spawning and rearing success. Riparian areas vary along the stream. The private lands near the mouth are more open, with some hardwood and conifer cover. The middle reaches managed by BLM have extensive conifer areas, including some large Douglas fir and cedar. Upper reaches were logged within the past two decades, and are dominated by red alder. At least the lower reaches of Shotgun Creek were used to float log rafts; together with stream cleaning and the lack of large wood to provide instream structure, Shotgun Creek was lacking in channel complexity. The overall lack of woody structure, large cover elements, and a shortage of quality pools were the reasons a major instream restoration effort was implemented in 1993-94. Sampling by BLM, the state, and observations by BLM biologists have confirmed the presence of cutthroat trout throughout the basin, plus seasonal use by rainbow trout and, on occasion, steelhead. Migrations of cutthroat and rainbow from the McKenzie and Mohawk into Shotgun occur during winter and spring months. These fish spawn in Shotgun and its tributaries; young rear for an unknown period of time before migrating downstream. Shotgun is useable by all species of resident and migratory salmonids in the McKenzie basin. Several culvert barriers and one waterfall were identified in the headwaters of Shotgun Creek. Plans are underway for some culvert replacement work in the drainage.

CROOKED CREEK - This 4th order tributary to Shotgun Creek was characterized by a number of rather small, fair to poor quality pools (Table @@) with little cover or quality rearing habitat (Table ??). The most noticeable substrates were cobble and rubble, with little gravel or boulders (Table ##). The stream in Section 24 is generally low gradient in an unconfined valley. There are several older meanders, suggesting the channel has shifted in the past. Instream structure is limited. A falls and, in the past a large beaver dam, blocked access upstream for migrating fish in the NW corner of section 24. Additional culverts upstream have partial or complete barriers to fish migration. In Section 23, Crooked Creek has considerable logging debris in the channel in some reaches which creates good to excellent habitat. Otherwise, it has moderate to steep gradient with stair-step habitats of predominantly rapids and cascades. Riparian areas are dominated by red alder, with some young to middle age conifer. This stream was the focus of a stream restoration effort (using horse logging) in 1994. Several culvert barriers were identified and culvert replacement plans were initiated in the same year to allow fish passage and reduce erosion.

SEELEY CR - This fourth order Shotgun Cr. tributary had 52% pools, most in fair or poor condition. Most were small, although over 25% were in the 700-5000 sq ft. range which indicates some good quality adult habitat may be available (Table @@). However there was little structural or bank cover for fish and only 5% of quality juvenile rearing habitat (Table ??). Substrate composition, was predominantly silt, with generally smaller rock and few large boulders (Table ##). Seeley is, with the exception of its uppermost headwaters, a low gradient stream. Along most of its length it is in an unconfined valley, with confinement increasing in the upper reaches. Following logging after World War II, the stream had considerable woody debris accumulation, but most was in short segments generated by logging and has flushed from the system over time, leaving only limited amounts of woody debris. There has been considerable beaver activity, with several large dams still in the system. In addition, there is a nice pump chance pond in its headwaters. The beaver activity has created considerable wetland area in some reaches, and associated off-channel rearing habitat. The habitat associated with the beaver activity is excellent. Cutthroat trout are found throughout the stream, but access for migrating fish was blocked at the mouth and again upstream by impassable culverts. Two culverts in the lowest part of the drainage were replaced in 1994 with ones that will allow access for migrating salmon and steelhead. Plans are underway to replace other culvert barriers in Seely Creek. Instream and some riparian habitat restoration were implemented during 1994 in Seeley Cr.

OWL CREEK - This is a 3rd order tributary to Shotgun Creek. The lower portions have a moderate gradient, and flow, for the most part, in an unconfined channel. The stream then enters a highly confined channel with steep gradient. It flattens more in its headwaters, where it flows in young forests. At the time of the last inventory, it had less than 50% pool habitats, all of these were small, and less than 25% were in good or excellent condition (Table @@). Little cover was available for fish, quality juvenile rearing habitat was limited (Table ??) and silt and organic material were the dominant substrates (Table ##). At the time of the 1983 inventories there were several large log accumulations in the channel in Owl Creek, at least one of which several hundred feet long and over twenty feet high. Most of these accumulations have gradually broken apart and the materials redistributed, so that habitat overall has improved. The first approximately 100 meters of Owl Creek were re-located for construction of Road 15-2-13; being diverted into a deep, narrow ditch. Velocities in this ditch retarded movements of fish seeking to migrate into Owl Creek. Instream habitat restoration was implemented during 1994 in Owl creek, with step structures being added to the ditch to improve access for migrating fish.

One impassable waterfall was identified in this drainage.

Polly Creek
This third order eastside tributary enters the Mohawk River in Section 5 and is potentially fish bearing to the middle of section 4. A waterfall near the mouth of this stream is a barrier to fish passage. Very little of this stream flows through BLM land and no habitat data are available.

Drury Creek
This 3rd order stream flows southward from the Mohawk-Calapooia divide, with approximately 1 1/2 miles of habitat managed by BLM. Inventories have not been completed. The stream is low-gradient near its mouth and again in the middle reaches. The lower reaches are unconfined, and flow through pasture and residential areas. On public lands, the stream flows through forest lands of mixed age. Roads cross and parallel the stream along much of its length, contributing silt to the channel and reducing riparian areas. Beaver have been active in the stream, creating a series of ponds, some of large size, and wetlands scattered along the channel. The channel substrate is composed mostly of silt, sand, smaller rock and gravel. Riparian areas are conifer, red alder, with considerable willow. Cutthroat are found throughout the drainage. Access for fish migration is blocked at Road 15-1-21 by a culvert with a downstream drop exceeding two meters. Several other culvert barriers are located in this stream and plans are underway for their replacement.

Bette Creek
This 3rd order eastside stream is fish bearing to the upper forks in section 34 (Figure 1). Approximately 1/3 mile of the l mile long perennial stream flows through BLM land. No inventories have been done on Bette Creek. The stream flows from the east, and is low to moderate gradient. There is considerable beaver activity on public lands. On private lands, a small reservoir blocks the stream. The road, and a BLM road upstream, have created a network of wetlands, augmented by beaver activity. Water from the reservoir are used to irrigate private pastures downstream to the Mohawk River. Four barriers block movements of fish. The mouth has a steep drop into the Mohawk River that preclude fish entering. A culvert on private land, the dam for the reservoir, and the BLM road culvert, currently blocked by beavers, are all barriers to fish movements. The stream has limited riparian vegetation on private land and along the wetlands. Upstream, riparian vegetation is predominantly alder, although willow is proliferating around the beaver ponds.

Log Creek
This is a fourth order stream flowing southward off the Mohawk-Calapooia divide. It had an abundance of pools when surveyed. However, the majority were small and less than 25% were in good or excellent condition (Table @@). This stream offered little cover for fish of any size and limited juvenile rearing habitat, much of it associated with beaver dams. (Table ??). Virtually no spawning gravel existed; silt and organic material made up over 90% of the substrate in this system (Table ##). At the time of the inventory, the reach inventoried and the private lands downstream were dominated by a series of beaver dams. Since that time, the beaver dams have been blasted out of the channel, which now flows in an incised channel and has more exposed bedrock and greatly reduced pool habitat. Spawning areas are present on somewhat steeper lands upstream. The stream provided good to excellent cutthroat habitat, but the quality has been considerably reduced by the removal of the beaver dams. The riparian area on private lands downstream is quite open, and is in pasture and residential areas. On BLM, it is dominated by red alder. Much of the headwaters timber has been harvested during the past two decades, and is in early successional stages.

No name tributary T15S R1W Sec23
This 2nd order stream is fish bearing to the section line (Figure 1) and flows though approximately 1/4 mile of BLM land. No habitat data are available.

No name tributary T15S R1W Sec24
This 3rd order, fish bearing stream (Figure 1)), runs parallel to road #2030 and does not pass through BLM land. No habitat data are available.

North and South Forks Mohawk River
These portions of the Mohawk River are predominantly on Weyerhaeuser land but are not specifically addressed in their Upper Mohawk Watershed Analysis Report (Light and Stark 1994). The pending ODFW Analysis of Mohawk fish populations (Ziller, et al. in press) may be more explicit.

APPENDIX V

Vegetation History

Historical Conditions
This attempt to reconstruct the vegetation history of the recent past (the period from approximately 1800 to 1935) uses three sources: survey notes compiled by Deputy Surveyors of the U. S. General Land Office, a timber type map published by the Oregon State Board of Forestry in 1914 and a forest type map published by the USDA, Forest Service Pacific Northwest Experimental Station in 1936. A fourth source, a map prepared by Gilbert Thompson from information compiled by A.J. Johnson showing the classification of lands and forests in Oregon as of 1900 was not utilized due to inaccuracies. Comparing information obtained from cadastral survey notes from 1852 through 1896 revealed some major inconsistencies between the observations of the surveyors and data recorded on this map. Most telling was the fact that the 1900 map depicts the vegetation of that portion of the Coburg Hills upland north of Township 16 North as scattered woodland with much non-forested land. The surveyors' notes and the plat maps show the area as generally forested although there were some tracts of "scattering timber" and other stands of brushy young timber. The map published by the Forest Service in 1936 is more accurate than the one published by the Oregon State Board of Forestry in 1914; consequently, it is difficult to compare the data from one map, and time period, with that of the later map and time period.

Early Historic Period. A reconstruction of the vegetation pattern as it existed shortly after the upper Willamette Valley was settled by Euro-Americans and prior to the period of extensive timber harvest is depicted on Map ___ . This map was compiled from information garnered from cadastral survey notes and the resulting survey plat maps made between 1852 and 1896. The data sources consulted to prepare this map are the following: J. Hyde 1852a, 1852b, 1852c; J. Freeman 1853a, 1853b, 1853c, 1853d; J. Latshaw 1853; D. Murphy et al 1854a, 1854b, 1854c, 1854d, 1854e; J.H. McClung and W. Pengra 1871; J. Wilkins 1872a, 1872b; J.H. McClung 1873a, 1873b; E. Sharp 1891; C.M. Collier 1896. It was possible to define nine vegetation categories from the notes and maps: bottomland forest, agricultural land, prairie/savannah, scattering timber of Douglas-fir and oak, scattering timber of pine (Pinus ponderosa) and oak, ash swamp, brush and small timber, heavily timbered areas, and areas of fire-killed timber. A cautionary word is apropos at this point. Reconstructions of past vegetation patterns based on cadastral survey notes are subject to several vagaries most importantly the capability, honesty and verbosity of the observer/note taker and the fact that observations were made along section lines only (although some surveyors did note an occasional feature not on the line but visible from the line).

Bottomland forests in the Mohawk Valley consisted of a mixture of typical riparian deciduous species such as willow, alder, ash, maple and cottonwood as well as the coniferous western red cedar and Douglas-fir. This vegetation type occupied the annually flooded portion of the bottomland along the river.

Prairie/savannah vegetation consisted of native prairies with widely scattered oaks and Douglas-firs. The prairies on the valley floor appear to have been anthropogenic in nature maintained by Native American burning practices. Fires were intentionally set, perhaps as frequently as every year, to produce a number of desired conditions including the production of new grass to attract game, to remove brush allowing easier travel and to promote the growth and aid in the harvest of certain food plants. This vegetation type occurred in a discontinuous distribution intermixed with stands of "scattering timber" along both side of the valley to a point approximately one mile upstream from the present location of the town of Marcola. Two other prairies are noted in the early GLO survey documents a small prairie that is still in existence on the southwest aspect upper slope of Grassy Mountain (Sec. 11, T.15S., R.1W.) and a small prairie on the line between Secs. 25/26 of T. 15S., R.1E. The Grassy Mountain prairie is a typical hill prairie which occupies an area of shallow droughty soils on moderately steep slopes(although its long term maintenance may depend on fire). The prairie in T. 15S., R. 1E. was also a small hill prairie. One non-forested area not noted by the GLO surveyors in the Nineteenth Century are the extensive meadows along the upper south aspect slopes of Horse Rock in Secs. 1 and 2, T.15S., R. 2W. However, the survey notes do indicate an area of brush and small timber in the vicinity of the present location of the meadows.

Scattering timber was a term frequently used by the cadastral surveyors of the Nineteenth Century to indicate areas that modern foresters would term understocked. The cadastral surveyors working in the Mohawk watershed interchanged the term scattering timber with the descriptors "oak openings", "fir and oak openings" and "pine and oak openings". This vegetation pattern was, in part, intimately associated with the anthropogenic prairies in the lower Mohawk valley lying along the upslope margins of the prairie/savannah zone. The zone of scattering timber owes its form and composition to the frequent, low intensity fires that maintained the prairies. Species composition within the scattering timber zone consisted primarily large specimens of species which attain a degree of fire resistance once they grow beyond the sapling or pole stage. This includes Douglas-fir, Ponderosa pine and Oregon white oak but excludes many other deciduous species as well as the true firs and western hemlock. There are also some areas of scattering timber in the Log Creek, Drury Creek and Shotgun Creek drainages which are not adjacent to prairie/savannah vegetation but probably owe their existence to anthropogenic fires none-the-less. These areas lie along, or adjacent to, the trail connecting the Mohawk River watershed via Log Creek with the Calapooya River watershed via Brush Creek. This is the same general area where surveyors recorded the only deforested burns in the 1850's. The origin of the small tract of scattering timber noted in the upper end of the Mohawk watershed is not necessarily explained by Native American land management practices (burning) but this may be the case as there was apparently an aboriginal trail which ran along the divide between the upper Mohawk drainage and the upper Calapooya drainage.

