McKenzie River Subbasin Assessment

Summary Report

February 2000

Prepared for the McKenzie Watershed Council

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McKenzie River Subbasin Assessment Summary
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The McKenzie River Subbasin Assessment was funded by grants from the Bonneville Power Administration and the U.S. Forest Service.

High Priority Action Items for Conservation, Restoration, and Monitoring

Our analysis indicates that aquatic and wildlife habitat in the McKenzie River subbasin is relatively good yet habitat quality falls short of historical conditions. High quality habitat currently exists at many locations along the McKenzie River. This assessment concluded, however, that the river's current condition, combined with existing management and regulations, does not ensure conservation or restoration of high quality habitat in the long term.

Significant short-term improvements in aquatic and wildlife habitat are not likely to happen through regulatory action. Current regulations rarely address remedies for past actions. Furthermore, regulations and the necessary enforcement can fall short of attaining conservation goals. Regulations are most effective in ensuring that habitat quality trends improve over the long period.

We see a strong need for the McKenzie Watershed Council to embrace a proactive approach to habitat conservation and restoration in order to ensure significant short- and long-term improvements in habitat quality. We recommend that these voluntary activities for the McKenzie River subbasin be based on educational outreach, conservation actions, restoration actions, institutional change, and monitoring. The most important action items are summarized on the next several pages. Following the action items are three figures highlighting key conservation areas for the lower McKenzie River subbasin.

<u>Education</u>

1. **Educate landowners and the general community about the need to give the river room to roam.** When free of riverbank development, riprap, and diking, a river has the opportunity to meander and create critical habitat features such as gravel bars, side channels, ponds, and islands. Siting houses and other infrastructure a distance from the river provides space for these important habitats. Currently, one-third of riverfront parcels in the study area are vacant. Many of these sites will be developed and some existing riverfront houses will be torn down and rebuilt during the next few decades. Educating landowners about the value of setting structures back from the river may pay dividends in both better river protection and less flood damage.

2. **Educate landowners about the importance of maintaining natural riparian vegetation along the river for the benefit of fish and wildlife**. Older trees are now scarce along the McKenzie River. When natural vegetation of various types and age classes occurs along a river, more species of birds and other animals can exist along the river. Older trees are particularly important because they result in useful snags and, when they fall over, result in large wood for riparian areas and the channel.

3. **Increase awareness of the scarcity and decline of oak woodlands and of the unique role oak trees have in supporting certain species of wildlife.** Compared to historical conditions, oak woodlands are rare in the lower McKenzie River subbasin.

4. **Educate landowners and the general community about the need to leave large wood in the river channel and in the floodplain to help maintain channel complexity, improve fish habitat, and enhance riparian conditions.** Currently, large wood in the channel and on the floodplain is very scarce due, in part, to intentional removal (firewood cutting, boat safety).

Conservation

5. **Conserve river segments that could and currently do provide good off-channel habitat and/or older forests along the river, gravel bars, side channels, islands, ponds, and willows.** Segments with the best remaining habitat include the McKenzie River between Hendricks and Hayden bridges and the Willamette River between the old and new McKenzie River confluences. Other high-quality reaches are scattered throughout the study area but occur mostly downstream from Leaburg Lake. Segments with these features usually provide preferred habitat for multiple organisms including fish, pond turtles, and birds.

6. **Conserve quality riparian woodlands with large trees for bird habitat. The highest quality habitat includes large tracts (greater than 50 acres) containing large-diameter (greater than 22 inches) cottonwoods, and an understory of ash or willow rather than introduced species.** Most of the remaining large patches of riparian woodlands are located in confluence area of the McKenzie and Willamette rivers, around the edges of the Springfield, and the lower portions of the Cedar Creek and Mohawk River watersheds.

7. **Conserve remaining oak woodland patches.** Oak woodlands are rare on the current landscape; most of the remaining large patches are located in the lower subbasin, primarily in the Mohawk River, Cedar Creek and Camp Creek watersheds.

8. **Conserve wetlands in the subbasin.** High priority wetland conservation areas are located in the confluence area of the McKenzie and Willamette rivers, and the lower portions of the Cedar Creek and Mohawk River watersheds. These portions of the study area once had the most wetlands.

Restoration

9. **Restore channel complexity in areas where human influences (reduced peak flows and channelization) have caused the river to become simplified.** Excavating the upstream ends of plugged side channels, excavating alcoves and ponds, or removing dikes and riprap can help the river occupy features that provide special habitat features for fish and wildlife. These deliberate actions are needed to restore channel complexity since peak flow dampening at the reservoirs prevents the river from doing this on its own. Channel complexity restoration options are best downstream from the I-5 Bridge in the confluence area of the McKenzie and Willamette rivers and at other locations that were historically complex such as the McKenzie River between Hendricks Bridge and Hayden Bridge.

10. **Remove invasive plants such as blackberry, reed canarygrass, and Scotch broom in riparian areas and replant with native vegetation.** Riparian areas free of invasive plants that restrict regeneration of native trees are more capable of producing habitat features important to fish and wildlife.

11. **Restore wetlands in subbasin.** High priority restoration areas include the confluence area of the McKenzie and Willamette rivers, and the lower portions of the Cedar Creek and Mohawk River watersheds, and other areas that once had important wetlands.

Institutional Change

12. **Encourage the Oregon Department of Fish and Wildlife (ODFW) to limit hatchery introductions throughout the basin.** Fish hatchery operations currently produce fish (spring chinook, steelhead, rainbow trout, and brook trout) in the McKenzie River subbasin that have potential to compete with wild native stocks and lead to the decline of wild stocks. Spring chinook is a federally listed species that faces the threat of gene dilution due to interactions with hatchery spring chinook. Bull trout is also a federally listed species and faces the threat of hybridization with introduced brook trout.

13. **Encourage ODFW to improve the accuracy of their wild chinook population assessment by eliminating the practice of introducing unmarked hatchery chinook fry into Cougar Reservoir.**

14. **Encourage the city of Springfield and Lane County to revise zoning and land use rules so that harmful development does not occur in floodplains and riparian areas.** Harmful development includes that which limits the river's meander pattern or cuts it off from its side channels, alcoves, and ponds. It also includes major disturbances of natural vegetation.

15. **Encourage the city of Springfield and Lane County to identify and eliminate sources of bacteria and fecal river contamination (e.g., failing septic systems and stormwater pipes), in Cedar Creek, Mohawk River, and the lower McKenzie River.**

16. **Encourage the US Army Corps of Engineers to seek funding to modify Blue River Dam, in order to repair the problem of warm water releases in late summer and fall from Blue River Reservoir.** The artificially warm water hinders spring chinook egg development.

17. **Encourage the US Army Corps of Engineers to transport logs trapped at the reservoirs to reaches below the dams so that the logs can continue to benefit fish habitat in downstream reaches.**

Monitoring

18. **Survey western pond turtles and their remaining habitat in the lower McKenzie River subbasin.** Little is currently known about western pond turtle abundance, how well they are reproducing, or habitat quality. Most potential western pond turtle habitat is on private land and so coordination with landowners would be needed.

19. **Identify additional tributary streams that are abnormally warm in the summer.** A subset of tributaries flowing through forest land have been measured, but few have been measured once they enter non-forest land. The survey should also identify causes and locations of abnormal warming.

20. **Conduct an investigation into why lower McKenzie River tributaries have low densities of insects that are the preferred food for salmonids.** Also, determine aquatic insect abundance in the McKenzie River main channel throughout the study area.