Ash Swamp identifies one occurrence of what was likely a more common but otherwise unnoted vegetation type on the floor of the Mohawk valley. This particular feature is noteworthy because it still exists today although improved drainage has rendered the tract less of a swamp and more of seasonally wet ash grove.

Heavily Timbered was used by the Nineteenth Century cadastral surveyors operating in the Mohawk watershed to characterize fully stocked mature stands dominated by conifers. In the Mohawk/McGowan LAU this vegetation type occupied most of the lands beyond the usual reach of the frequent aboriginally set fires.

The **Brush and small timber** vegetation type is interpreted as characteristic of tracts which had burned in the past but had recovered sufficiently that the surveyors did not record the presence of burned snags.

Deforested burns are exactly that. Tracts that were burned in the recent past and were characterized as such by the cadastral surveyors. Deforested burns and tracts characterized by brush and small timber are concentrated on south aspect slopes at higher elevations along the northern end of the watershed. Both the recent and the older burns may have been anthropogenic or they may have been caused by lightning.

Agricultural lands are those small tracts cultivated or at least fenced as pasture by the early settlers in the southern part of the watershed. The majority of the early settlements in the Mohawk valley were made on the native prairies which did not have to be cleared of timber preparatory to planting a crop. Two small homesteads were staked in the zone of scattering timber and one associated with water-powered mills was staked on the edge of the bottomland forest.

The acreage of each vegetation type identified for early historic period within the Mohawk/McGowan LAU is detailed in Table ____.

Table ____. Vegetation classes and their approximate acreage within the Mohawk/McGowan LAU for the Early Historic Period.

Bottomland forest	1909 A. (2.2%)
Prairie/savannah	4533 A. (5.2%)
Scattering timber, fir and oak	7471 A. (8.5%)
Scattering timber, pine and oak	1288 A. (1.5%)
Heavily timbered	69840 A. (79.4%)
Ash swamp	34 A. (<0.1%)

Agricultural land	648 A. (0.7%)
Brush and small timber	1636 A. (1.9%)
Deforested burns	526 A. (0.6%)
TOTAL	87887 A. (100%)

Early Twentieth Century. The timber type map published by the Oregon State Board of Forestry in 1914 documents the condition of the forested lands of the state as of the end of the first decade of the Twentieth Century (Elliott 1914). Map ___ depicts the vegetation

pattern in the Mohawk/McGowan LAU as shown on the 1914 State Board of Forestry map. There are six condition classes delineated on the for the area in the Mohawk/McGowan LAU: non-forested land, unstocked cut-over land, brushfields, burned restocking, burned not restocking, and merchantable timber. Table ____ gives the acreage and percentage of total area for each condition class.

Table ___. Vegetation classes and their approximate acreage in the Mohawk/McGowan LAU in the early Twentieth Century.

Non-forested	11,024 A. (12.7%)
Unstocked cut-over land	4,687 A. (5.3%)
Brushfields	419 A. (0.5%)
Burned, restocking	3,560 A. (4.1%)
Burned, not restocking	480 A. (0.6%)
Merchantable timber	67,537 A. (76.8%)
TOTAL	87,877A. (100%)

The marked increase in the acreage of non-forested land in the fifty-odd years between 1854 and the end of the first decade of the Twentieth Century and the cut-over lands which mark the beginnings of large-scale commercial lumbering in the Mohawk drainage are two prominent features of Map ___. Agriculture, whether row crops or stock raising, was responsible for the big increase in the non-forested land category. By the time the information used to produce the State Board of Forestry timber type map had been compiled all of the lands which could be easily converted to agricultural use had been cleared resulting in an increase of approximately 6000 acres of non-forested land. The valley bottom to a point just upstream from the juncture of Log Creek and the Mohawk River had been cleared of major stands of timber. This marks the present day upstream extent of "agricultural lands" in the Mohawk valley although today much of this acreage is used for rural homesite.

Three small tracts of non-forested land that are not located on the valley bottom are of interest. The first is in Sec. 12, T. 17S., R. 3W. This is the location of Mt. Baldy, a hill prairie that has long been a noted Eugene landmark. Because this locale has physical restraints limiting the growth of trees, notably shallow droughty soil, it has probably been without trees for a long time. However, the 1853 cadastral survey notes for this township do not mention prairies or "balds" on any of the lines run. The second upland non-forested tract of interest occurs in Secs. 1 and 2, T. 15S., R. 2W. This is the meadow on the south slope below Horse Rock. Due to the nature of the soil at this location it is highly probable that this meadow has been in existence for several thousands of years but was not noted during the cadastral survey of the township. The third upland non-forested tract of interest occurs in Sec. 14, T. 15S., R. 1W. This tract is of interest because the location is incorrect. The feature supposedly mapped is the meadow on the southwest slope of Grassy Mountain which is actually in Sec. 11, T. 15S., R. 1W.
Large scale timber harvest had obviously begun in the Mohawk watershed by the time the data for the 1914

map was compiled. Map ___ shows timber had been harvested in the Parsons Creek/Wade Creek drainage, probably by the Fischer Lumber Co. and the Fischer-Bally Co. Coast Range Lumber Co. activities in the Shotgun Creek drainage are indicated but the compiler of the map shows the acreage as "burned restocked" rather than harvested. This may represent an error on the part of the compiler, but it may also point out an attempt by the land owner to defraud the county government out of tax monies by misrepresenting the status of the land. The boundaries of this parcel are far too regular and conform too well to property lines andor terrain mandated yarding limitations to represent the extent of a fire. A tract of burned restocked acreage in the Parsons Creek drainage also conforms to property boundaries in a highly suspicious manner. There also appears to be an unlikely mixture of harvested and burned restocked acres in the upper Mohawk drainage which may represent another error of compilation or attempted fraud. However, some of the patterning in the upper Mohawk drainage has the footprint of actual fire scars. If one combines the "cut-over not restocked" acreage with the "burned restocked acreage" the total area of harvested and probable harvested tracts is around 6000 acres. However, even using this combination of known harvested and probable harvested acres the actual acreage of harvested lands seems under-represented given the information provided by Polley concerning timber harvest in the Mohawk Valley during the early years of the present century. Polley (1984:79) indicates that the Briggs Mill, located on the lower course of McGowan Creek, began operating around 1904 harvesting timber in the McGowan Creek drainage and fluming the lumber to the railroad siding in Donna. The 1914 map showed no harvested lands in the McGowan Creek drainage.

Brushfields, some restocked burns (see above for possible exceptions) and unstocked burns shown on Map ___ are all interpreted as marking the locations of past fires. Three unstocked burns in the upper Mohawk River drainage appear to be intimately associated with logging activities with the fires either occurring during logging or burning through slash in recently logged locations. The restocked burns in Secs. 17, 18 and 21, T. 15S., R. 1E. appear to be records of actual burns and not attempts to cover up previously harvested tracts. So too are the small areas of restocked burns located along the south edge of the upper Mohawk River drainage. These represent fires which started in the Mill Creek drainage, burned upslope to the ridge line and were contained or put out by natural causes as the fire began backing down the north aspect slope. The brushfield located on the middle reaches of McGowan Creek and the restocked burn located in the upper portion of the Crooked Creek drainage do not appear to be associated with logging. These fires may be associated with homesteading activities as a number of cash entry claims were filed in the upper portions of both drainages during the first decade of the Twentieth Century.

<u>Mid-1930s</u>. Information supplied by the forest type map compiled by the USDA, Forest Service and published in 1936 is much more differentiated than that supplied by the 1914 map published by the Oregon State Board of Forestry. One also perceives that the base data used to produce the 1936 map was more accurate than the data used to produce the 1914 map. Map ___ reproduces information from the 1936 map for the Mohawk/McGowan LAU. There are eight vegetation classes delineated on this map. The acreage included in each class as well as the percentage of the Mohawk/McGowan LAU that each class comprises is presented in Table ___.

Table ___. Vegetation classes and their approximate acreage for the Mohawk/McGowan LAU as of the mid-1930's.

Non-forest lands	13217 A. (15.0%)
Douglas-fir seedlings and saplings	804 A. (0.9%)
Douglas-fir small second growth	10165 A. (11.6%)
Douglas-fir large second growth	4608 A. (5.2%)
Douglas-fir old growth	40879 A. (46.5%)
Unstocked cut-overs, pre-1920 harvest	5971 A. (6.8%)
Recent cut-overs, post-1920 harvest	11123 A. (12.7%)

Deforested burns	1120 A. (1.3%)
TOTAL	87887 (100%)

Several observations can be drawn from a study of Map ___ and Table ___. One of the salient features of the map is the apparently finer grain and greater diversity of the vegetation pattern depicted on this map as compared to Map ___ which is based on a map published in 1914. Standing timber is no longer classified simply as "merchantable" as in 1914, rather it is broken out into four categories ranging from young reproduction to old growth. This diversity permits the investigator to identify, or at least speculate on the identity of, burned tracts too old to show up as deforested burns.

Another notable feature is the large acreage of relatively recently cut-over land in the Shotgun Creek and Parsons Creek drainages. This reflects the operations of the Coast Range Lumber Company and the Fischer Lumber Company, respectively. A mixture of early and recent harvest activity characterizes the middle and lower reaches of the McGowan Creek drainage and Black Canyon. The early harvest is reflected in the expansion of non-forested land in the lower reaches (converted to pasture after logging with much of the area now reforested) and the small second growth along the flanks of the drainages. Portions of the drainages harvested at a somewhat later date are shown as pre-and-post-1920 cut-overs. The earlier (turn of the century) timber harvest activity in the Mohawk drainage above the juncture with Drury Creek show as small second growth with the somewhat later timber harvest activity shown as pre-and-post-1920 cut-overs.

The distribution of non-forested lands at the lower elevations probably reflects a more accurate mapping of this vegetation type than occurred on the 1914 map. The non-forested tracts in Secs. 21 and 22, T. 15S., R. 1W. probably represent logged areas which had been converted to agricultural purposes, ie. grazing while the tract of non-forested land in Sec. 8, T. 15S., R. 1W. is anomalous and may well represent an error by the compilers of the 1936 map. The compilers of the 1936 map certainly erred by failing to indicate the non-forested tracts associated with Grassy Mountain and Horse Rock. (Note: the non-forested tracts in Secs. 21 and 22 are now occupied by rural homesite.)

Much of the acreage around the margin of the lower Mohawk Valley occupied by small and large second growth during the mid-1930's as shown on Map ___ are the same areas which were shown as "scattering timber" on Map ___ depicting the early historic period vegetation pattern. In the early 1850's these tracts were lightly forested with a mixture of either mature Douglas-fir and oak or Ponderosa pine and oak. Personal observation of forested, or recently harvested, tracts in areas classified as scattering timber on the map of early historic vegetation patterns has shown that the present stands occupying these areas are composed of two or three sharply defined age-based cohorts of coniferous species plus a component of shade tolerant and fire susceptible deciduous hardwoods. Members of the oldest coniferous cohort in these stands are Douglas-firs which also exhibit open-grown form characterized by many large limbs, or large limb stubs, extending well down the bole to within a few feet of the ground. These multiple component stands reflect the filling in of lightly timbered areas through a process of natural reproduction from local seed sources in the absence of a fire regime characterized by frequent fires of anthropogenic origin. As the young conifers filled in the open stands they gradually shaded out most of the oaks which had formed the major hardwood component of the original stands. The absence of fire accompanied by the rapid and abundant production of Douglas-fir seedlings and saplings resulted in the formation of the second cohort of Douglas-firs and favored the development of an additional component composed of shade-tolerant, fire susceptible coniferous species such as hemlock, cedar and the true firs and a deciduous hardwood component composed of species such as big-leaf maple.

The distribution of deforested burns on Map ___ displays a strong association with areas of pre-1920 timber harvest, a not unexpected phenomenon given the flammability of slash-filled cut-over units. Of the 1120 acres of deforested burn the only tract so identified that is not immediately adjacent to a previously logged area is located in the upper reaches of the Crooked Creek drainage. The possible causes of ignition for this burn are likely associated with human activity but not with timber harvest.

Tracts of large second growth scattered about the LAU may mark the locations of fires which burned prior to the beginning of the Nineteenth Century while some of the stands of younger second growth such as the one in Secs. 9, 10 and 15, T. 15S., R. 1W. may mark the location of burns which occurred around the middle of the Nineteenth Century or slightly later. There are only two seedling and sapling age stands in the LAU. Both of these appear to be reforesting burns. The tract in the Cash Creek drainage probably represents a fire in a previously logged area. One may speculate on the origin of the seedling and sapling stand in Sec. 14, T. 15S., R. 2W. The stand has the footprint of a reforesting burn and may have been attributable to human agents. Section 14 was settled by Cash Entries patented between 1902 and 1908. Settlements on upland tracts such as Sec. 14 during the first decade of the Twentieth Century follow the pattern of land fraud associated with the "O & C land fraud" perpetrated by the Southern Pacific Railroad in collusion with some of the large timber companies (Polley 1984:45-46). It seems probable that these tracts were settled by "entrymen" hired by agents of a timber company to claim the land and then turn it over to the company and that one of the "entrymen" accidently set the fire which, twenty-five years later, was identifiable as a stand of young timber with the footprint of a forest fire.