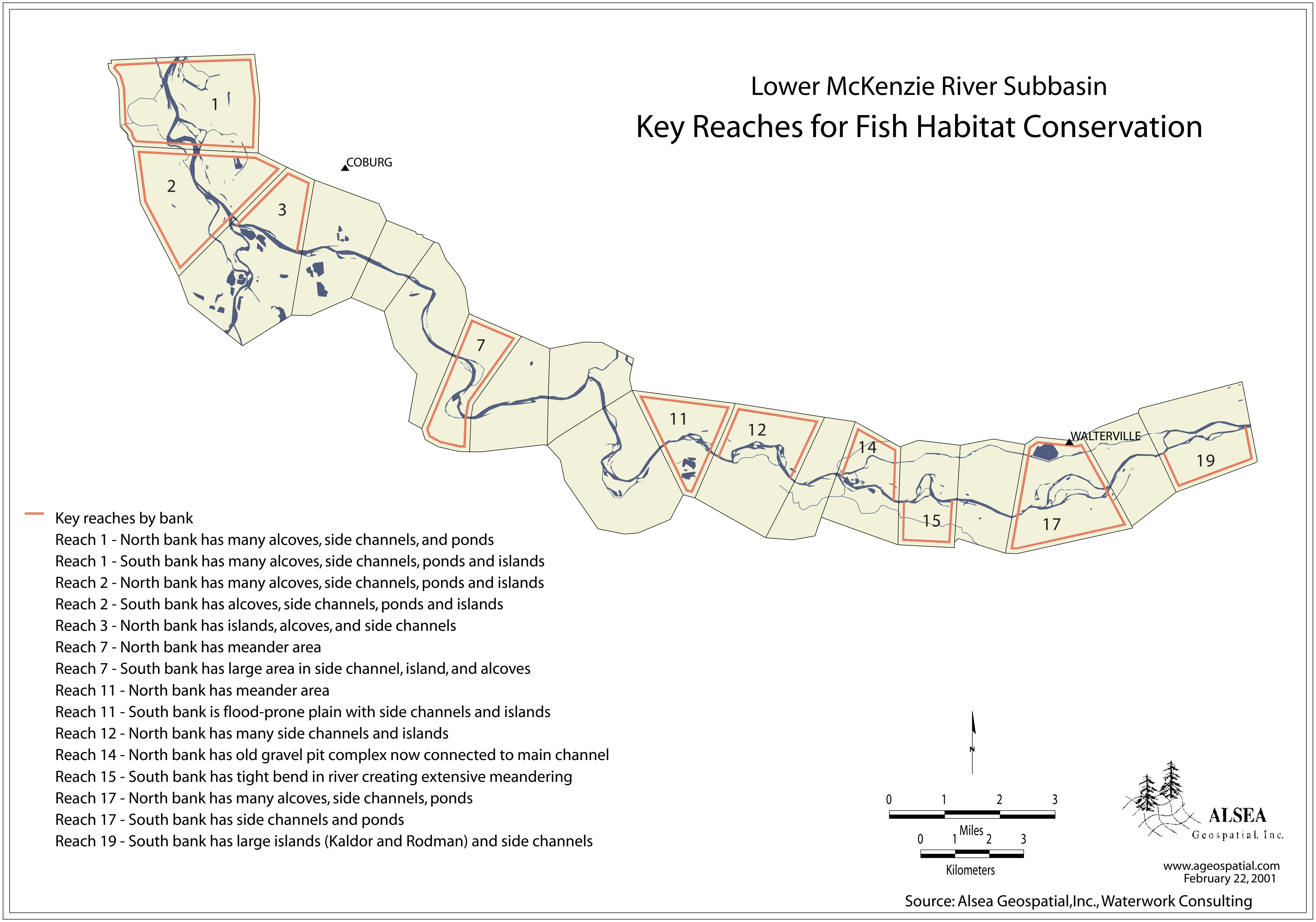
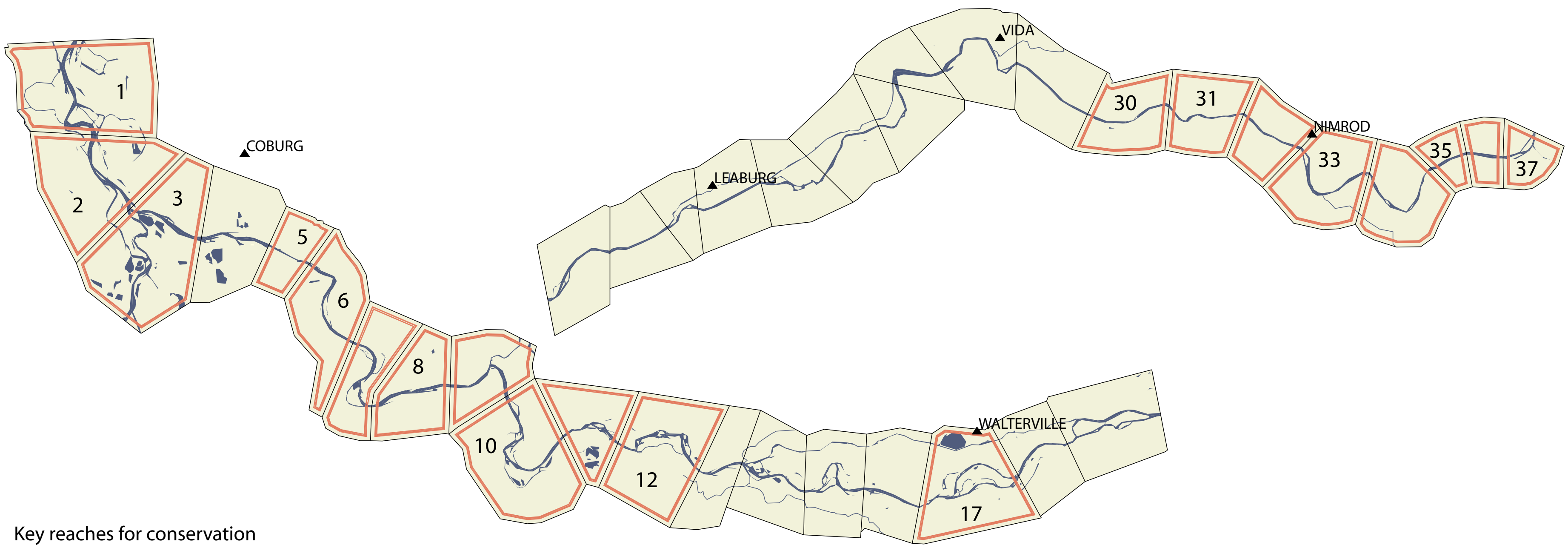

Lower McKenzie River Subbasin
Key Reaches for Fish Habitat Conservation
COBURG
WALTERVILLE
1
2
3
7
11
12
14
15
17
19
Key reaches by bank
Reach 1 - North bank has many alcoves, side channels, and ponds
Reach 1 - South bank has many alcoves, side channels, ponds and islands
Reach 2 - North bank has many alcoves, side channels, ponds and islands
Reach 2 - South bank has alcoves, side channels, ponds and islands
Reach 3 - North bank has islands, alcoves, and side channels
Reach 7 - North bank has meander area
Reach 7 - South bank has large area in side channel, island, and alcoves
Reach 11 - North bank has meander area
Reach 11 - South bank is flood-prone plain with side channels and islands
Reach 12 - North bank has many side channels and islands
Reach 14 - North bank has old gravel pit complex now connected to main channel
Reach 15 - South bank has tight bend in river creating extensive meandering
Reach 17 - North bank has many alcoves, side channels, ponds
Reach 17 - South bank has side channels and ponds
Reach 19 - South bank has large islands (Kaldor and Rodman) and side channels
N
0 1 2 3
Miles
0 1 2 3
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 22, 2001
Source: Alsea Geospatial,Inc., Waterwork Consulting

Figure 1

Lower McKenzie River Subbasin

Key Reaches for Wildlife Habitat Conservation



Key reaches for conservation
Reach 1 - Pond-turtle strongholds, riparian hardwoods, wetlands
Reach 2 - Pond-turtle strongholds, riparian hardwoods, wetlands
Reach 3 - Pond-turtle strongholds
Reach 5 - Riparian hardwoods
Reach 6 - Riparian hardwoods, oak woodlands
Reach 7 - Riparian hardwoods, oak woodlands
Reach 8 - Riparian hardwoods, oak woodlands
Reach 9 - Oak savannahs and woodlands
Reach 10 - Pond-turtle strongholds
Reach 11 - Pond-turtle strongholds, oak woodlands, wetlands
Reach 12 - Pond-turtle strongholds, wetlands
Reach 17 - Wetlands
Reaches 30-37 - Limnetic features (older conifers near river for bald eagles)

N

0 1 2 3 4
Miles
0 1 2 3 4
Kilometers

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Geospatial, Inc.

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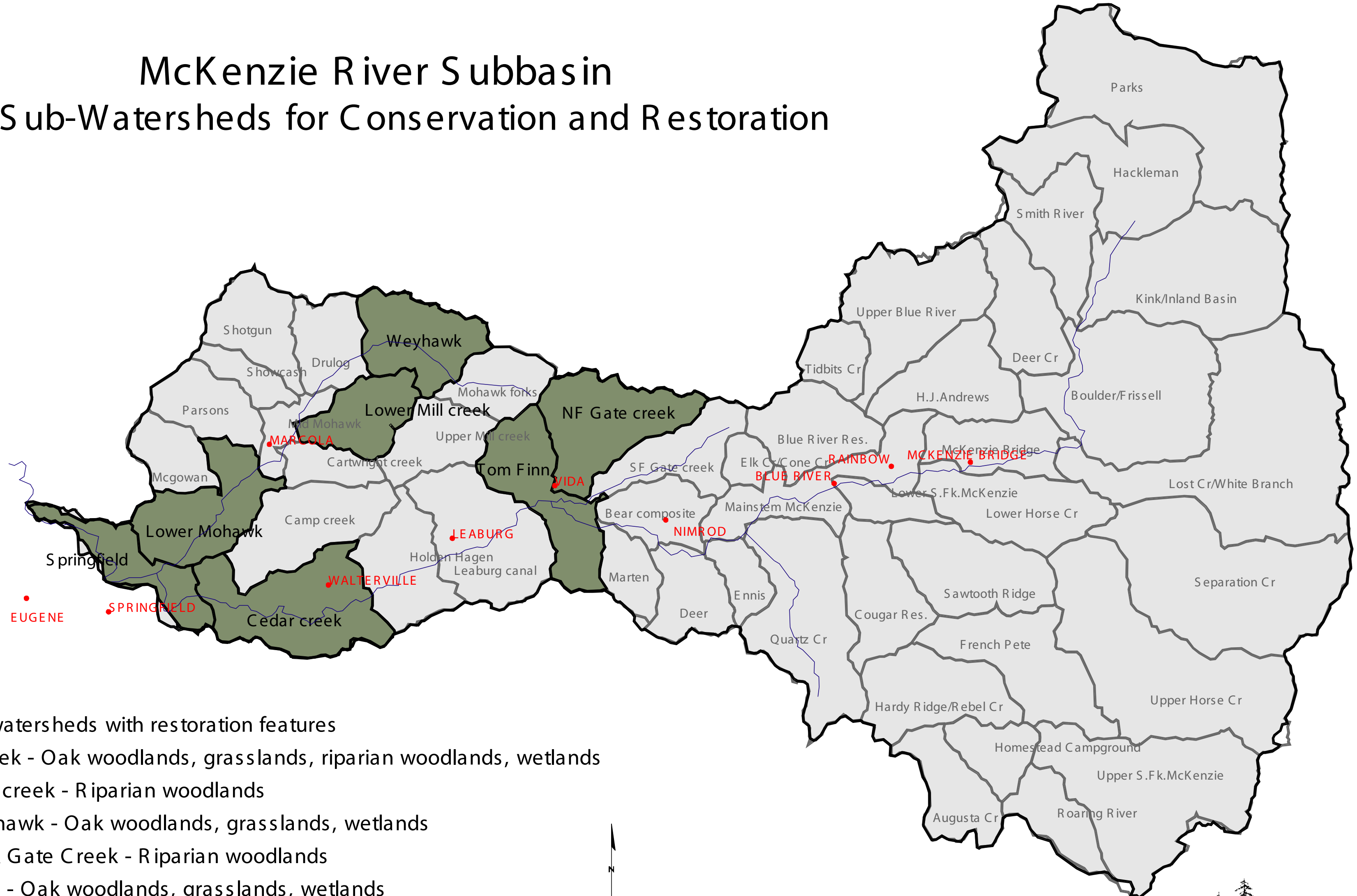
February 22, 2001

Source: Waterwork Consulting, Pacific Wildlife Research, Inc.

Figure 2

McKenzie River Subbasin
Key Sub-Watersheds for Conservation and Restoration



Key Sub-watersheds with restoration features

Cedar Creek - Oak woodlands, grasslands, riparian woodlands, wetlands

Lower Mill creek - Riparian woodlands

Lower Mohawk - Oak woodlands, grasslands, wetlands

North Fork Gate Creek - Riparian woodlands

Springfield - Oak woodlands, grasslands, wetlands

Tom Finn - Riparian woodlands

Weyhawk - Riparian woodlands

N

0 1 2 3 4 5 6 7 8 9 10
Miles

0 1 2 3 4 5 6 7 8 9 10
Kilometers

ALSEA Geospatial, Inc.
www.ageospatial.com

Source: USFS Willamette National Forest/BLM Eugene District
Source: Pacific Wildlife Research Inc. February 22, 2001

Figure 3

The McKenzie River Watershed

This document summarizes the findings of the *McKenzie River Subbasin Assessment: Technical Report*. The subbasin assessment tells a story about the McKenzie River watershed. What is the McKenzie's ecological history, how is the McKenzie doing today, and where is the McKenzie watershed headed ecologically? Knowledge is a good foundation for action. The more we know, the better prepared we are to make decisions about the future. These decisions involve both protecting good remaining habitat and repairing some of the parts that are broken in the McKenzie River watershed.

The subbasin assessment is the foundation for conservation strategy and actions. It provides a detailed ecological assessment of the lower McKenzie River and floodplain, identifies conservation and restoration opportunities, and discusses the influence of some upstream actions and processes on the study area. The assessment identifies restoration opportunities at the reach level. In this study, a reach is a river segment from 0.7 to 2.7 miles long and is defined by changes in land forms, land use, stream junctions, and/or cultural features. The assessment also provides flexible tools for setting priorities and planning projects.

The goal of this summary is to clearly and concisely extract the key issues, findings, and recommendations from the full-length Technical Report. The high priority recommended action items highlight areas that the McKenzie Watershed Council can significantly influence, and that will likely yield the greatest ecological benefit. People are encouraged to read the full Technical Report if they are interested in the detailed methods, findings, and references used in this study. The report can also be viewed on the McKenzie Watershed Council's website, listed below.

http://www.mckenziewatershedcouncil.org/library.html

A CD-ROM for computers is also available; the CD-ROM has the GIS datasets (Geographic Information System), for those who want to work with the information. To obtain the CD-ROM, call Alsea Geospatial, Inc., at 541-754-5034, or go to Alsea Geospatial's website, listed below.

http://www.alseageo.com

This summary begins with an overview of the McKenzie River watershed, which is a subbasin within the larger Willamette River basin. The summary presents the Technical Report's key issues and findings for the aquatic ecosystems, fish, wildlife species, and habitats of concern. Finally, the summary has a section on "Putting the Assessment to Work," and concludes with references and a glossary. If you're reading this summary on the CD-ROM, you can open the glossary as a separate document.

I. Watershed Overview

The McKenzie River watershed extends from the ridge of the central Cascade Mountains to the floor of the Willamette Valley, where the McKenzie River joins the Willamette River (see Figure 4, below). The river and State Highway 126 pass through several small towns including Nimrod, Vida, Leaburg, and Walterville. The river flows from one of the most remote and rugged parts of the Cascades to Oregon's second largest metropolitan area—Eugene-Springfield (Figure 5). Main tributaries include the Mohawk River, Blue River, South Fork of the McKenzie, Gate Creek, Quartz Creek, Horse Creek, and Lost Creek.

Figure 4

People have lived in the McKenzie River watershed for thousands of years. European-Americans began to settle in the watershed about 150 years ago. The watershed provides a rich variety of resources and recreational opportunities. People's uses of the watershed's resources, combined with the population growth in the cities, have altered the ecosystem significantly. For example, Figure 6 shows the changes to the river channel in the area around the confluence of the McKenzie and Willamette rivers. In 1944 the river interacted with its floodplain through a series of side channels, alcoves, islands, and ponds, providing an abundance of diverse habitats. Aerial photographs from 1910 show an even more complicated river system. Today the river is confined to a narrow course through this same area, with riprapped banks in many places. A timeline of significant events affecting the watershed is included in the Technical Report.