APPENDIX W

Seral Stage Classification

Successional Stages - Succession is the replacement of vegetative communities following events that change or alter the original community. Eventually the original community is restored and remains reasonably stable and constant until the next disturbance event. In the Pacific Northwest, the dominant species are so long-lived that the probability of succession restoring the original community before another disturbance event happens is low.

The following is a general description of the various successional stages. The ages are somewhat different then that utilized in the vegetation class age class descriptions, but the overall stand level dynamics and interactions are well documented.

Early Seral Stage - This seral stage occurs from the time of disturbance that exposes bare ground to the time when the site is revegetated with conifer or hardwood saplings. Domination of the site with hardwood and/or conifer saplings typically occurs before 15 years after disturbance. The first 2 to 5 years are usually dominated by grass, forbs, and herbaceous vegetation followed by a dominance of shrubs and/or hardwoods. Species diversity is highest in this seral stage and biomass is relatively low, but increases rapidly throughout this stage. The conifers develop slowly at first but gradually become dominant. Once conifer dominance occurs and the crowns close to fully occupy the site, then the early seral stage is concluded. [1] These descriptions assume that **all** stands currently in this seral stage have developed as a result of man-caused disturbance (forest management) and there are no stands in this seral stage that have resulted from natural disturbances.

There are 3 separate stand conditions that exist during the early seral stage: [2]

- grass-forb stand condition
- shrub stand condition
- open sapling-pole stand condition

Grass-Forb Stand Condition - This stand condition usually lasts 2 to 5 years and occasionally as long as 10 years. After timber harvest or disturbance, the area is usually devoid of vegetation for the first growing season. Resident herbs and new plants quickly dominate the site. Some shrubs and sprouting hardwoods may be present, but not yet dominant. This stage can be bypassed if residual overstory tree cover does not create openings, e.g., a shelterwood harvest.

This stage can be defined as: "Shrubs less than 40 percent crown cover and less than 5 feet tall; areas may range from mainly devoid of vegetation to dominance by herbaceous species (grasses and forbs); tree regeneration generally is less then 5 feet tall and 40 percent crown cover." [3] Stands in the grass-forb stand condition are classified as clear cut patch types for this analysis.

Shrub Stand Condition - The shrub condition typically lasts from 3 to 10 years, but can remain for 20 or more years if tree regeneration fails or is delayed. Shrubs become the dominant vegetation and provide some habitat for wildlife that is different from the grass-forb condition. Tree regeneration is common, but the trees are generally less then 10 feet tall and provide less then 30 percent of the crown cover.

This stage can be defined as: "Shrubs greater than 40 percent crown canopy; they can be any height; trees less than 40 percent crown canopy and less than 1 inch dbh. When trees exceed 1 inch dbh for the stand average, they should be classified in the "open sapling" or "closed sapling" category." [46] Stands in the shrub stand condition are classified as clear cut patch types for this analysis.

Open Sapling-Pole Stand Condition - This stand condition exists when the trees reach 10 feet in height, but still have less then 60 percent crown cover. The trees generally average less then 1 inch in dbh. A dominant shrub understory is common and generally consist of vine maple, hazel, oceanspray, thimbleberry, salal, and Oregon grape. This stage may be bypassed if initial stocking densities exceed 400 to 500 trees per acre. This stage can also be reinitiated or prolonged through precommercial thinning. This stage may last from 8 to 20 years depending upon tree crown closure and subsequent stand treatments.

This stand condition is defined as: "Average stand diameter greater than 1 inch dbh and tree crown canopy less than 60 percent. Saplings are 1 to 4 inches in dbh; poles 4 to 9 inches." [46] Stands in the open sapling pole condition are classified into the sapling-pole patch type for this analysis.

Mid Seral Stage - This stage is characterized by dominance of conifers (from the time of crown closure to the time of first merchantability). This stand condition can also be called closed sapling-pole sawtimber [45] or stem exclusion stage [49]. These sites are characterized by a dense conifer stand, a closed canopy with crown cover ranging from 60 to 100 percent, and a relatively low occurrence of understory vegetation. Stands typically exhibit these characteristics between 16 and 45 years of age. [45]

The overstory trees are growing very rapidly and begin to lose the lower, deeply shaded foliage and branches. Stem growth slows down and the stem form becomes more tapered. As individual trees within the stand differ in growth rates and occupy different amounts of growing space, some trees gain a competitive advantage. Since the overstory is growing very rapidly, the larger more dominant trees begin to overtake the growing space of the smaller less competitive individuals. This process is called stand differentiation and is generally manifested first in diameter differences, and then later in height differences. Stand differentiation creates a stand with individual trees of different crown sizes and positions, as well as different heights and diameters. This allows for a classification of individual trees by canopy position or crown class -- dominants, codominants, intermediates, and overtopped or suppressed.

Species diversity decreases in most cases. These stands can change to large sawtimber and eventually old growth if thinning treatments and long rotations are used. The size and number of snags and coarse woody debris is dependant upon the stand origin. Managed stands created by forest management during the past decades tend to be devoid of large snags and downed logs. However a large number of small snags are present. These snags are created by stand differentiation and competition mortality; which tends to be the smaller sized trees in the intermediate and overtopped crown classes. Natural stands may have a greater number of snags and large downed logs that are legacies from the original forest as well as the high amounts of small snags and downed logs created by competition mortality. These existing natural stands tend to be limited in the number of large snags as a result of past fire management policies, but still have some levels of downed logs. These snags and downed logs currently present tend to be in the more advanced decay classes; classes 3, 4, and 5.[4]

This stand condition can be defined as: "average stand diameters between 1 and 21 inches in dbh and crown cover exceeding 60 percent." [46] The average stand diameter range used can overlap into the late seral stage, depending upon stand management treatments applied and the site productivity. Stands in the mid seral stage are classed in the pole-young patch type for this analysis.

Late Seral Stage - This stage typically is characterized by openings in the canopy with a corresponding increase in forbs and shrubs or the understory reinitiation stage. [49] Species diversity, although minimal, is once again beginning to increase but at a slower rate than what occurred in the early seral stage. For conifer growth, it is the time of first merchantability to the time of culmination of mean annual increment (CMAI). During this period, stand diversity is low but increasing. Stands generally exhibit these characteristics between 46 and 80 years [45]. Stands in the late seral stage are classified as pole-young patch types.

These stands typically have large numbers of small diameter snags and downed logs resulting from stand density and competition related mortality. The large diameter snags and downed logs, legacies from the previous forest, tend to be few in number, limited in distribution, and those present are typically in the more advanced decay classes. The number of legacy and small diameter snags and downed logs tends to be greater in naturally regenerated stands. Past management activities and silvicultural treatments like precommercial and commercial thinning tend to decrease the number of small snags and downed logs present in these stands .

Mature Seral Stage - This stage typically occurs between ages 81 and 195. Stand diversity is gradually increasing in response to openings in the canopy created by windthrow, disease, insects, and stand mortality.

Biomass is still increasing but at a relatively slow rate. For conifers it is the time from CMAI to an old growth state.

This stage could also be called the large sawtimber stand condition [46] that is characterized by trees with an average dbh of 21 inches or larger. The conifers usually exceed 100 feet in height with crown cover generally less than 100 percent, permitting the development of ground vegetation. Stands in the mature seral stage generally have a more open canopy than the mid seral aged stands. These stands create different wildlife habitat than smaller sized stands. Natural stands in this condition can have nearly as much standing and downed woody material as old growth stands. Stands that have had silvicultural treatments are generally lacking in standing and downed woody material. These stands also tend to lack the more tolerant, successional understory species required for the old growth stage. For this analysis the stands in the late seral stage are classified as mature or mature over young if a 2-storied stand condition is present.

Old Growth Seral Stage - This stage typically occurs after 195 years and represents climax and subclimax plant communities. The subclimax condition may persist for centuries depending on the frequency of natural disturbances. Whether in the climax or subclimax condition, old growth is characterized by 2 or more tree species with a wide range of size and age including long-lived seral dominants, decadence of the long lived dominants, a deep, multi-layered canopy, significant amounts of snags and downed logs, and openings or gaps in the canopy. More tolerant conifers (western hemlock and western red cedar) and/or shrub species occur in the understory or in the gaps and openings caused by windthrow or other disturbance. Old growth stands are optimal habitat for saprophytic plants, lichens, mosses, and liverworts. Biomass reaches a maximum and species diversity approaches the level found in the early seral stages. Forest stands in the old growth seral stage are classed as old forest or old over young if a 2-storied stand condition exists.

1 *extracted from "Analysis of the Management Situation", Eugene District Office Resource Management Plan, January, 1991. Ages altered to reflect the current Record of Decision and Standards and guidelines for Management for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.*

2 *"Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington , Part I - Chapter Narratives". Chapter 2 Plant Communities and Stand Conditions. Brown,et al. June 1985.*

3 *"Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington*, Part *2 - Appendices." Appendix 6 Brown, et al. June, 1985.*

4 *"Forest Stand Dynamics"*, Oliver, C.D. and Larson, Bruce C., McGraw-Hill, 1990.

5 *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington, Part 1 - Chapter Narratives" . Chapter 7 Snags (Wildlife Trees). Brown et al. June, 1985.*

˝' àÝøÛÒÝ Ðû êÒãú ËÒãÒÜÛÃÛãõ' éÒãÝÒøÞ' ˝ΚΚ˝' ÛðõøÒÚõÛú ûøÐÃ ·*Analysis of the Management Situation*·' ÆÝÜÛãÛ åÙÕõøÙÚõ ÈûûÙÚÛ íÛÕÐÝøÚÛ ËÒãÒÜÛÃÛãõ èÿÒã'

¸' àøÐÐã Ûõ Òÿ' ˝Κß˝' ·ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ˝ ¸ ÅüÒðõÛø ëÒøøÒõÙýÛÕ·' ÅüÒðõÛø ¸ èÿÒãõ ÅÐÃÃÝãÙõÙÛÕ Òãú ÎõÒãú ÅÐãúÙõÙÐãÕ'

˛' àøÐÐã Ûõ Òÿ' ˝Κß˝' ·ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ¸ ¸ ÀððÛãúÙÚÛÕ'· ÀððÛãúÙð ¯'

˘' àøÐÐã Ûõ Òÿ' ˝Κß˝' ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ˝ ¸ ÅüÒðõÛø ëÒøøÒõÙýÛÕ· ' ÅüÒðõÛø ˘ ÎãÒÜÕ ¨ÌÙÿúÿÙûÛ îøÛÛÕ¯'

APPENDICES

All Appendices are not complete and are not included in this report at this time. As each Appendix is completed, it will be added to this section.

APPENDIX A

Cultural Resources/Watershed History

Beginning in 1975 cultural resource surveys were conducted in advance of all potentially surface disturbing projects throughout the Eugene District. In 1977 a program of post-harvest survey was initiated. The post-harvest cultural resource survey program was not designed to cover all harvested BLM acres within the District; however, within the area under consideration approximately 30 percent of the final harvest acreage has been surveyed since 1978. Between October 1975 and the present a total of 5,760 acres within the Mohawk/McGowan watershed were surveyed for cultural resources in advance of surface disturbing projects and an additional 1,400 acres of post-harvest cultural resource surveys were conducted. This effort with some contract survey work conducted on private lands has resulted in the location and recordation of an additional 72 prehistoric archaeological sites in the Mohawk River, Camp Creek, and lower McKenzie River drainages. The majority of these sites were discovered by BLM personnel and are located on BLM administered lands.

A Class III literature review and synopsis of existing data for lands within the Eugene District, including those within the lower McKenzie River drainage, was conducted by Heritage Research Associates during 1980-81. The results were published in the University of Oregon Anthropological Papers series (Beckham, Minor, Toepel 1981). Those interested in an explanation of topics such as the cultural sequence employed in the Willamette Basin, aboriginal settlement patterns of the area, or information concerning the ethnographic lifeways of the aboriginal inhabitants should consult this reference.

Prehistoric Period

Three sites in the watershed have been extensively excavated. The Halverson site (35LA261) is a Late Archaic Period campsite excavated by a University of Oregon Department of Anthropology field school crew during the summer of 1977 (Minor and Toepel 1982). The Mill Creek #6 site (35LA365), a dense lithic scatter with a variety of tool forms is assigned to the Early Archaic/Middle Archaic transitional period on the basis of temporally sensitive tool forms (Southard 1991a) and the Log Site (35LA1023), a very low density lithic scatter assigned to the Middle Archaic period based on the recovery of a single broad-necked projectile point fragment (Southard, in progress), were excavated by BLM personnel and volunteers.

An additional 13 sites within the area have been the object of some subsurface testing.

Horse Rock Shelter(35LIN92) (Southard 1977)
Bissel's Corner(35LA488) (Southard 1981)
Crackshot (35LA848) (Southard 1991b)
Mill King(35LA805) (Southard 1991c)
Vacuum(35LA875) (Southard 1991d)
Scant (35LA945) (Southard 1991e)
Watson (35LA878) (Southard 1991f)
Lalone Ranger (35LA874)
Marksman (35LA1098)
Walterville Overlook (35LA654) (Southard, in progress)
(35LA951) (Toepel and Bland 1991)
(35LA952 and 35LA953) (Toepel and Beckham 1991)

The Walterville Overlook site is assigned to the Early Archaic period on the basis of temporally sensitive tool types. The Marksman site has produced projectile point types identified with the Early, Middle, and Late Archaic periods. The Mill King and Watson sites have yielded projectile point types identified with the Middle and Late

Archaic periods. Crack Shot, Vacuum, Lalone Ranger, and site 35LA951 are assigned to the Late Archaic period solely based on the recovery of narrow-necked projectile points. The Scant site, Bissel's Corner, and sites 35LA952 and 35LA953 did not yield temporally sensitive artifacts and are not assigned to a specific prehistoric period.

Surface collections from 24 of the remaining 65 sites have yielded temporally sensitive tool forms and have components assignable to one or more cultural periods between the Early Archaic and the Early Historic. Forty-one sites have not yielded temporally sensitive tool forms and are not assigned to a specific prehistoric period.

In addition to the 72 recorded sites, the locations of 86 isolated artifacts have been recorded in the watershed. Approximately 25 percent of these isolates consisted of temporally sensitive artifact forms and can contribute to our understanding of the aboriginal use of the area through time.

Given the number of sites in the lower McKenzie drainage with components that can be assigned to a specific developmental period within the Willamette Basin cultural sequence, and the distribution of these sites across a variety of ecological zones, there is excellent potential for developing information on settlement patterns for Middle and Late Archaic period occupations within the drainage. This should be particularly true for the Late Archaic period because we know that portion of the lower McKenzie drainage, which included the Mohawk River and Camp Creek, was within the territory of a single ethnographically known band, the Mohawk or Pe'u band of the Kalapuya (Beckham 1976). The only serious gap identified in the data necessary for the conduct of such a study relates to winter village sites. No locations identified as winter village sites have been excavated or discovered in this watershed area.

Connolly (1983) utilized site size and locational data from recorded sites in the Mohawk Valley in a comparative study of aboriginal settlement patterns within 3 of the sub-basins of the southern Willamette Basin. Connolly's study did not consider site age, was completed during a time when the number of recorded sites in the Mohawk Valley was approximately one-half the present number, and was conducted prior to the initiation of the site testing program conducted in the Mohawk and Camp Creek drainages. The use of site age and the additional information gained from the site testing program could contribute valuable information to future studies similar to the one carried out by Connolly.

Ethnographic Period

Ethnographic information on the Native American inhabitants of the Willamette Valley is rather scant and much of what is known relates to Kalapuya bands who resided in the northern part of the valley. Each band, actually a residential group set off from its neighbors by language differences at the dialect level, occupied a portion of the main Willamette Valley or the valley of a major tributary stream (Zenk 1976). Each territory contained the requisite ecological diversity to permit the occupants to practice a subsistence economy based on the exploitation of seasonally available food resources within the territory. In order to be successful the band members relied on a high degree of residential mobility and careful scheduling that placed some or all members of the primary food-producing unit (usually the nuclear family or a minimal expression of the extended family) at the location of harvestable resource at the time when the resource could yield the best return for the effort expended in the harvest activity.

Each territory contained one or more winter village sites to which band members repaired with the coming of the rains and colder weather of late fall. These winter village locations contained the only permanent structures utilized by the Kalapuya. During the remainder of the year, whether occupying base camps or small extractive stations, they erected temporary windbreaks or camped in the open.

Ethnographic research with Kalapuya informants did not begin until the third decade of the Twentieth Century and was conducted using informants on the Grand Ronde reservation who traced their ancestry to Kalapuya bands inhabiting the central and northern portions of the valley. Henry Zenk (1976) has reviewed and synthesized this earlier ethnographic work. The following synopsis of the Kalapuyan lifestyle is based in large part on Zenk's work.

The Kalapuya practiced a subsistence economy based on hunting and gathering following a scheduled seasonal round that placed members of the band at locations of seasonally abundant wild foods within the territory occupied by the band. Each band appears to have occupied all or a portion of a major drainage that gave them access to a wide variety of upland and valley floor resources. The settlement pattern of each band was a response to the seasonal round as it was followed within the band's territory. The year began and ended in the winter village, a collection of multi-family houses constructed of poles and matting or bark erected over a shallow pit. Earth was banked up around the base of the structures to further insulate them. Winter village sites were located in well drained locations, such as natural levees or the leading margins of terraces beyond the reach of annual flooding, on the floor of the Willamette Valley or the valley of a larger tributary stream. Much of what was eaten while in the winter village consisted of stored foods gathered and preserved during the other seasons of the year. As early as March people began leaving the winter villages to gather the few vegetable foods available at this the leanest season of the year when stored provisions were scarce or entirely depleted. This marked the beginning of a period of high mobility during which no permanent shelters were used and work groups erected lean-tos or brush wind breaks beneath the branches of large fir trees for temporary shelter.

Camas (*Camassia quamash* and *Camassia leichtlinii)*, a member of the lily family with edible bulbs was a staple of the Kalapuya. The bulbs were dug beginning as soon as the first shoots appeared above ground in the early spring, although the greatest number were collected in June when large amounts were collected, baked in earth ovens, and pressed into cakes and stored for winter use. Tarweed seeds were also collected in large amounts during the late summer. The seeds were toasted and ground to a coarse meal and stored for winter use. Berries were also gathered and dried for storage. Much of the gathering of plant foods was the work of the women while the men hunted for game, using deerskins with the head attached as disguises to enable them to approach close enough for a shot. They also used drives and surrounds employing many people in order to kill a number of animals at a single time. Men fished using hook and line, spears, and willow basket traps. At the onset of the rainy season in late fall the various family groups who had been gathering and preserving provisions for the winter returned to the winter village to refurbish the huts for another long winter (Toepel and Beckham 1981:63-70).

All Native American groups inhabiting the Willamette Valley and the valley of the lower Columbia River suffered devastating population losses from introduced epidemic diseases during the late 1700s and early 1800s. One estimate places the population of the Willamette Valley prior to Euro-American contact at 10,000 individuals. By the late 1830s the native population had dwindled to 600 individuals. Following the signing of the Dayton Treaty in 1855 most of the remaining Native American inhabitants of the Willamette Valley were moved to the Grand Ronde Reservation in 1856 (Toepel and Beckham 1981: 80-81).

Management Objectives - There are 13 aboriginally generated archaeological sites located on BLM administered lands within the Mohawk/McGowan LAU. The following table lists those sites and their management categories.

TABLE___. Management Objectives for Archaeological Sites in the Mohawk/McGowan LAU

SITE	OBJECTIVE
OR-09-027	Discharged from management
OR-09-054	Discharged from management
OR-09-081	Manage for scientific use
OR-09-125	Manage for scientific use

OR-09-142	Discharged from management. This site has been formally determined **not eligible for listing on the National Register**.
OR-09-143	Manage for scientific use
OR-09-150	Manage for scientific use
OR-09-162	Manage for scientific use
OR-09-169	Manage for scientific use
OR-09-185	Discharged from management
OR-09-189	Manage for scientic use. This site may be eligible for listing on the National Register. A request for a formal determination of eligibility will be made to the Oregon SHPO.
OR-09-190	Manage for scientific use
OR-09-191	Manage for scientific use

Euro-American Settlement
When deputy surveyors from the Surveyor General's Office arrived to survey townships 15S., 16S., and 17S. of ranges 1 and 2 west between 1853 and 1855, 17 settlers lived within the boundaries of the Mohawk/McGowan LAU. These were established settlers with tilled fields, albeit small, and well constructed dwellings who had staked claims on the natural prairies and oak savannah portions of the Mohawk River Valley as far upstream as the vicinity of present day Marcola. That some of these settlers had been here for a number of years is evident from notations on the township map for T. 15 S., R. 1 W. identifying a trail running N-S through the center of the township as the "Pack Trail to the Calapooya Mills." Settlers had been in the area long enough to establish a trail to grist mills where flour for domestic use could be ground. However, by 1854 William Simmons had "a sawmill in operation and a flouring mill in course of erection" along the Mohawk River in T. 17 S., R. 2 W. (Daniel and Matthew O'C. Murphy 1854).

The earliest settlers sought land for the purpose of developing farms and staked their claims on natural prairies or savannahs, which were easily cleared and quickly cultivated. Of course, these settlers needed some timber for building cabins, barns, fences, and fuel. However, there was no real demand for lumber other than for local domestic purposes; consequently there was no strong move to file claims on heavily forested tracts. This changed as markets for lumber developed and transportation systems evolved to haul lumber to markets in the midwest and east. Once the transportation infrastructure was in place around 1898, a flood of fraudulent claims were filed by individuals who turned over the claims to big lumber companies for a fee. The timber was quickly harvested and the land forgotten or sold.

APPENDIX C

Mass Movement Assessment - Purpose, Assumptions and Methodology

Purpose & Key Questions - This assessment will identify the potentially unstable mass movement areas in the Mohawk/McGowan Watershed Analysis area. The following key question will be addressed by this assessment:

WS1 What mass wasting processes are active, and where is there evidence of, or potential for, mass wasting in the watershed (what areas are sensitive)?

Assumptions

- Identification of existing mass movement features can be used to predict the likelihood of future instability. Areas prone to these processes can be mapped based on physical characteristics, as interpreted from aerial photographs, topographic maps, and geologic and soils maps.

- Results from research, inventories, and models can be used to help predict the likelihood of future instability.

- It is feasible to extrapolate from one sub-basin to another having similar characteristics.

Methodology - A mass movement potential map was constructed using GIS with topography (slope steepness), stream location, and timber Productivity Capability Classification (TPCC)(field identified unstable areas) themes, and aerial photo inventory of rotational slump areas. Three categories of relative potential for mass movement were mapped using the following criteria:

High
- Mass movement features are common and/or there is significant potential for mass wasting
- Mapped FGNW and FPNW areas in TPCC
- Stream adjacent (within 100ft. of streams) sideslopes >75%
- Steep (>75%) and convergent slopes

Moderate
- Mass movemnt features and potential for mass wasting are intermediate and do not fit into the High or Low categories
- Stream adjacent sideslopes with 55-75% slopes
- Slopes >100ft. from streams with slopes >65%
- Moderate (55-75%) and convergent slopes
- Mapped FPR and FGR areas in TPCC
- Landslide geomorphic units determined through aerial photograph interpretation

Low
- Mass movement features are few to nonexistent and factors contributing to slope instability are practically absent
- Stream adjacent sideslopes <55%
- Planar slopes >100ft. from streams <65%
- Convergent slopes <55%

Slope criteria mentioned above are based on limited data from surveys of known failure sites conducted by the BLM in areas similar to the analysis area.

APPENDIX E

Hillslope Erosion Assessment - Purpose, Assumptions, and Methodology

Purpose & Key Questions - The purpose of this assessment is to identify the existing and potential hillslope related surface erosion areas that contribute sediment to stream channels. The following key question will be addressed by this assessment:

WS2 What is the hillslope erosion potential, i.e. what areas are sensitive?

Assumtions

- Sheet erosion of hillslopes is influenced primarily by soil type, hillslope gradient, protective cover, perticipation intensity, and human activity

- Certain soils (easily detachable) and slope conditions (steeper) are conducive to surface erosion

- On potentially erodible soils, the primary factors determining whether surface erosion occurs are exposure and compaction of mineral soil and topography. Surface erosion tends to increase as these three characteristics increase.

- Certain management practices can expose and/or compact surface mineral soil and significantly increase surface erosion. Practices that do not expose or disrupt the surface mineral soil are unlikely to increase surface erosion.

- Surface erosion may be delivered anywhere in the stream system by dry ravel or overland flow, but is fairly easily disrupted by a buffer of slash, duff, and other protective soil cover. Therefore, sediment is generally not delivered to the stream system if adequate buffers exist of the hillslopes.

- Dry ravel is primarily a function of slope gradient, hillslope storage potential, surface cover, and soil erodibility.

- Most surface erosion occurs within five years of a contributing activity.

Methodology - A soil erosion potential map (Map C) was constructed using GIS with topography (slope steepness) and soils (USDA Soil Conservation Service, K-factors) themes. Three categories of relative potential for erosion of exposed mineral soil were mapped using the following criteria:

High	Slopes >65%, K >.25
	Slopes >30%, K >.40
Moderate	Slopes >65%, K <.25
	Slopes 30-65%, K .25-.40
	Slopes <30%, K >.40
Low	Slopes <30%, K .25-.40
	Slopes <65%, K <.25

From past experience, it was decided that the use of aerial photographs would not be helpful in determining sites with existing surface erosion (i.e. gullies). Field visits were conducted for the 3 erosion potential categories to determine presence (and degree) or absence of erosion.

APPENDIX F-1

Potential habitat for Chinook salmon, steelhead/rainbow trout and cutthroat trout was identified by computer based upon stream order and gradient. The following assumptions were used.

1. Chinook salmon: Stream Order >3; Gradient <4%

2. Steelhead/rainbow trout: Stream order >2; Gradient <7%

3. Cutthroat trout: Stream Order >1; Gradient <18%

Cutthroat will sometimes use first order streams if sufficient water is present, and will be found higher up in the system than any other fish including non-salmonids.

APPENDIX F-2

Life History Characteristics Of Mohawk River Salmonids

Because little is known about the details of fish populations inhabiting the Mohawk watershed, this section will review information on the pertinent life history characteristics of upper Willammette River cutthroat and McKenzie River spring chinook and resident rainbow trout as representative of populations within the assessment area.