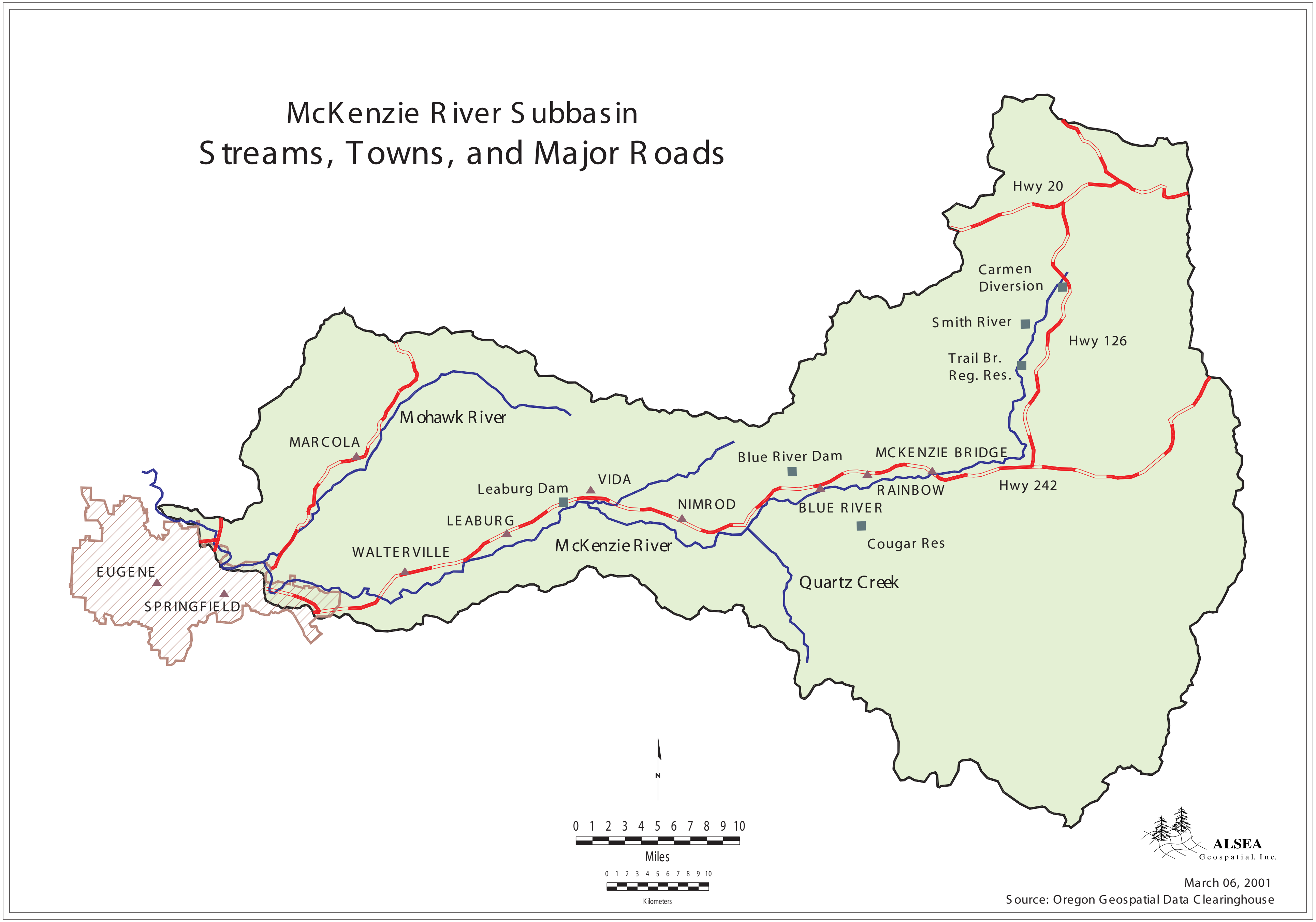

McKenzie River Subbasin
Streams, Towns, and Major Roads
Hwy 20
Carmen Diversion
Smith River
Hwy 126
Trail Br. Reg. Res.
Mohawk River
MARCOLA
MCKENZIE BRIDGE
Blue River Dam
VIDA
Leaburg Dam
RAINBOW
Hwy 242
NIMROD
BLUE RIVER
LEABURG
Cougar Res
WALTERVILLE
McKenzie River
EUGENE
Quartz Creek
SPRINGFIELD
N
0 1 2 3 4 5 6 7 8 9 10
Miles
Kilometers
ALSEA Geospatial, Inc.
March 06, 2001
Source: Oregon Geospatial Data Clearinghouse

Figure 5

Study Plan

The McKenzie Watershed Council directed the consultants to concentrate their resources on a detailed analysis of the area over which the Council has the greatest influence. Therefore this summary is concerned primarily with the lower McKenzie River subbasin and floodplain—the study area. The Technical Report places the lower subbasin in a broader watershed context, while still emphasizing watershed issues. The lower McKenzie River subbasin is primarily private property that has been changed greatly over the last century, primarily as a result of population growth and a variety of land uses. There may be significant opportunities in the lower subbasin for conservation and restoration actions. This summary identifies important linkages between the lower McKenzie River subbasin and the rest of the McKenzie River subbasin; these linkages are discussed in detail in the Technical Report.

The main channel of the McKenzie River within the study area was divided into 37 reaches, or segments, defined by changes in geomorphology, land use, tributary junctions, and/or cultural features (e.g., Leaburg Dam). Reach numbering starts at the historical confluence of the McKenzie and Willamette rivers (Reach 1), and goes upstream. The present-day confluence of the McKenzie and Willamette rivers defines the boundary between Reaches 2 and 3. Farther upstream, Leaburg Dam defines the boundary between Reaches 26 and 27; and finally, Reach 37 contains the confluence of Quartz Creek and the McKenzie River. The reaches are further subdivided into north and south bank (e.g., Reach 10N and 10S). Current land uses, such as forest, farms, or residential, were mapped within 0.5 miles of the river, using April 2000 aerial photographs. Historical photographs were used for land use delineation within 1,000 feet of the river. In this document, “historical” means circa 1944, the year when the first usable series of aerial photographs was taken of the river. The 1944 aerial photographs go upstream only to Leaburg Lake.

Land Ownership Patterns

In the upper subbasin, large contiguous blocks of federal land are managed by the USDA Forest Service. Below Blue River, federal and private forest lands are mixed in a checkerboard ownership pattern, with federal lands managed by the Bureau of Land Management (BLM), and the private forest lands owned and managed by forest industry companies. Almost all of the floodplain is private land (Figure 7).

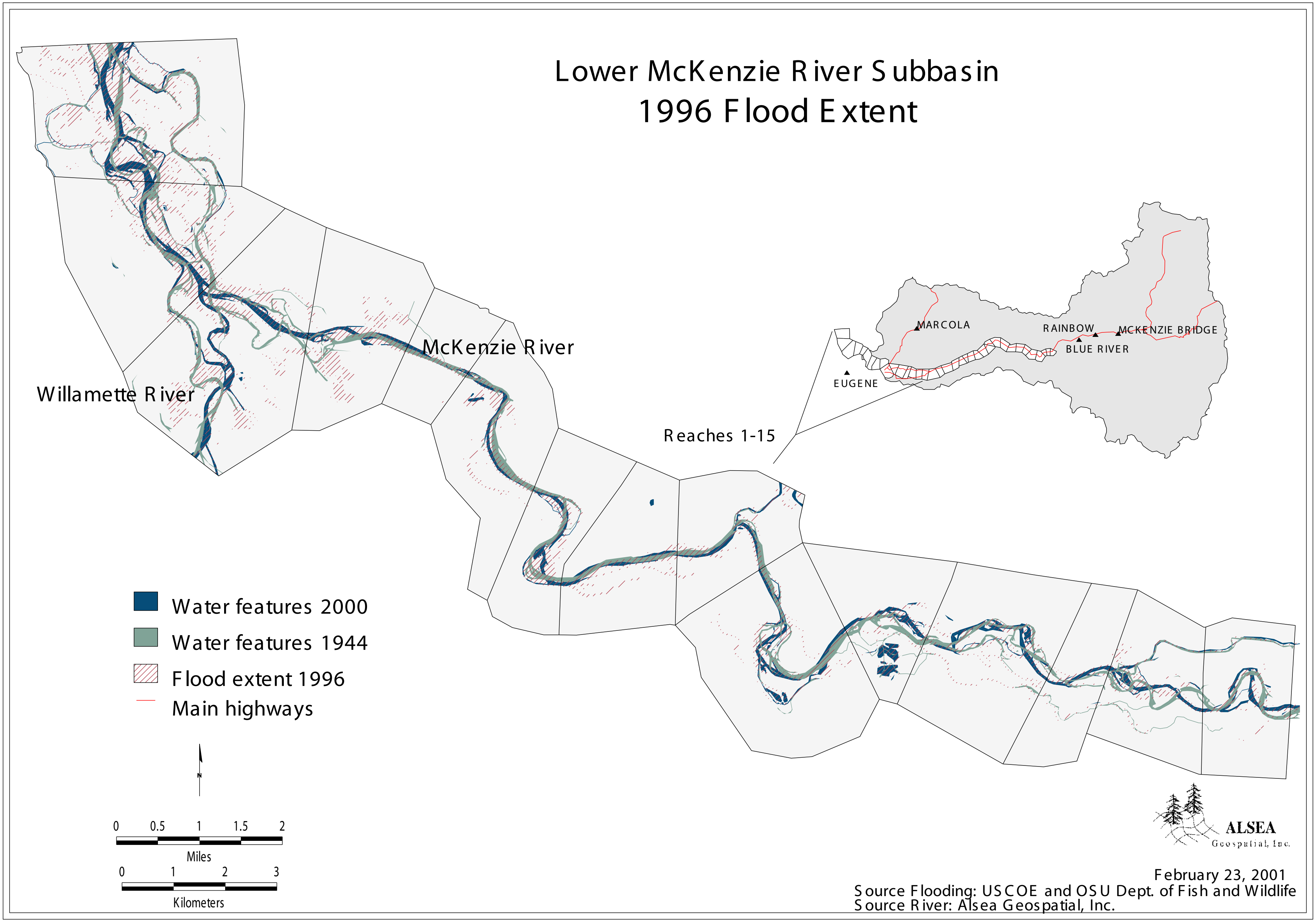

Lower McKenzie River Subbasin
1996 Flood Extent
McKenzie River
Willamette River
Reaches 1-15
MARCOLA
RAINBOW
MCKENZIE BRIDGE
BLUE RIVER
EUGENE
Water features 2000
Water features 1944
Flood extent 1996
Main highways
0 0.5 1 1.5 2
Miles
0 1 2 3
Kilometers
ALSEA
Geospatial, Inc.
February 23, 2001
Source Flooding: USCOE and OSU Dept. of Fish and Wildlife
Source River: Alsea Geospatial, Inc.