<u>Resident Cutthroat Trout</u> - Cutthroat may spawn at almost any month of the year, but reports have shown over 80% spawn January to March (Nicholas 1978, Moring and Youker 1979). Wyatt (1959) reported cutthroat spawning in small tributaries from late March to early June. Fish entering tributaries on the valley floor may spawn earlier than those entering higher elevation Cascade slope streams. Where a mixture of salmonids is present in a basin, cutthroat are known to dominate the higher gradient, small tributaries and have been found spawning in streams with flow rates as low as 0.5 to 1.00 cfs, but will spawn in any accessible stream with suitable habitat.

Fry emerge earliest in warmer streams or sections of streams (as influenced by elevation, shading and groundwater) and move downstream during summer and fall. Cutthroat that rear in cool headwater tributaries are generally smaller that fish rearing in lower elevation tributaries and mainstem reaches (Hunt 1980). Growth typically accelerates when fish move from smaller tributaries to larger waters (Nicholas 1978). Some cutthroat trout mature by age 2, most by age 3.

Cutthroat trout may move upstream from larger streams into smaller tributaries from late fall through early summer. The timing of this activity is probably influenced by local water flow and temperature. Some evidence also indicated that cutthroat will return to their natal tributary to spawn. It is poorly understood how many fish show this behavior and how much straying may occur.

There are three general life history patterns exhibited by cutthroat trout, and all three patterns are probably found within the Mohawk watershed:

1. Trout that are above impassable barriers and therefore constitute reproductively isolated populations. Any individuals that emigrate downstream past these barriers are removed from the original population.

2. Trout that are largely resident in the middle or upper sections of tributaries (including the mainstem Mohawk R.), but are not isolated above barriers. The opportunity exists for some individuals to move downstream to rear and then return to spawn with individuals that did not move.

3. Trout that are largely migratory. They emerge and rear for an undetermined length of time in small to medium sized natal tributaries, move downstream to large mainstem reaches (e.g. McKenzie River) to mature, and then return to smaller tributaries to spawn.

Resident Rainbow Trout - Rainbow trout have the same general life history as cutthroat, although they may not occupy many areas of the watershed year-round in great numbers. It appears that most of the population resides in the mainstem McKenzie and selected tributaries, while some portion of the population uses the tributaries and upper Mohawk watershed for spawning and short-term rearing. Only a scattering of juvenile rainbow trout were found during summer electrofishing surveys in the upper Mohawk mainstem (Ziller et al. in press). The lower portions of the Mohawk and other tributaries are believed to function as winter rearing areas for some of the resident rainbow trout population that inhabits the McKenzie R. mainstem (M.Wade, ODFW, pers. comm. 1994).

Spring Chinook - Adult spring chinook enter the McKenzie River from as early as April to as late as November (Howell et al. 1988). Peak migration occurs in June. Spawning largely takes place during September. Adults may therefore spend several months in the McKenzie and its tributaries prior to spawning.

Timing of chinook fry (<2in.) emergence appears to be quite variable, depending on location, but begins as early as January (Howell et al. 1988). Fry have been captured as late as August. Most juveniles presently leave the McKenzie between September and December.

APPENDIX M

Methods For Channel Morphology

Gradient and confimenent were assessed for all GIS identified streams in the Mohawk/McGowan watershed beginning at the mouth of the Mohawk River and ending at the eastern boundary of R.1.W., where BLM land becomes scarce (Figure 1). Gradient was determined by computer modeling.

Confinement (the ratio of valley floor width to stream channel width) was estimated using a 1:24000 topo map. Valley floor width was actually measured on the topo map. Stream channel width data collected in the Shotgun Creek basin in 1983 was used to obtain an estimated ratio (confinement class) for that basin. I then extraoplated these ratios across the watershed based on actual valley floor width. The confinement classes were: unconfined (VW>4CW), moderately confined (2CW<VW<4CW), and tightly confined (VW<2CW) (TFW, 1993).

Each stream in the system had been previously divided into gradient segments by the computer based on intersection with tributaries (nodes). These segments roughly corresponded to confinement designations in most areas, and so were used throught the analysis. A combination gradient/confinement map was then generated for the watershed.

The accuracy of confinement estimations was assessed in the field. I drove the four major basins (McGowan, Parsons, Cash, and Shotgun Creeks) and stopped at 58 channel crossings. At each stop I visually determined the appropriate classification. After all field checks were completed, I compared the estimated and observed confinements and found that 76% of the estimates were correct. The most common error was estimating moderate confinement when an unconfined condition was observed. I suggest that a computer model be developed for future confinement estimation. We now have information on average channel widths based upon stream order that could be used. This should improve estimation accuracy. Because of time constraints, the original, estimated confinements are used in this report.

APPENDIX R

Potential Impacts of Recreation Activities

The moderate climate associated with the watershed further promotes year-round public use of the area. Unlike the higher cascade areas managed by the Forest Service, the Mohawk-McGowan watershed doesn't have the luxury of a late fall - early spring reprieve from most social uses. Therefore, this area is constantly being used even when the ground is wet and more vulnerable to impacts.

- Because of the watershed's close proximity to a metropolitan area, it serves as a strong magnet to teenage and *twenty-something* youth--particularly on weekends and evenings. The culture of this age group is such that a sense of mortality is immature at best. In addition, many young individuals have not yet formed a positive relationship with the land that guides them in displaying stewardship actions. The consequences of this situation are wide ranging and include excessive driving speeds, vandalism, soil and stream damage, blatant antagonism of other visitors, violence, etc.

- The watershed is heavily impacted across the board geographically by gun shooting recreationists. A recent Connecticut court decision and lead cleanup on the Santa Fe National Forest indicate that there is substantial liability associated with small arms shooting ranges on public lands due to lead as a hazardous material. Think of the ramifications to the extensive hazardous waste situation linked to the pervasive informal shooting situation we have in the Mohawk-McGowan watershed where there is limited to no control or management of the situation.

- Much of the recreational use within the watershed is group oriented. It's common to have several dirt bike riders, 4X4s, hang gliders, plinkers, bicyclists, etc. together at any given time. This type of concentration results in visible impacts within the watershed in areas that are not "hardened" for certain types of recreational use.

- There are people who don't flinch at the idea of dumping household garbage and old car batteries on the land, creating 3' ruts with their vehicles, poaching wildlife, and littering the landscape with shooting targets. This situation appears most concentrated within the McGowan drainage, but is evidenced in notable quantity within the Drury drainage.

- An area on the "17 Road" serves as a popular hang gliding launch site. The road commonly used by the hang gliders to access this site is not maintained at a level consistent with the heavy use it sustains and shows signs of wear.

- The emphasis of Horse Rock Ridge is research and education. Recreational use of the area, however, is desired by some visitors. This type of use is not consistent with the research emphasis of the area and is a point of concern because of physical impacts to the fragile area.

- The Coburg Ridge is a natural attractant for a variety of recreational uses: partying, viewing, hang gliding, paragliding, riding, etc. These activities are impacting because, in some cases, they result in trash, drug paraphernalia, and unattended fires left behind. Likewise, some of the activities are positive in the sense that they serve a presence in the area that helps curb illicit activities (e.g., air monitoring and electronic communication).

- The Drury waterhole site located at the end of Drury Creek Road has sentimental value to some visitors, but is violated with regularity by others who target shoot in the area and leave evidence of their activity. While some degree of vehicular riding occurs northwest of the site, I'm not convinced that the use is a point source detriment to the site.

- The powerline clearing west of Marcola road receives heavy impact from various recreation activities.

- Rock pile locations within the watershed invariably serve as staging areas for motorcycle and ATV users. It is not uncommon for these areas to have an associated extensive trail network.

- The Mountain Bike Ride Guide of Lane County describes popular mountain biking routes within the watershed. Bicycling use within the watershed is year round and occurs during the night and day. It impacts the watershed because some route segments are not maintained to sustain the level of use received and become point source detriments.

- The meadow areas located on the upper part of McGowan Road northwest of the power line are taking a beating from 4 X 4 use during wet conditions. Tire tracks are readily visible.

- Horse use in the watershed may be impacting the native vegetation by and disseminating non-native invaders.

- In general, where not provided, visitors are creating their own recreational backdrops and access within the watershed. These range from social trails, to launch pads, to shooting galleries. Their placement may not be light on the land and, in some cases, should not be present at all because of fragile resource condition. Also, these visitors' created recreational sites are not maintain and they are often not designed with other resources in mind.

- Mud Lane is a mountain bike trail written up in the Mountain Bike Guide. Parts of this trail is on private land along road 15-2-23 which is receiving resource damage because of ruts in the road.

APPENDIX S

Sub-watershed Stream Information

Black Canyon (T17S R2W Sec 7 road 17-2-8)
This 4th order stream is fish bearing to the forks (Figure 1). Approximately 3/4 mile of the 2.25 mile length flows through BLM land. While a formal inventory of Black Canyon has not been done, some information was gathered in conjunction with timber sale planning in the basin. The stream has a moderate gradient, and is primarily riffle-rapid-cascade habitat types, with only limited pool area. There are several cut banks along the stream, and some sedimentation from the roads. During periods with limited rainfall, flows become quite low to intermittent. Some cutthroat trout are present.

Spores Creek
This 4th order stream is fish bearing to the middle of section 5, possibly no fish on BLM (Figure 1). When visited during a period with limited rainfall, Spores Creek on Public Lands was dry. Spores Cr. flows through less than 1/4 mile of BLM land. No habitat data are available.

Kelley Creek
This 4th order stream flows from the east and joins the Mowhawk River in section 35 (T16S R2W). It is fish bearing for much of its length, but the portion flowing through BLM land in section 25 is probably not fish bearing. No habitat data are available.

McGowan Creek and Tributaries
McGOWAN CREEK - This is a 4th order stream flowing off the Coburg Hills, with two major tributaries, South Fork McGowan Creek and Allison Creek. The 1985 inventory of McGowan Creek showed a system with relatively few small pools, most of fair or poor quality (Table @@). Little cover or juvenile rearing habitat was present, although this stream had a higher percentage of rearing habitat (8.8%) than any other surveyed stream in the basin (Table ??). Sand was the dominant substrate type (Table ##). The channel shows considerable instability during the past 15 years. A storm event about 1982 brought considerable material into the channel, much of which accumulated above the first road crossing on public lands. This material, plus the culvert, created a partial barrier to upstream movements of fish. Below this culvert, the channel shows signs of active down cutting, with the secondary incision. As a result of the lack of structural materials, McGowan in this reach lacks spawning and rearing area, although the potential is quite good. In the northwest quarter of section 29, McGowan forks; both forks have road culverts with deep drops at their lower ends that area barriers to upstream fish migration.

The two forks of McGowan are both in largely confined channels, although in their upper reaches there are a number of benches providing flatter gradients. In the flatter areas, and where beavers have worked for extended periods of time, there are some ponds and wetlands, creating good fish and wildlife habitat. The dominant riparian species is red alder, with willow abundant on the benches and conifer more abundant in the most confined reaches. The channels are stair-step, with cobble, rubble and small boulders common. Some woody debris is present, but it is mostly shorter pieces left after logging.

SOUTH FORK McGOWAN CR. - This is a 3rd order tributary of McGowan Cr. The stream is of moderate gradient, with a generally stair-step appearance. Gradient is lowest near the mouth. All of the relatively few pools in this stream, were <300 sq. ft. in area, and were of fair or poor quality (with the exception of 2 excellent pools) (Table @@). This suggests a lack of suitable habitat for adult fish. More cover was found in this stream than any other, but only 14% of habitats surveyed had cover elements and no quality juvenile habitat was present as defined in table ??, but the abundance of smaller pools, with perhaps a lack of large fish could be a benefit to juveniles. Cobble and rubble were the dominant substrates, approximately 25% of substrates were gravel and very little silt was present (Table ##). Collectively these data suggest that this segment of the drainage may have been somewhat suitable for juvenile rearing and if these gravels were aggregated (which is unknown), spawning conditions may also have been acceptable.

ALLISON CR - This is a third order tributary to McGowan Cr. The lower, more moderate gradient portion of the stream flows through open meadows on private lands. The upper portions are in timber of different age classes, with a moderate to steep channel with a stair-step appearance. A former road crossing at one time had considerable erosion, adding extensive silt to the stream. The stream is accessible to migrating fish, and has habitat for salmonids although the overall habitat quality would be rated as fair or poor.

Wade Creek
This 3rd order stream is fish bearing to the forks and does not flow through BLM land. no habitat data is available.

Parsons Creek and Tributaries
This 5th order stream flowing off the Coburg Hills, together with its four major tributaries, Whiskey, Drake, Wendy, and Small Creeks, is fish bearing for most of its length. The status of fish habitat and fish populations in the sections flowing through BLM lands are unknown (Figure 1). The stream has not been inventoried. Parsons Creek is one of the larger drainages in the Mohawk basin, and is suitable for use by resident and anadromous salmonids. Access for migrating fish to the upper reaches is blocked by a culvert on the Parsons Creek road. The majority of the basin is privately owned, with the lower half flowing through agricultural and urban areas. The stream is down-cutting in many reaches and lacks instream structure. The headwaters are steeper and are forested. Much of the forest is in second growth, although there are some remnant older forest patches. The tributaries of Parsons creek are moderate to steep gradient, stair-stepped in appearance and dominated by rocky substrates. Pools tend to be small in size. Parsons creek has considerable potential for restoration projects, if done on a basin-wide basis.

Cash Creek/Showalter Creek
CASH CREEK - This a 4th order stream with little pool habitat. What there is generally small and of fair to poor quality (Table @@). There is also little cover or quality juvenile rearing habitat (Table ??). Cobble and rubble (at greater than 50%)were the dominant substrates (Table ##). Riparian vegetation is predominantly hardwood in lower reaches, but with a greater percentage of conifer in upper reaches, possibly due in part to the loss of deposits of finer substrates. In the lower reaches, gradients are low to moderate, and the valley floor is unconfined. The majority of the stream is in a more confined valley, with gradients from moderate to steep. Except for a short section near its mouth, Cash Creek flows through timber lands, most of which are in younger age classes. Cash Creek has resident cutthroat trout, and is accessible for use by migrating trout, salmon and steelhead. The stream lacks instream structure, but has considerable potential for restoration projects.
SHOWALTER CR - This is a third order tributary to Cash Cr., entering about one mile above the mouth of Cash Creek. It is primarily moderate to steep gradient, dominated by cobble, rubble and small boulder, with a stair-step habitat sequence of rapids, cascades and some pools. It is lacking in woody structure. Streamside areas are primarily young conifers and some red alder. The stream has habitat for cutthroat trout, and is accessible for use by migrating trout and steelhead.

Shotgun Creek and Tributaries

SHOTGUN CR - This is 5th order stream flowing off the Coburg Hills near Bald Mountain and Horse Rock. It is one of the larger tributaries of the Mohawk River, with an extensive basin which, with its tributaries, flows primarily through lands managed by BLM. The lower reaches of Shotgun Creek are on the Mohawk floodplain, and have a low gradient and wide, unconfined valley floor. BLM maintains a major recreational area about one and a half miles above the mouth, which includes a swimming area formed seasonally by damming Shotgun Creek. Wastes from the campground are treated off-site.

Pools represented only 24% of the habitats surveyed, but, while they were generally of fair to poor quality, 40% were fairly large and probably provided some habitat for large fish (Table @@). There are several large, high-quality pools which receive heavy use by fish. Overall, cover or quality juvenile habitat was limited,(Table ??). Many of the larger pools contain extensive rearing habitat, and this drainage is replete with floodplain areas that probably provide quality habitat at higher flows. A variety of substrate types were present and little silt was noted (Table ##) suggesting a potential for spawning and rearing success. Riparian areas vary along the stream. The private lands near the mouth are more open, with some hardwood and conifer cover. The middle reaches managed by BLM have extensive conifer areas, including some large Douglas fir and cedar. Upper reaches were logged within the past two decades, and are dominated by red alder. At least the lower reaches of Shotgun Creek were used to float log rafts; together with stream cleaning and the lack of large wood to provide instream structure, Shotgun Creek was lacking in channel complexity. The overall lack of woody structure, large cover elements, and a shortage of quality pools were the reasons a major instream restoration effort was implemented in 1993-94. Sampling by BLM, the state, and observations by BLM biologists have confirmed the presence of cutthroat trout throughout the basin, plus seasonal use by rainbow trout and, on occasion, steelhead. Migrations of cutthroat and rainbow from the McKenzie and Mohawk into Shotgun occur during winter and spring months. These fish spawn in Shotgun and its tributaries; young rear for an unknown period of time before migrating downstream. Shotgun is useable by all species of resident and migratory salmonids in the McKenzie basin. Several culvert barriers and one waterfall were identified in the headwaters of Shotgun Creek. Plans are underway for some culvert replacement work in the drainage.

CROOKED CREEK - This 4th order tributary to Shotgun Creek was characterized by a number of rather small, fair to poor quality pools (Table @@) with little cover or quality rearing habitat (Table ??). The most noticeable substrates were cobble and rubble, with little gravel or boulders (Table ##). The stream in Section 24 is generally low gradient in an unconfined valley. There are several older meanders, suggesting the channel has shifted in the past. Instream structure is limited. A falls and, in the past a large beaver dam, blocked access upstream for migrating fish in the NW corner of section 24. Additional culverts upstream have partial or complete barriers to fish migration. In Section 23, Crooked Creek has considerable logging debris in the channel in some reaches which creates good to excellent habitat. Otherwise, it has moderate to steep gradient with stair-step habitats of predominantly rapids and cascades. Riparian areas are dominated by red alder, with some young to middle age conifer. This stream was the focus of a stream restoration effort (using horse logging) in 1994. Several culvert barriers were identified and culvert replacement plans were initiated in the same year to allow fish passage and reduce erosion.

SEELEY CR - This fourth order Shotgun Cr. tributary had 52% pools, most in fair or poor condition. Most were small, although over 25% were in the 700-5000 sq ft. range which indicates some good quality adult habitat may be available (Table @@). However there was little structural or bank cover for fish and only 5% of quality juvenile rearing habitat (Table ??). Substrate composition, was predominantly silt, with generally smaller rock and few large boulders (Table ##). Seeley is, with the exception of its uppermost headwaters, a low gradient stream. Along most of its length it is in an unconfined valley, with confinement increasing in the upper reaches. Following logging after World War II, the stream had considerable woody debris accumulation, but most was in short segments generated by logging and has flushed from the system over time, leaving only limited amounts of woody debris. There has been considerable beaver activity, with several large dams still in the system. In addition, there is a nice pump chance pond in its headwaters. The beaver activity has created considerable wetland area in some reaches, and associated off-channel rearing habitat. The habitat associated with the beaver activity is excellent. Cutthroat trout are found throughout the stream, but access for migrating fish was blocked at the mouth and again upstream by impassable culverts. Two culverts in the lowest part of the drainage were replaced in 1994 with ones that will allow access for migrating salmon and steelhead. Plans are underway to replace other culvert barriers in Seely Creek. Instream and some riparian habitat restoration were implemented during 1994 in Seeley Cr.

OWL CREEK - This is a 3rd order tributary to Shotgun Creek. The lower portions have a moderate gradient, and flow, for the most part, in an unconfined channel. The stream then enters a highly confined channel with steep gradient. It flattens more in its headwaters, where it flows in young forests. At the time of the last inventory, it had less than 50% pool habitats, all of these were small, and less than 25% were in good or excellent condition (Table @@). Little cover was available for fish, quality juvenile rearing habitat was limited (Table ??) and silt and organic material were the dominant substrates (Table ##). At the time of the 1983 inventories there were several large log accumulations in the channel in Owl Creek, at least one of which several hundred feet long and over twenty feet high. Most of these accumulations have gradually broken apart and the materials redistributed, so that habitat overall has improved. The first approximately 100 meters of Owl Creek were re-located for construction of Road 15-2-13; being diverted into a deep, narrow ditch. Velocities in this ditch retarded movements of fish seeking to migrate into Owl Creek. Instream habitat restoration was implemented during 1994 in Owl creek, with step structures being added to the ditch to improve access for migrating fish.

One impassable waterfall was identified in this drainage.

Polly Creek
This third order eastside tributary enters the Mohawk River in Section 5 and is potentially fish bearing to the middle of section 4. A waterfall near the mouth of this stream is a barrier to fish passage. Very little of this stream flows through BLM land and no habitat data are available.

Drury Creek
This 3rd order stream flows southward from the Mohawk-Calapooia divide, with approximately 1 1/2 miles of habitat managed by BLM. Inventories have not been completed. The stream is low-gradient near its mouth and again in the middle reaches. The lower reaches are unconfined, and flow through pasture and residential areas. On public lands, the stream flows through forest lands of mixed age. Roads cross and parallel the stream along much of its length, contributing silt to the channel and reducing riparian areas. Beaver have been active in the stream, creating a series of ponds, some of large size, and wetlands scattered along the channel. The channel substrate is composed mostly of silt, sand, smaller rock and gravel. Riparian areas are conifer, red alder, with considerable willow. Cutthroat are found throughout the drainage. Access for fish migration is blocked at Road 15-1-21 by a culvert with a downstream drop exceeding two meters. Several other culvert barriers are located in this stream and plans are underway for their replacement.

Bette Creek
This 3rd order eastside stream is fish bearing to the upper forks in section 34 (Figure 1). Approximately 1/3 mile of the l mile long perennial stream flows through BLM land. No inventories have been done on Bette Creek. The stream flows from the east, and is low to moderate gradient. There is considerable beaver activity on public lands. On private lands, a small reservoir blocks the stream. The road, and a BLM road upstream, have created a network of wetlands, augmented by beaver activity. Water from the reservoir are used to irrigate private pastures downstream to the Mohawk River. Four barriers block movements of fish. The mouth has a steep drop into the Mohawk River that preclude fish entering. A culvert on private land, the dam for the reservoir, and the BLM road culvert, currently blocked by beavers, are all barriers to fish movements. The stream has limited riparian vegetation on private land and along the wetlands. Upstream, riparian vegetation is predominantly alder, although willow is proliferating around the beaver ponds.

Log Creek
This is a fourth order stream flowing southward off the Mohawk-Calapooia divide. It had an abundance of pools when surveyed. However, the majority were small and less than 25% were in good or excellent condition (Table @@). This stream offered little cover for fish of any size and limited juvenile rearing habitat, much of it associated with beaver dams. (Table ??). Virtually no spawning gravel existed; silt and organic material made up over 90% of the substrate in this system (Table ##). At the time of the inventory, the reach inventoried and the private lands downstream were dominated by a series of beaver dams. Since that time, the beaver dams have been blasted out of the channel, which now flows in an incised channel and has more exposed bedrock and greatly reduced pool habitat. Spawning areas are present on somewhat steeper lands upstream. The stream provided good to excellent cutthroat habitat, but the quality has been considerably reduced by the removal of the beaver dams. The riparian area on private lands downstream is quite open, and is in pasture and residential areas. On BLM, it is dominated by red alder. Much of the headwaters timber has been harvested during the past two decades, and is in early successional stages.

No name tributary T15S R1W Sec23
This 2nd order stream is fish bearing to the section line (Figure 1) and flows though approximately 1/4 mile of BLM land. No habitat data are available.

No name tributary T15S R1W Sec24
This 3rd order, fish bearing stream (Figure 1)), runs parallel to road #2030 and does not pass through BLM land. No habitat data are available.

North and South Forks Mohawk River
These portions of the Mohawk River are predominantly on Weyerhaeuser land but are not specifically addressed in their Upper Mohawk Watershed Analysis Report (Light and Stark 1994). The pending ODFW Analysis of Mohawk fish populations (Ziller, et al. in press) may be more explicit.

APPENDIX V

Vegetation History

Historical Conditions

This attempt to reconstruct the vegetation history of the recent past (the period from approximately 1800 to 1935) uses three sources: survey notes compiled by Deputy Surveyors of the U. S. General Land Office, a timber type map published by the Oregon State Board of Forestry in 1914 and a forest type map published by the USDA, Forest Service Pacific Northwest Experimental Station in 1936. A fourth source, a map prepared by Gilbert Thompson from information compiled by A.J. Johnson showing the classification of lands and forests in Oregon as of 1900 was not utilized due to inaccuracies. Comparing information obtained from cadastral survey notes from 1852 through 1896 revealed some major inconsistencies between the observations of the surveyors and data recorded on this map. Most telling was the fact that the 1900 map depicts the vegetation of that portion of the Coburg Hills upland north of Township 16 North as scattered woodland with much non-forested land. The surveyors' notes and the plat maps show the area as generally forested although there were some tracts of "scattering timber" and other stands of brushy young timber. The map published by the Forest Service in 1936 is more accurate than the one published by the Oregon State Board of Forestry in 1914; consequently, it is difficult to compare the data from one map, and time period, with that of the later map and time period.

Early Historic Period. A reconstruction of the vegetation pattern as it existed shortly after the upper Willamette Valley was settled by Euro-Americans and prior to the period of extensive timber harvest is depicted on Map ___ . This map was compiled from information garnered from cadastral survey notes and the resulting survey plat maps made between 1852 and 1896. The data sources consulted to prepare this map are the following: J. Hyde 1852a, 1852b, 1852c; J. Freeman 1853a, 1853b, 1853c, 1853d; J. Latshaw 1853; D. Murphy et al 1854a, 1854b, 1854c, 1854d, 1854e; J.H. McClung and W. Pengra 1871; J. Wilkins 1872a, 1872b; J.H. McClung 1873a, 1873b; E. Sharp 1891; C.M. Collier 1896. It was possible to define nine vegetation categories from the notes and maps: bottomland forest, agricultural land, prairie/savannah, scattering timber of Douglas-fir and oak, scattering timber of pine (Pinus ponderosa) and oak, ash swamp, brush and small timber, heavily timbered areas, and areas of fire-killed timber. A cautionary word is apropos at this point. Reconstructions of past vegetation patterns based on cadastral survey notes are subject to several vagaries most importantly the capability, honesty and verbosity of the observer/note taker and the fact that observations were made along section lines only (although some surveyors did note an occasional feature not on the line but visible from the line).

Bottomland forests in the Mohawk Valley consisted of a mixture of typical riparian deciduous species such as willow, alder, ash, maple and cottonwood as well as the coniferous western red cedar and Douglas-fir. This vegetation type occupied the annually flooded portion of the bottomland along the river.