Figure 6

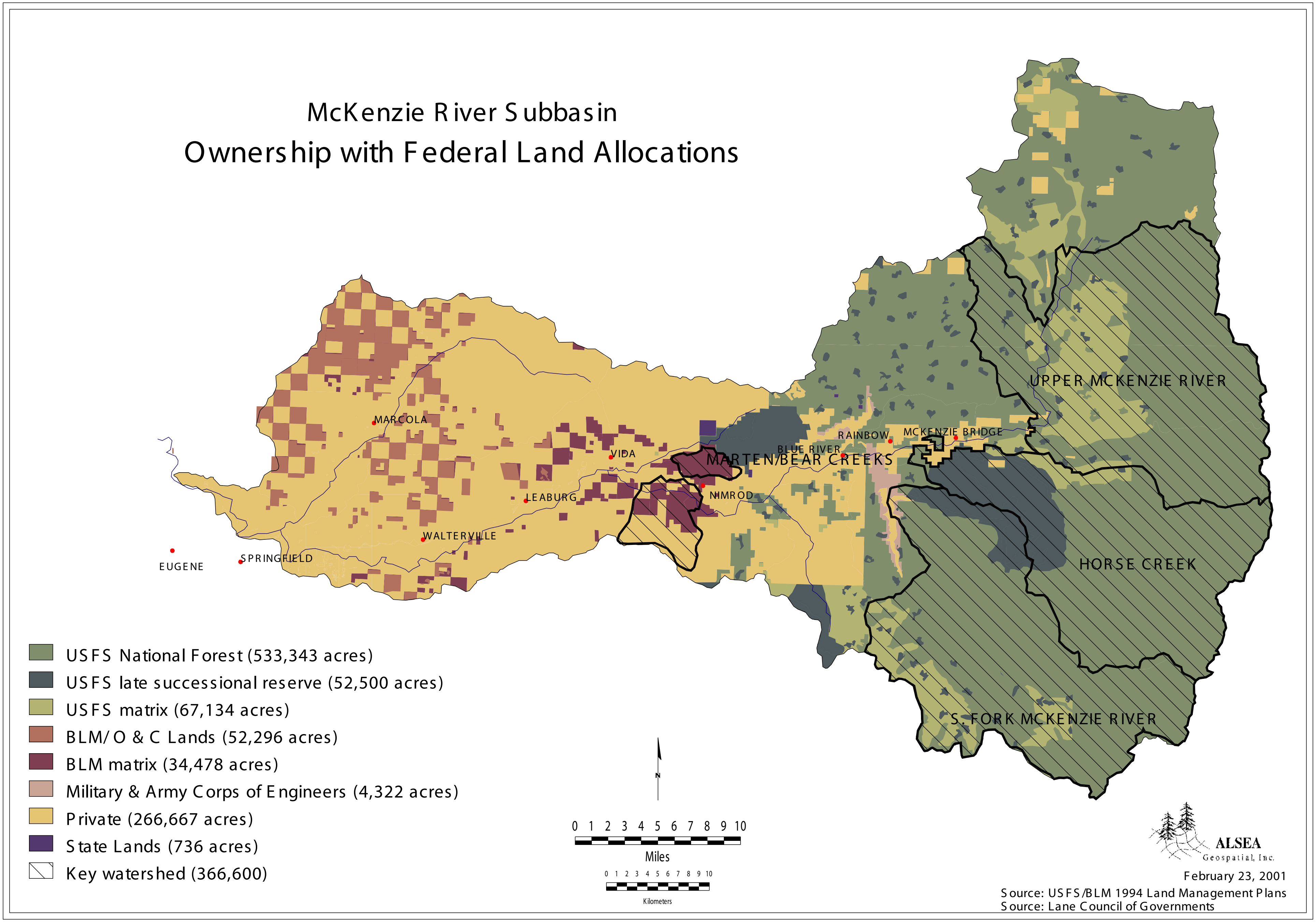

McKenzie River Subbasin
Ownership with Federal Land Allocations
MARCOLA
VIDA
LEABURG
WALTERVILLE
SPRINGFIELD
EUGENE
NIMROD
BLUE RIVER
RAINBOW
MCKENZIE BRIDGE
MARTEN/BEAR CREEKS
UPPER MCKENZIE RIVER
HORSE CREEK
S. FORK MCKENZIE RIVER
USFS National Forest (533,343 acres)
USFS late successional reserve (52,500 acres)
USFS matrix (67,134 acres)
BLM/O & C Lands (52,296 acres)
BLM matrix (34,478 acres)
Military & Army Corps of Engineers (4,322 acres)
Private (266,667 acres)
State Lands (736 acres)
Key watershed (366,600)
N
0 1 2 3 4 5 6 7 8 9 10
Miles
0 1 2 3 4 5 6 7 8 9 10
Kilometers
ALSEA
Geospatial, Inc.
February 23, 2001
Source: USFS/BLM 1994 Land Management Plans
Source: Lane Council of Governments

Figure 7

Table 1 shows land ownership in the basin, in acres and as a percent of the total, as well as ownership within the floodplain (defined as the area within 0.5 miles of the river channel) of the McKenzie River.

Table 1. Ownership in the McKenzie. Source: Lane Council of Governments, Alsea Geospatial.

Ownership	**Subbasin acres (percent)**	**Floodplain acres (percent)**
Military & US Army Corps of Engineers	4,322 (< 1%)	0 (0%)
Private	266,677 (31%)	37,842 (91%)
State Lands	736 (< 1%)	0 (0%)
USFS National Forest	533,343 (62%)	493 (1%)
Bureau of Land Management/ Oregon and California Lands	52,296 (6%)	3,068 (7%)
Total	**857,364**	**41,403**

Land Use Allocations and Zoning

Forestry is the dominant land use in the McKenzie watershed. However, in the ecologically important floodplain of the lower McKenzie, agriculture and commercial and residential development are the dominant uses. Lane County zoning and real estate values both encourage residential and commercial concentration on the valley floor, in part due to the existing infrastructure, and also due to the high desirability of such development. Approximately 4,313 acres within the floodplain are either developed or available for development. Some impacts of residential development in the floodplain are discussed below and in the Technical Report.

Land Management Regulations

The regulations for land and water management vary widely within the McKenzie River subbasin, by land ownership and type of land use. The federal, state, county, and city agencies involved in the basin are described below.

- **The USDA Forest Service and Bureau of Land Management** are the two federal agencies that manage federal forest lands in the subbasin. All federal forest land in the McKenzie River subbasin is managed according to the standards and guidelines prescribed in the *Northwest Forest Plan* and the *Record of Decision* (USDA Forest Service et al., 1994a and b). These documents prescribe standards for timber harvest, road building and maintenance, forest regeneration, and many other activities on federal lands, along with a process for developing site-specific prescriptions. The *Record of Decision* designated four areas as Key Watersheds: Upper McKenzie River/Boulder, Horse Creek, South Fork McKenzie River, and Marten/Bear (Figure 7). A Key Watershed designation indicates that a watershed analysis must be completed prior to activities and that there be no net increase in roads. Most federal land is upstream from Leaburg Dam.

- **The Oregon Department of Forestry** regulates timber harvest and management on privately owned forest lands. The agency's Oregon Forest Practices Rules prescribe acceptable logging practices, road building and maintenance standards, tree planting requirements, and requirements for leaving trees along streams. Most private forest lands in the watershed are located in the hills downstream from Leaburg Dam.
- **Agricultural practices** are addressed by a farming management plan for the watershed, developed in compliance with Senate Bill 1010. Senate Bill 1010 established a process for developing local, voluntary plans to end agricultural practices that are harmful to streams and the land. The plan for the McKenzie River subbasin is scheduled to be completed in 2002. In the McKenzie watershed, agricultural activities are concentrated on the valley floors of the McKenzie River, Mohawk River, and Camp Creek. Major crops include grass seed, filberts, and pasture.
- **Lane County** develops regulations that govern other private land use outside the urban growth boundaries of Eugene and Springfield. Lane County has developed riparian rules that are currently under review. These rules were designed to protect natural vegetation and minimize disturbance near fish-bearing streams. The county also administers land use planning and building permits outside urban growth boundaries. Springfield and Eugene regulate land use within their respective urban growth boundaries. The two cities are currently evaluating their influence on fish in the McKenzie River, Willamette River, and tributaries.
- **The Oregon Department of Environmental Quality (DEQ)** regulates point source discharges into the McKenzie River and its tributaries, as mandated by the Clean Water Act. Any business or activity that discharges water into these waterways must get a permit from DEQ, which regulates the types and amounts of pollutants allowed in the discharge. The DEQ also establishes TMDL (total maximum daily load) standards for rivers in Oregon. TMDL is the maximum amount of pollutants allowed to enter a river; DEQ then allocates the total pollution load among the different sources, and sets goals to reduce the discharges. DEQ is scheduled to establish a TMDL standard for temperature in the McKenzie River subbasin, by 2002. This new standard will establish a maximum allowable temperature for water discharged into the river, in addition to the permits' existing standards on pollutants.
- **The Oregon Water Resources Department** issues permits for water withdrawals from the McKenzie River and its tributaries. Currently, if all McKenzie River permit holders were to use their right to withdraw water at the same time, the demand would exceed the river's natural summer flows in most years. This has not been a problem only because the US Army Corps of Engineers releases enough water from Cougar and Blue River reservoirs in the summer to keep river flows higher than the natural level would be. The Oregon Department of Fish and Wildlife has obtained instream water rights for most of the McKenzie River basin, in order to help guarantee enough water flow for fish. But these instream rights were obtained in the late 1980s so they are junior to most other water rights. Under Oregon law, water rights are allocated by seniority (original date) of the right. Senior water rights

holders can use their allowed amount of water before—and to the exclusion of, if water is limited—junior water rights holders.

- **The Federal Energy Regulatory Commission (FERC)** licenses non-federal dams and hydropower facilities. The FERC-licensed dams in the McKenzie River subbasin are the Walterville project, Leaburg project, and Carmen-Smith Reservoir project, all of which are operated by the Eugene Water and Electric Board (EWEB). The Cougar and Blue River dams, which are owned and operated by the US Army Corps of Engineers, are not subject to FERC review. However, operations at Cougar and Blue River dams are subject to the Clean Water Act and the Endangered Species Act. Funding must be obtained from Congress in order to make any major changes to the two federal dams for the benefit of fish. For example, currently a water temperature control system is being installed at Cougar Dam, so that water releases from the reservoir are the same temperature that the water in the river would have been before the dam changed water flows and water temperatures. Congressional funding was granted for the Cougar project but no funding has yet been provided to remedy the water temperature problem at Blue River Dam.

- **The US Army Corps of Engineers** regulates any proposed alterations to river and stream channels and the fill or removal of materials from a channel (or wetland), under the authority of the Clean Water Act. This responsibility is generally delegated to the Oregon Division of State Lands, which reviews applications and issues permits. A permit to alter a waterway channel must also be accompanied by a water quality certification by the Oregon Department of Environmental Quality.

- **The Oregon Department of Geology and Mineral Industries** regulates gravel mining operations that occur next to the lower McKenzie River. In addition, the Oregon Department of Environmental Quality requires permits for discharging gravel pit water into the river. The Oregon Division of State Lands would regulate any gravel mining that occurred in the current river channel, but currently there are no gravel mining operations within the McKenzie River. The US Army Corps of Engineers requires permits for building dikes and constructing riprap, as well as for gravel removal.

- **The federal Endangered Species Act** lists two fish species in the McKenzie River subbasin, bull trout and spring chinook salmon, as threatened species. Bull trout live their entire lives in freshwater, and therefore the US Fish and Wildlife Service is responsible for bull trout recovery. Spring chinook salmon spend part of their lives in the ocean and are classified as marine species; this classification means that the National Marine Fisheries Service is responsible for their recovery. These two federal agencies rely on state and other federal agencies (USDA Forest Service, Bureau of Land Management, US Army Corps of Engineers) to implement recovery actions, and also they often require agencies and individuals to consult directly with them. The Oregon Department of Fish and Wildlife (ODFW) lists the western pond turtle in the “critical” category of the sensitive species list.

II. Aquatic Ecosystem

An ecosystem is defined as a community of plants, animals, and other living organisms, and their physical environment. The physical environment determines in many ways what the ecosystem is or can be. The geology of the McKenzie watershed and the natural processes that continue to shape the watershed today are major influences on the aquatic ecosystem. The geology is described briefly below (see Figure 8).

- **The upper portion of the McKenzie River watershed** comes from volcanic material that erupted between 9 million and 12 thousand years ago. Glaciers later scoured and cut the volcanic plateau. The area west of Smith River and north of Belknap Springs is composed of volcanic rock much older than 9 million years; glaciers had only minor influence on this area. From 10 million to 3 million years ago, geologic forces caused uplift and faulting in the subbasin, fracturing the mountains extensively (USDA Forest Service, 1995).

- **Massive ice fields** formed in the Cascade Mountains and slowly moved down the valleys. Three major ice ages influenced the watershed, with the first starting 1.6 million years ago and the last ice age ending 12,000 years ago. The ice fields usually melted slowly, but sometimes temporary lakes built up behind ice dams. When the ice dams gave way, massive floods poured down the valleys. Over time, glacial outwash filled the valley with gravel and cobbles and often led to major channel changes in the river. (USDA Forest Service, 1995).

- **Downstream from Hendricks Bridge on Highway 126,** the McKenzie River valley changes abruptly. An extensive terrace dominates the lower valley. The terrace is capped by a layer of fine deposits 10 to 30 feet deep. This layer was left by a series of catastrophic floods caused when a huge ice dam in Idaho was breached, reformed, refilled, and breached again repeatedly during the last ice age. Each time the ice dam was breached, the water in the huge lake behind it poured out. The flood waters raged down the Columbia River, backed into the Willamette valley, and released their load of silt (Alt and Hyndman 1996). Since the last of these catastrophic floods, the McKenzie River has cut down through the deposits to the underlying gravel and cobble.

- **Water flows are affected by the unique geology** of the McKenzie River watershed. In the upper watershed, highly porous and fractured volcanic rock and glacial deposits allow snow and rain runoff to filter down and flow far beneath the surface. As a result, it takes longer for rain and melting snow to reach stream and river channels, and the runoff does not pick up much sediment. Thus streams in the upper watershed are less likely to flood during heavy rains, and have exceptionally clear water. The same phenomenon happens to a lesser extent in the lower watershed, where the rock is less fractured and there are fewer glacial deposits. Some runoff travels slowly through the watershed's porous and fractured geology, taking months to reach the river. This slow-moving runoff adds significant amounts of cool water to the river during the summer.