Prairie/savannah vegetation consisted of native prairies with widely scattered oaks and Douglas-firs. The prairies on the valley floor appear to have been anthropogenic in nature maintained by Native American burning practices. Fires were intentionally set, perhaps as frequently as every year, to produce a number of desired conditions including the production of new grass to attract game, to remove brush allowing easier travel and to promote the growth and aid in the harvest of certain food plants. This vegetation type occurred in a discontinuous distribution intermixed with stands of "scattering timber" along both side of the valley to a point approximately one mile upstream from the present location of the town of Marcola. Two other prairies are noted in the early GLO survey documents a small prairie that is still in existence on the southwest aspect upper slope of Grassy Mountain (Sec. 11, T.15S., R.1W.) and a small prairie on the line between Secs. 25/26 of T. 15S., R.1E. The Grassy Mountain prairie is a typical hill prairie which occupies an area of shallow droughty soils on moderately steep slopes(although its long term maintenance may depend on fire). The prairie in T. 15S., R. 1E. was also a small hill prairie. One non-forested area not noted by the GLO surveyors in the Nineteenth Century are the extensive meadows along the upper south aspect slopes of Horse Rock in Secs. 1 and 2, T.15S., R. 2W. However, the survey notes do indicate an area of brush and small timber in the vicinity of the present location of the meadows.

Scattering timber was a term frequently used by the cadastral surveyors of the Nineteenth Century to indicate areas that modern foresters would term understocked. The cadastral surveyors working in the Mohawk watershed interchanged the term scattering timber with the descriptors "oak openings", "fir and oak openings" and "pine and oak openings". This vegetation pattern was, in part, intimately associated with the anthropogenic prairies in the lower Mohawk valley lying along the upslope margins of the prairie/savannah zone. The zone of scattering timber owes its form and composition to the frequent, low intensity fires that maintained the prairies. Species composition within the scattering timber zone consisted primarily large specimens of species which attain a degree of fire resistance once they grow beyond the sapling or pole stage. This includes Douglas-fir, Ponderosa pine and Oregon white oak but excludes many other deciduous species as well as the true firs and western hemlock. There are also some areas of scattering timber in the Log Creek, Drury Creek and Shotgun Creek drainages which are not adjacent to prairie/savannah vegetation but probably owe their existence to anthropogenic fires none-the-less. These areas lie along, or adjacent to, the trail connecting the Mohawk River watershed via Log Creek with the Calapooya River watershed via Brush Creek. This is the same general area where surveyors recorded the only deforested burns in the 1850's. The origin of the small tract of scattering timber noted in the upper end of the Mohawk watershed is not necessarily explained by Native American land management practices (burning) but this may be the case as there was apparently an aboriginal trail which ran along the divide between the upper Mohawk drainage and the upper Calapooya drainage.

Ash Swamp identifies one occurrence of what was likely a more common but otherwise unnoted vegetation type on the floor of the Mohawk valley. This particular feature is noteworthy because it still exists today although improved drainage has rendered the tract less of a swamp and more of seasonally wet ash grove.

Heavily Timbered was used by the Nineteenth Century cadastral surveyors operating in the Mohawk watershed to characterize fully stocked mature stands dominated by conifers. In the Mohawk/McGowan LAU this vegetation type occupied most of the lands beyond the usual reach of the frequent aboriginally set fires.

The **Brush and small timber** vegetation type is interpreted as characteristic of tracts which had burned in the past but had recovered sufficiently that the surveyors did not record the presence of burned snags.

Deforested burns are exactly that. Tracts that were burned in the recent past and were characterized as such by the cadastral surveyors. Deforested burns and tracts characterized by brush and small timber are concentrated on south aspect slopes at higher elevations along the northern end of the watershed. Both the recent and the older burns may have been anthropogenic or they may have been caused by lightning.

Agricultural lands are those small tracts cultivated or at least fenced as pasture by the early settlers in the southern part of the watershed. The majority of the early settlements in the Mohawk valley were made on the native prairies which did not have to be cleared of timber preparatory to planting a crop. Two small homesteads were staked in the zone of scattering timber and one associated with water-powered mills was staked on the edge of the bottomland forest.

The acreage of each vegetation type identified for early historic period within the Mohawk/McGowan LAU is detailed in Table____.

Table____. Vegetation classes and their approximate acreage within the Mohawk/McGowan LAU for the Early Historic Period.

Bottomland forest	1909 A. (2.2%)
Prairie/savannah	4533 A. (5.2%)
Scattering timber, fir and oak	7471 A. (8.5%)
Scattering timber, pine and oak	1288 A. (1.5%)
Heavily timbered	69840 A. (79.4%)
Ash swamp	34 A. (<0.1%)

Agricultural land	648 A. (0.7%)
Brush and small timber	1636 A. (1.9%)
Deforested burns	526 A. (0.6%)
TOTAL	87887 A. (100%)

Early Twentieth Century. The timber type map published by the Oregon State Board of Forestry in 1914 documents the condition of the forested lands of the state as of the end of the first decade of the Twentieth Century (Elliott 1914). Map ___ depicts the vegetation

pattern in the Mohawk/McGowan LAU as shown on the 1914 State Board of Forestry map. There are six condition classes delineated on the for the area in the Mohawk/McGowan LAU: non-forested land, unstocked cut-over land, brushfields, burned restocking, burned not restocking, and merchantable timber. Table ____ gives the acreage and percentage of total area for each condition class.

Table ___. Vegetation classes and their approximate acreage in the Mohawk/McGowan LAU in the early Twentieth Century.

Non-forested	11,024 A. (12.7%)
Unstocked cut-over land	4,687 A. (5.3%)
Brushfields	419 A. (0.5%)
Burned, restocking	3,560 A. (4.1%)
Burned, not restocking	480 A. (0.6%)
Merchantable timber	67,537 A. (76.8%)
TOTAL	87,877A. (100%)

The marked increase in the acreage of non-forested land in the fifty-odd years between 1854 and the end of the first decade of the Twentieth Century and the cut-over lands which mark the beginnings of large-scale commercial lumbering in the Mohawk drainage are two prominent features of Map ___. Agriculture, whether row crops or stock raising, was responsible for the big increase in the non-forested land category. By the time the information used to produce the State Board of Forestry timber type map had been compiled all of the lands which could be easily converted to agricultural use had been cleared resulting in an increase of approximately 6000 acres of non-forested land. The valley bottom to a point just upstream from the juncture of Log Creek and the Mohawk River had been cleared of major stands of timber. This marks the present day upstream extent of "agricultural lands" in the Mohawk valley although today much of this acreage is used for rural homesite.

Three small tracts of non-forested land that are not located on the valley bottom are of interest. The first is in Sec. 12, T. 17S., R. 3W. This is the location of Mt. Baldy, a hill prairie that has long been a noted Eugene landmark. Because this locale has physical restraints limiting the growth of trees, notably shallow droughty soil, it has probably been without trees for a long time. However, the 1853 cadastral survey notes for this township do not mention prairies or "balds" on any of the lines run. The second upland non-forested tract of interest occurs in Secs. 1 and 2, T. 15S., R. 2W. This is the meadow on the south slope below Horse Rock. Due to the nature of the soil at this location it is highly probable that this meadow has been in existence for several thousands of years but was not noted during the cadastral survey of the township. The third upland non-forested tract of interest occurs in Sec. 14, T. 15S., R. 1W. This tract is of interest because the location is incorrect. The feature supposedly mapped is the meadow on the southwest slope of Grassy Mountain which is actually in Sec. 11, T. 15S., R. 1W.
Large scale timber harvest had obviously begun in the Mohawk watershed by the time the data for the 1914

map was compiled. Map ___ shows timber had been harvested in the Parsons Creek/Wade Creek drainage, probably by the Fischer Lumber Co. and the Fischer-Bally Co. Coast Range Lumber Co. activities in the Shotgun Creek drainage are indicated but the compiler of the map shows the acreage as "burned restocked" rather than harvested. This may represent an error on the part of the compiler, but it may also point out an attempt by the land owner to defraud the county government out of tax monies by misrepresenting the status of the land. The boundaries of this parcel are far too regular and conform too well to property lines andor terrain mandated yarding limitations to represent the extent of a fire. A tract of burned restocked acreage in the Parsons Creek drainage also conforms to property boundaries in a highly suspicious manner. There also appears to be an unlikely mixture of harvested and burned restocked acres in the upper Mohawk drainage which may represent another error of compilation or attempted fraud. However, some of the patterning in the upper Mohawk drainage has the footprint of actual fire scars. If one combines the "cut-over not restocked" acreage with the "burned restocked acreage" the total area of harvested and probable harvested tracts is around 6000 acres. However, even using this combination of known harvested and probable harvested acres the actual acreage of harvested lands seems under-represented given the information provided by Polley concerning timber harvest in the Mohawk Valley during the early years of the present century. Polley (1984:79) indicates that the Briggs Mill, located on the lower course of McGowan Creek, began operating around 1904 harvesting timber in the McGowan Creek drainage and fluming the lumber to the railroad siding in Donna. The 1914 map showed no harvested lands in the McGowan Creek drainage.

Brushfields, some restocked burns (see above for possible exceptions) and unstocked burns shown on Map ___ are all interpreted as marking the locations of past fires. Three unstocked burns in the upper Mohawk River drainage appear to be intimately associated with logging activities with the fires either occurring during logging or burning through slash in recently logged locations. The restocked burns in Secs. 17, 18 and 21, T. 15S., R. 1E. appear to be records of actual burns and not attempts to cover up previously harvested tracts. So too are the small areas of restocked burns located along the south edge of the upper Mohawk River drainage. These represent fires which started in the Mill Creek drainage, burned upslope to the ridge line and were contained or put out by natural causes as the fire began backing down the north aspect slope. The brushfield located on the middle reaches of McGowan Creek and the restocked burn located in the upper portion of the Crooked Creek drainage do not appear to be associated with logging. These fires may be associated with homesteading activities as a number of cash entry claims were filed in the upper portions of both drainages during the first decade of the Twentieth Century.

<u>Mid-1930s</u>. Information supplied by the forest type map compiled by the USDA, Forest Service and published in 1936 is much more differentiated than that supplied by the 1914 map published by the Oregon State Board of Forestry. One also perceives that the base data used to produce the 1936 map was more accurate than the data used to produce the 1914 map. Map ___ reproduces information from the 1936 map for the Mohawk/McGowan LAU. There are eight vegetation classes delineated on this map. The acreage included in each class as well as the percentage of the Mohawk/McGowan LAU that each class comprises is presented in Table ___.

Table ___. Vegetation classes and their approximate acreage for the Mohawk/McGowan LAU as of the mid-1930's.

Non-forest lands	13217 A. (15.0%)
Douglas-fir seedlings and saplings	804 A. (0.9%)
Douglas-fir small second growth	10165 A. (11.6%)
Douglas-fir large second growth	4608 A. (5.2%)
Douglas-fir old growth	40879 A. (46.5%)
Unstocked cut-overs, pre-1920 harvest	5971 A. (6.8%)
Recent cut-overs, post-1920 harvest	11123 A. (12.7%)

Deforested burns	1120 A. (1.3%)
TOTAL	87887 (100%)

Several observations can be drawn from a study of Map ___ and Table ___. One of the salient features of the map is the apparently finer grain and greater diversity of the vegetation pattern depicted on this map as compared to Map ___ which is based on a map published in 1914. Standing timber is no longer classified simply as "merchantable" as in 1914, rather it is broken out into four categories ranging from young reproduction to old growth. This diversity permits the investigator to identify, or at least speculate on the identity of, burned tracts too old to show up as deforested burns.

Another notable feature is the large acreage of relatively recently cut-over land in the Shotgun Creek and Parsons Creek drainages. This reflects the operations of the Coast Range Lumber Company and the Fischer Lumber Company, respectively. A mixture of early and recent harvest activity characterizes the middle and lower reaches of the McGowan Creek drainage and Black Canyon. The early harvest is reflected in the expansion of non-forested land in the lower reaches (converted to pasture after logging with much of the area now reforested) and the small second growth along the flanks of the drainages. Portions of the drainages harvested at a somewhat later date are shown as pre-and-post-1920 cut-overs. The earlier (turn of the century) timber harvest activity in the Mohawk drainage above the juncture with Drury Creek show as small second growth with the somewhat later timber harvest activity shown as pre-and-post-1920 cut-overs.

The distribution of non-forested lands at the lower elevations probably reflects a more accurate mapping of this vegetation type than occurred on the 1914 map. The non-forested tracts in Secs. 21 and 22, T. 15S., R. 1W. probably represent logged areas which had been converted to agricultural purposes, ie. grazing while the tract of non-forested land in Sec. 8, T. 15S., R. 1W. is anomalous and may well represent an error by the compilers of the 1936 map. The compilers of the 1936 map certainly erred by failing to indicate the non-forested tracts associated with Grassy Mountain and Horse Rock. (Note: the non-forested tracts in Secs. 21 and 22 are now occupied by rural homesite.)