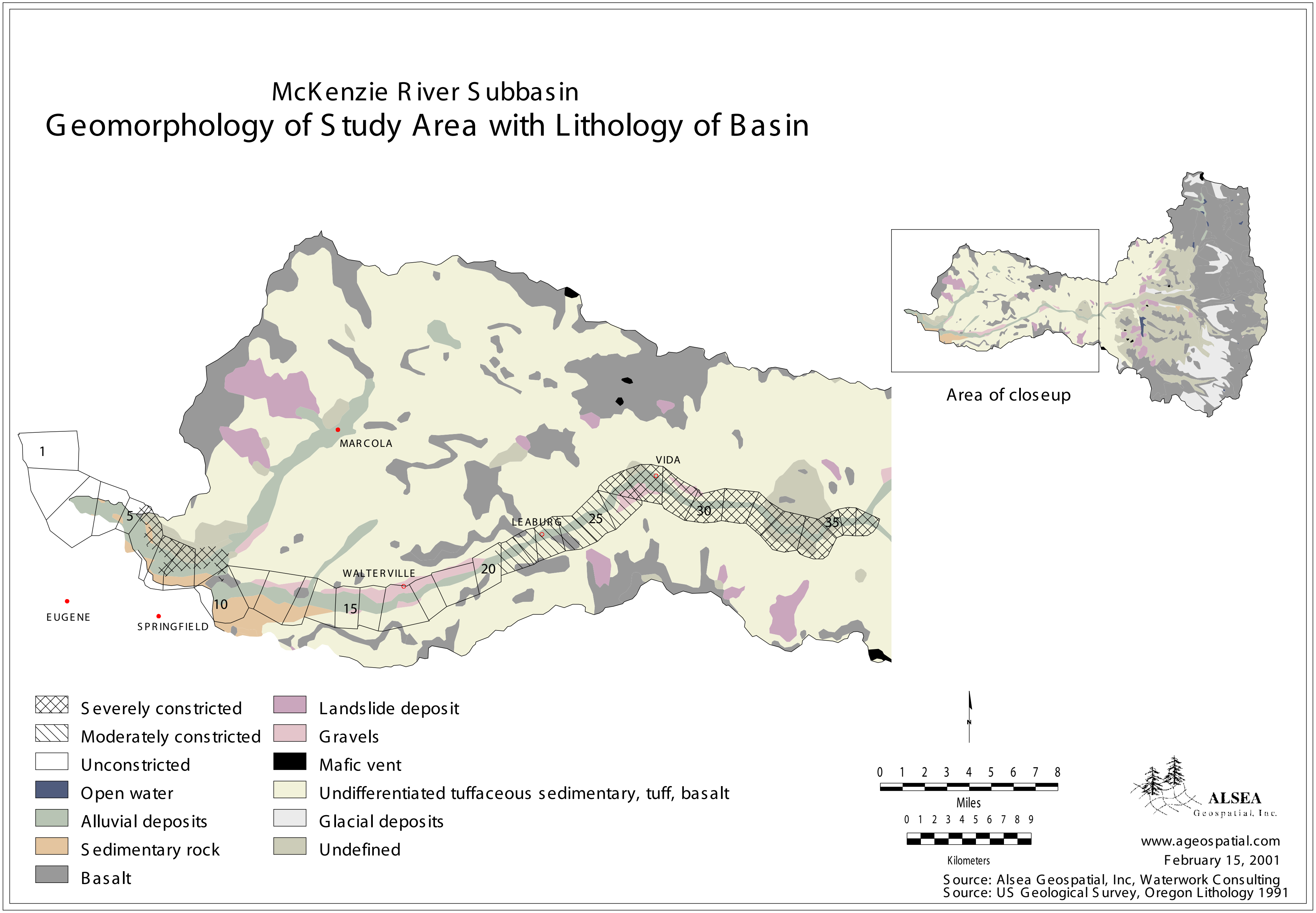

McKenzie River Subbasin
Geomorphology of Study Area with Lithology of Basin
MARCOLA
VIDA
LEABURG
WALTERVILLE
EUGENE
SPRINGFIELD
1
5
10
15
20
25
30
35
Area of closeup
Severely constricted
Moderately constricted
Unconstricted
Open water
Alluvial deposits
Sedimentary rock
Basalt
Landslide deposit
Gravels
Mafic vent
Undifferentiated tuffaceous sedimentary, tuff, basalt
Glacial deposits
Undefined
0 1 2 3 4 5 6 7 8
Miles
0 1 2 3 4 5 6 7 8 9
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 15, 2001
Source: Alsea Geospatial, Inc, Waterwork Consulting
Source: US Geological Survey, Oregon Lithology 1991

Figure 8

The watershed's natural physical features change considerably over the length of the study area. The main physical features are described below, beginning at the study area's upstream boundary, the confluence of Quartz Creek with the McKenzie River, and moving downstream to the study area's lower boundary, the confluence of the Willamette River with the old McKenzie River channel.

- **From the Quartz Creek confluence just below Finn Rock to Leaburg Lake,** the river is held in one channel by steep hills. Some old riverside terraces exist but generally are too high for the river to reach even during floods. The river drops steeply through this segment; the outstanding whitewater is evidence of the steep drop. The river bed is composed mostly of bedrock, boulders, and cobbles. Gravel bars occur mostly at the mouths of major tributaries.

- **Downstream from Leaburg Lake,** the valley widens slightly but the river is still bound by hills on the south side. The river gradient flattens somewhat, but is still steep enough to create a fast-moving current and some whitewater. The river bed has more boulders and cobbles and less bedrock than the segment upstream.

- **Between Hendricks Bridge on Highway 126 and Hayden Bridge north of Springfield,** the valley opens up and the channel gradient is low. The river meanders widely, with many side channels and other off-channel features. Here, the river terraces are low and easily flooded. The river bed is less rocky and is composed of finer gravel and sediments. In some places, where bedrock intrudes into the channel, the river drops some of its load of sediment immediately upstream from the rock obstacle. One example is the bedrock intrusion upstream from Hayden Bridge.

- **Downstream from Hayden Bridge,** the McKenzie River meanders to the north side of the valley and again becomes entrenched as it flows next to the steep rock slopes of the Coburg Hills.

- **Finally, downstream from Interstate 5,** the river enters what once was an extensive delta of multiple channels, ponds, and islands. The area is greatly simplified now, as a result of channelization and diking done to accommodate gravel mining operations at nearby gravel pits.

- **The McKenzie River enters the Willamette River** about 3 miles upstream from where it did before 1965. The old river channel now has water only during high flows. The segment of the Willamette River between the present-day confluence and the old McKenzie channel contains many islands, side channels, alcoves, and ponds. Right now there is little development next to this portion of the river.

The McKenzie River has changed greatly since European-American settlement in the watershed. Changes with potential to influence the river's ecological functions include:

- **Large logs** were once abundant in the channel, as were old streamside trees that were the source of those logs. Both large logs and old streamside trees are now scarce. Cougar and Blue River reservoirs intercept many logs from the upper McKenzie River that once would have floated to the lower river.

- **Cougar and Blue River reservoirs** dampen peak flows and provide some flood protection to downstream towns and cities along the McKenzie and Willamette rivers. In the summer, water is released from the reservoirs to improve downstream fish conditions, dilute pollution, and provide water for irrigation, industry, and cities.

- **Part of the McKenzie River is diverted into canals** at two locations in the study area. The diverted water is used to make electricity and then returned to the river downstream from the original diversion. This partial dewatering of the McKenzie River affects 5.9 miles of the river downstream from Leaburg Lake and 7.3 miles of the river downstream from Deerhorn.

- **Some stretches have been channelized and/or riprapped** to keep the river from widening its channel, changing location, or cutting new side channels.

The lower McKenzie River has excellent water quality. The water quality is of special importance to the city of Eugene, whose 200,000 residents depend on water from the McKenzie River. Water is withdrawn from the river below Walterville, so land uses throughout the watershed have the potential to affect the city's drinking water. Potential sources of water contamination include failing septic systems, stormwater from cities and towns, industrial point sources, cattle, wildlife, and spillage of toxic materials when cars or trucks are involved in accidents.

After studying the river, many fish biologists believe that there are more salmon and trout in the McKenzie River than in any other subbasin of the Willamette River. Salmon and trout are abundant for a number of reasons, including the cool water temperature in the summer, excellent water quality, good water flows in the summer, a rocky river bed, good enforcement of strict fishing regulations, and the existence of complex habitat where the river meanders and has side channels and off-channel habitats. In the future, salmon and trout populations could be hurt by increased riverfront development, further channelization, expansion of unmitigated stormwater systems, and further simplification of the river's natural complexity. The issues for aquatic ecosystems and the assessment's findings on these issues are discussed in the following pages.

Flow Regime

Issue

- Reservoirs on the South Fork McKenzie River and Blue River can potentially alter peak and monthly flows. How much do Cougar and Blue River dams influence downstream flows?

- Water is diverted from the main channel to power hydroelectric turbines at two locations downstream from Leaburg Lake. How much does this diversion affect flow in the main channel?

Findings

- Peak flows have been greatly diminished by Cougar and Blue River dams. When annual peak flows were compared, as measured at Vida, it was found that the average annual peak flows after dam completion in 1968 were only 60 percent of the average annual peak flows that occurred before dam construction.

- The highest river flow recorded before the dams were built was recorded in 1946, and it was twice the flow of the 1996 flood. Before the dams, a high flow of 31,000 cubic feet per second (cfs) occurred on a 3-year recurrence interval (that is, on an average of once every 3 years). Now, with the two large dams, the 31,000 cfs flow has an expected 100-year recurrence interval. But even though the dams dampen many peak flows, they may not be effective at controlling very large floods such as the one that occurred in 1964 (water year 1965).

- For the months between July and October, average flows are now 13 to 49 percent higher (depending on month) than average flows before dam construction. Conversely, average flows between March and June are now 8 to 27 percent lower (depending on month) than flows before dam construction. These changes coincide with reservoir filling in the spring and reservoir releases in summer and fall.

- The Leaburg power canal diversion reduces flow in the main channel for 5.5 miles and the Walterville power canal diversion reduces flow in the main channel for 7.5 miles. EWEB, the operator of these facilities, is required to leave at least 1,000 cfs of water in the McKenzie River downstream from the diversion points.

Water Temperature

Issues

- Water temperature can have significant effects on the timing of fish fry emergence and growth rates, nutrient cycling in the river, and biological activity of other plants and insects. How do the two large reservoirs and land use throughout the basin influence water temperature in the McKenzie River and its tributaries?

Findings

- The McKenzie River is cold for a large western Oregon river. The 7-day annual maximum values each year (the warmest river water temperature of the year, over a 7-day period) range from 53 to 55° F at McKenzie Bridge and 60 to 66° F near Walterville (US Army Corps of Engineers, 2000).