Much of the acreage around the margin of the lower Mohawk Valley occupied by small and large second growth during the mid-1930's as shown on Map ___ are the same areas which were shown as "scattering timber" on Map ___ depicting the early historic period vegetation pattern. In the early 1850's these tracts were lightly forested with a mixture of either mature Douglas-fir and oak or Ponderosa pine and oak. Personal observation of forested, or recently harvested, tracts in areas classified as scattering timber on the map of early historic vegetation patterns has shown that the present stands occupying these areas are composed of two or three sharply defined age-based cohorts of coniferous species plus a component of shade tolerant and fire susceptible deciduous hardwoods. Members of the oldest coniferous cohort in these stands are Douglas-firs which also exhibit open-grown form characterized by many large limbs, or large limb stubs, extending well down the bole to within a few feet of the ground. These multiple component stands reflect the filling in of lightly timbered areas through a process of natural reproduction from local seed sources in the absence of a fire regime characterized by frequent fires of anthropogenic origin. As the young conifers filled in the open stands they gradually shaded out most of the oaks which had formed the major hardwood component of the original stands. The absence of fire accompanied by the rapid and abundant production of Douglas-fir seedlings and saplings resulted in the formation of the second cohort of Douglas-firs and favored the development of an additional component composed of shade-tolerant, fire susceptible coniferous species such as hemlock, cedar and the true firs and a deciduous hardwood component composed of species such as big-leaf maple.

The distribution of deforested burns on Map ___ displays a strong association with areas of pre-1920 timber harvest, a not unexpected phenomenon given the flammability of slash-filled cut-over units. Of the 1120 acres of deforested burn the only tract so identified that is not immediately adjacent to a previously logged area is located in the upper reaches of the Crooked Creek drainage. The possible causes of ignition for this burn are likely associated with human activity but not with timber harvest.

Tracts of large second growth scattered about the LAU may mark the locations of fires which burned prior to the beginning of the Nineteenth Century while some of the stands of younger second growth such as the one in Secs. 9, 10 and 15, T. 15S., R. 1W. may mark the location of burns which occurred around the middle of the Nineteenth Century or slightly later. There are only two seedling and sapling age stands in the LAU. Both of these appear to be reforesting burns. The tract in the Cash Creek drainage probably represents a fire in a previously logged area. One may speculate on the origin of the seedling and sapling stand in Sec. 14, T. 15S., R. 2W. The stand has the footprint of a reforesting burn and may have been attributable to human agents. Section 14 was settled by Cash Entries patented between 1902 and 1908. Settlements on upland tracts such as Sec. 14 during the first decade of the Twentieth Century follow the pattern of land fraud associated with the "O & C land fraud" perpetrated by the Southern Pacific Railroad in collusion with some of the large timber companies (Polley 1984:45-46). It seems probable that these tracts were settled by "entrymen" hired by agents of a timber company to claim the land and then turn it over to the company and that one of the "entrymen" accidently set the fire which, twenty-five years later, was identifiable as a stand of young timber with the footprint of a forest fire.

APPENDIX W

Seral Stage Classification

Successional Stages - Succession is the replacement of vegetative communities following events that change or alter the original community. Eventually the original community is restored and remains reasonably stable and constant until the next disturbance event. In the Pacific Northwest, the dominant species are so long-lived that the probability of succession restoring the original community before another disturbance event happens is low.

The following is a general description of the various successional stages. The ages are somewhat different then that utilized in the vegetation class age class descriptions, but the overall stand level dynamics and interactions are well documented.

Early Seral Stage - This seral stage occurs from the time of disturbance that exposes bare ground to the time when the site is revegetated with conifer or hardwood saplings. Domination of the site with hardwood and/or conifer saplings typically occurs before 15 years after disturbance. The first 2 to 5 years are usually dominated by grass, forbs, and herbaceous vegetation followed by a dominance of shrubs and/or hardwoods. Species diversity is highest in this seral stage and biomass is relatively low, but increases rapidly throughout this stage. The conifers develop slowly at first but gradually become dominant. Once conifer dominance occurs and the crowns close to fully occupy the site, then the early seral stage is concluded. [1] These descriptions assume that **all** stands currently in this seral stage have developed as a result of man-caused disturbance (forest management) and there are no stands in this seral stage that have resulted from natural disturbances.

There are 3 separate stand conditions that exist during the early seral stage: [2]

- grass-forb stand condition
- shrub stand condition
- open sapling-pole stand condition

Grass-Forb Stand Condition - This stand condition usually lasts 2 to 5 years and occasionally as long as 10 years. After timber harvest or disturbance, the area is usually devoid of vegetation for the first growing season. Resident herbs and new plants quickly dominate the site. Some shrubs and sprouting hardwoods may be present, but not yet dominant. This stage can be bypassed if residual overstory tree cover does not create openings, e.g., a shelterwood harvest.

This stage can be defined as: "Shrubs less than 40 percent crown cover and less than 5 feet tall; areas may range from mainly devoid of vegetation to dominance by herbaceous species (grasses and forbs); tree regeneration generally is less then 5 feet tall and 40 percent crown cover." [3] Stands in the grass-forb stand condition are classified as clear cut patch types for this analysis.

Shrub Stand Condition - The shrub condition typically lasts from 3 to 10 years, but can remain for 20 or more years if tree regeneration fails or is delayed. Shrubs become the dominant vegetation and provide some habitat for wildlife that is different from the grass-forb condition. Tree regeneration is common, but the trees are generally less then 10 feet tall and provide less then 30 percent of the crown cover.

This stage can be defined as: "Shrubs greater than 40 percent crown canopy; they can be any height; trees less than 40 percent crown canopy and less than 1 inch dbh. When trees exceed 1 inch dbh for the stand average, they should be classified in the "open sapling" or "closed sapling" category." [46] Stands in the shrub stand condition are classified as clear cut patch types for this analysis.

Open Sapling-Pole Stand Condition - This stand condition exists when the trees reach 10 feet in height, but still have less then 60 percent crown cover. The trees generally average less then 1 inch in dbh. A dominant shrub understory is common and generally consist of vine maple, hazel, oceanspray, thimbleberry, salal, and Oregon grape. This stage may be bypassed if initial stocking densities exceed 400 to 500 trees per acre. This stage can also be reinitiated or prolonged through precommercial thinning. This stage may last from 8 to 20 years depending upon tree crown closure and subsequent stand treatments.

This stand condition is defined as: "Average stand diameter greater than 1 inch dbh and tree crown canopy less than 60 percent. Saplings are 1 to 4 inches in dbh; poles 4 to 9 inches." [46] Stands in the open sapling pole condition are classified into the sapling-pole patch type for this analysis.

Mid Seral Stage - This stage is characterized by dominance of conifers (from the time of crown closure to the time of first merchantability). This stand condition can also be called closed sapling-pole sawtimber [45] or stem exclusion stage [49]. These sites are characterized by a dense conifer stand, a closed canopy with crown cover ranging from 60 to 100 percent, and a relatively low occurrence of understory vegetation. Stands typically exhibit these characteristics between 16 and 45 years of age. [45]

The overstory trees are growing very rapidly and begin to lose the lower, deeply shaded foliage and branches. Stem growth slows down and the stem form becomes more tapered. As individual trees within the stand differ in growth rates and occupy different amounts of growing space, some trees gain a competitive advantage. Since the overstory is growing very rapidly, the larger more dominant trees begin to overtake the growing space of the smaller less competitive individuals. This process is called stand differentiation and is generally manifested first in diameter differences, and then later in height differences. Stand differentiation creates a stand with individual trees of different crown sizes and positions, as well as different heights and diameters. This allows for a classification of individual trees by canopy position or crown class -- dominants, codominants, intermediates, and overtopped or suppressed.

Species diversity decreases in most cases. These stands can change to large sawtimber and eventually old growth if thinning treatments and long rotations are used. The size and number of snags and coarse woody debris is dependant upon the stand origin. Managed stands created by forest management during the past decades tend to be devoid of large snags and downed logs. However a large number of small snags are present. These snags are created by stand differentiation and competition mortality; which tends to be the smaller sized trees in the intermediate and overtopped crown classes. Natural stands may have a greater number of snags and large downed logs that are legacies from the original forest as well as the high amounts of small snags and downed logs created by competition mortality. These existing natural stands tend to be limited in the number of large snags as a result of past fire management policies, but still have some levels of downed logs. These snags and downed logs currently present tend to be in the more advanced decay classes; classes 3, 4, and 5.[4]

This stand condition can be defined as: "average stand diameters between 1 and 21 inches in dbh and crown cover exceeding 60 percent." [46] The average stand diameter range used can overlap into the late seral stage, depending upon stand management treatments applied and the site productivity. Stands in the mid seral stage are classed in the pole-young patch type for this analysis.

Late Seral Stage - This stage typically is characterized by openings in the canopy with a corresponding increase in forbs and shrubs or the understory reinitiation stage. [49] Species diversity, although minimal, is once again beginning to increase but at a slower rate than what occurred in the early seral stage. For conifer growth, it is the time of first merchantability to the time of culmination of mean annual increment (CMAI). During this period, stand diversity is low but increasing. Stands generally exhibit these characteristics between 46 and 80 years [45]. Stands in the late seral stage are classified as pole-young patch types.

These stands typically have large numbers of small diameter snags and downed logs resulting from stand density and competition related mortality. The large diameter snags and downed logs, legacies from the previous forest, tend to be few in number, limited in distribution, and those present are typically in the more advanced decay classes. The number of legacy and small diameter snags and downed logs tends to be greater in naturally regenerated stands. Past management activities and silvicultural treatments like precommercial and commercial thinning tend to decrease the number of small snags and downed logs present in these stands .

Mature Seral Stage - This stage typically occurs between ages 81 and 195. Stand diversity is gradually increasing in response to openings in the canopy created by windthrow, disease, insects, and stand mortality.

Biomass is still increasing but at a relatively slow rate. For conifers it is the time from CMAI to an old growth state.

This stage could also be called the large sawtimber stand condition [46] that is characterized by trees with an average dbh of 21 inches or larger. The conifers usually exceed 100 feet in height with crown cover generally less than 100 percent, permitting the development of ground vegetation. Stands in the mature seral stage generally have a more open canopy than the mid seral aged stands. These stands create different wildlife habitat than smaller sized stands. Natural stands in this condition can have nearly as much standing and downed woody material as old growth stands. Stands that have had silvicultural treatments are generally lacking in standing and downed woody material. These stands also tend to lack the more tolerant, successional understory species required for the old growth stage. For this analysis the stands in the late seral stage are classified as mature or mature over young if a 2-storied stand condition is present.

Old Growth Seral Stage - This stage typically occurs after 195 years and represents climax and subclimax plant communities. The subclimax condition may persist for centuries depending on the frequency of natural disturbances. Whether in the climax or subclimax condition, old growth is characterized by 2 or more tree species with a wide range of size and age including long-lived seral dominants, decadence of the long lived dominants, a deep, multi-layered canopy, significant amounts of snags and downed logs, and openings or gaps in the canopy. More tolerant conifers (western hemlock and western red cedar) and/or shrub species occur in the understory or in the gaps and openings caused by windthrow or other disturbance. Old growth stands are optimal habitat for saprophytic plants, lichens, mosses, and liverworts. Biomass reaches a maximum and species diversity approaches the level found in the early seral stages. Forest stands in the old growth seral stage are classed as old forest or old over young if a 2-storied stand condition exists.

1 *extracted from "Analysis of the Management Situation", Eugene District Office Resource Management Plan, January, 1991. Ages altered to reflect the current Record of Decision and Standards and guidelines for Management for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.*

2 *"Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington , Part I - Chapter Narratives". Chapter 2 Plant Communities and Stand Conditions. Brown,et al. June 1985.*

3 *"Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington*, Part *2 - Appendices." Appendix 6 Brown, et al. June, 1985.*

4 *"Forest Stand Dynamics"*, Oliver, C.D. and Larson, Bruce C., McGraw-Hill, 1990.

5 *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington, Part 1 - Chapter Narratives" . Chapter 7 Snags (Wildlife Trees). Brown et al. June, 1985.*

˝' àÝøÛÒÝ Ðû êÒãú ËÒãÒÜÛÃÛãõ' éÒãÝÒøÞ' ˝ΚΚ˝' ÛðõøÒÚõÛú ûøÐÃ ·*Analysis of the Management Situation*·' ÆÝÜÛãÛ åÙÕõøÙÚõ ÈûûÙÚÛ íÛÕÐÝøÚÛ ËÒãÒÜÛÃÛãõ èÿÒã'

¸' àøÐÐã Ûõ Òÿ' ˝Κß˝' ·ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ˝ ¸ ÅüÒðõÛø ëÒøøÒõÙýÛÕ·' ÅüÒðõÛø ¸ èÿÒãõ ÅÐÃÃÝãÙõÙÛÕ Òãú ÎõÒãú ÅÐãúÙõÙÐãÕ'

˛' àøÐÐã Ûõ Òÿ' ˝Κß˝' ·ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ¸ ¸ ÀđđÛãúÙÚÛÕ'· ÀđđÛãúÙð ¯'

˘' àøÐÐã Ûõ Òÿ' ˝Κß˝' ËÒãÒÜÛÃÛãõ Ðû ÌÙÿúÿÙûÛ Òãú æÙÕü çÒòÙõÒõÕ Ùã æÐøÛÕõÕ Ðû ÌÛÕõÛøã ÈøÛÜÐã Òãú ÌÒÕüÙãÜõÐã' èÒøõ ˝ ¸ ÅüÒðõÛø ëÒøøÒõÙýÛÕ· ' ÅüÒðõÛø ˘ ÎãÒÜÕ ¨ÌÙÿúÿÙûÛ îøÛÛÕ¯'