- Water releases from the two large reservoirs cool down the river in early summer but warm it in late summer and fall. Construction is beginning on a structure at Cougar Dam that will allow dam operators to release water taken from different levels in the reservoir. When the structure is finished, operators will be able to release water that has the same temperature that natural river flows would have, and thus they should be able to maintain water temperatures in the South Fork McKenzie River that are comparable to pre-dam temperatures (US Army Corps of Engineers, 2000).

- After water is diverted into the two power canals, the remaining water in the main river becomes slightly warmer. Computer modeling indicates that increasing the minimum flow from 1,000 to 1,500 cfs in the bypass reaches (the sections of the river immediately below the power canals) would decrease river temperature about 1° F during warm summers. Water temperature in the bypass reaches would decrease 2° F if minimum water flow were increased from 1,000 to 2,000 cfs (EA Engineering, 1994).

- The water diverted into the power canals does not warm significantly, and when the diverted water flows back into the main river, there is no net change in the river water temperature. Thus the abnormal water temperature increases in the bypass reaches are offset by reduced warming of the water in the power canals (EA Engineering, 1994).

- Most tributary streams that were sampled flowed across forest land and were less than 70° F (7-day maximum). Most had natural levels of shading except some streams that flowed through non-forest land. Shaded streams usually get warmer at a predictable rate in a downstream direction. Lack of shade or water withdrawals can cause streams to be warmer than expected for a certain distance downstream. Among tributaries that were sampled, the abnormally warm streams included South Fork Gate Creek, Deer Creek (near Quartz Creek), lower Mohawk River, Finn Creek, lower Potter Creek, and Taylor Creek.

- In spite of its unique coolness, the McKenzie River and selected tributaries (Horse Creek, Mill Creek, Blue River, South Fork McKenzie River, Deer Creek (near Belknap), and Mohawk River) have been placed on the 303(d) list as water quality-limited streams by the Oregon Department of Environmental Quality. These streams are on the list because data shows that they exceed temperature standards. The temperature standard varies according to the type of fish using the stream. At this point, further analysis is needed to determine whether the stream temperature is naturally higher than the DEQ standard or if human activities have caused it to be warmer than normal.

Turbidity and Sediment

Issues

- Suspended sediment influences the ability of sunlight to penetrate the water and reach aquatic organisms in the river and on the river bed. The turbidity created by suspended sediment also affects the ability of many fish to see their prey. How has suspended sediment in the main channel changed since the 1950s?

- Water turbidity is highly variable in the McKenzie River watershed. In the upper watershed, a significant portion of runoff flows below the surface and does not carry much sediment. In the lower watershed, streams are more likely to flow fast and above the ground, thereby picking up more suspended sediment. How does turbidity vary throughout the watershed during high flows?

Findings

- Because the dams reduce the river's peak flows, in the early 1990s the river's average annual suspended sediment load was only 60 percent of the pre-dam load, as measured in the early 1950s. Suspended sediment in the water increased as water flow increased, and this occurred at the same rate in the 1950s and the 1990s. However, before dam construction there were more days with very high peak flows than occurred after the dams were built. Thus, in most years the river carried a higher total load of suspended sediment before the dams were built.

- In 1998, turbidity sampling was done throughout the watershed during heavy rainfall. The data showed that tributaries were nearly always more turbid than the main channel of the McKenzie River. Water turbidity was highly variable during different rain storms and probably depended on localized rainfall intensity. Monitored streams with abnormally high turbidity levels included Cedar Creek, Mohawk River, Boulder Creek, Indian Creek, Gate Creek, and Ennis Creek (Runyon 2000).

- A study was done of the erosion that occurred after the major storm and flooding in February 1996. The study found that road-related landslides and landslides on forest slopes contributed equally to erosion rates. Landslide erosion rates from clearcut and replanted slopes (less than 9 years old) were over 3 times greater than erosion rates from slopes with stands more than 100 years old (Robison et al. 1999).

Water Quality

Issues

- Water quality in the McKenzie River is important for downstream communities that rely on the McKenzie River for drinking water, for fish and insects that are sensitive to nutrient levels, and for plants in and near the river. How is the water quality of the McKenzie River?

Findings

- Throughout the lower McKenzie River, there is a very low level of nitrogen available for uptake by plants. Upriver, the reservoirs release water that has slightly elevated nitrogen levels (US Army Corps of Engineers, 2000).

- There is also a very low level of phosphorus available for biologic uptake. The level declines in a downstream direction. Although many riverfront homes have septic systems near the river, the phosphorus level does not increase in river segments with a high density of riverfront homes. The reservoirs are phosphorus sinks during the summer; the result is probably a decline of primary productivity in the McKenzie River (US Army Corps of Engineers).

- Chlorophyll *a* concentrations are very low (thus, the McKenzie's clear water). Blue River Reservoir contributes higher than normal concentrations of chlorophyll *a* to the McKenzie River but Cougar Reservoir does not (US Army Corps of Engineers, 2000).

- Indicators of the McKenzie River's excellent water quality include moderate dissolved organic carbon concentrations that are relatively constant in a downstream direction, high levels of dissolved oxygen concentrations in the daytime, consistent levels of dissolved oxygen along the length of the river, and normal pH levels (US Army Corps of Engineers, 2000).

- The Mohawk River has slightly depressed levels of dissolved oxygen concentrations in the daytime, due to the Mohawk's high temperature.

- During the winter, *E. coli* bacteria levels are generally low in most of the lower McKenzie River. However, the Mohawk River and Cedar Creek occasionally have high *E. coli* levels. Bacteria levels are highest in the Cedar Creek subbasin within those tributaries that receive stormwater outfall from the city of Springfield (Runyon 2000).

- Heavy metals are at very low concentrations except for iron and copper, which are naturally at moderate concentrations (US Army Corps of Engineers, 2000).

Channel Complexity

Issues

- Channel complexity influences the quality of habitat for fish spawning and rearing. Usually, higher channel complexity creates more opportunities for fish to hide from predators, feed effectively, avoid being swept downstream during high flows, and find preferred river bed materials for egg-laying sites. How has channel complexity changed over recent decades?

Findings

- Using current and historic topographic maps, Ligon et al. (1991) determined that from 1930 to 1990, the total wetted area of the McKenzie River from Leaburg Dam to the river mouth decreased 28 percent and island perimeter decreased 41 percent.
- Using 1944 and 2000 aerial photographs, we found that the combined area of alcoves, side channels, and natural pond area is greatest within the river segment from Hendricks Bridge to Hayden Bridge and the river segment between the present-day and old McKenzie River confluence with the Willamette River. For reaches between Hendricks Bridge and the present-day McKenzie-Willamette confluence, off-channel area is slightly greater today than it was in 1944. For the upstream reach from Leaburg Dam to Hendricks Bridge, the opposite is true; there was more off-channel area in 1944.
- Channel complexity is naturally low within the upper half of the study area due to the constrained valley. In the study area's upper half, areas with channel complexity are usually limited to the confluences of major tributaries where the sediment load is dropped in the river immediately downstream from the tributary.
- Alcoves are more abundant today than they were in 1944, with most of the change occurring between Hendricks Bridge and Hayden Bridge. Conversely, side channels are less abundant today in that segment of river. It is likely that the dampening of peak flows since dam construction has allowed more side channels to become plugged by sediment at the upstream end and become alcoves. Significant side channel loss also occurred in the McKenzie River downstream from the I-5 Bridge, a result of gravel mining.
- Natural pond area was low in both years, but less in 1944 than in 2000. Currently, pond area is highest downstream from the current McKenzie-Willamette confluence and between Deerhorn Bridge and Hendricks Bridge.
- There was more island area downstream from Hendricks Bridge in 1944 than there is now. Several large islands have been lost near the McKenzie-Willamette confluence, mostly due to channelization. Upstream from Hendricks Bridge, island area is now greater than in 1944, mostly because the large McNutt Island did not exist in 1944.

Bank Hardening

Issues

- It is becoming more common along the McKenzie River to artificially harden river banks with berms and riprap in order to protect homes and businesses. Riprapped banks support a smaller number of fish and fewer fish species than natural banks. Extensive riprapping can prevent the river from meandering and creating complex features for fish. How much riprap occurs along the McKenzie River in the study area?

Findings

- Although the length of riprap bank increases each year, the majority of banks along the McKenzie River have no riprap. In the lower half of the study area, 13 percent of banks are riprapped. Only 0.3 percent of the banks are riprapped in the upper half. Riprap is most common downstream from the I-5 Bridge, due to the gravel operations. Riprap is also common in reaches downstream from Hendricks Bridge, especially along the south bank within Springfield.

Riparian Vegetation and Land Use

Issues

- Vegetation and land use patterns adjacent to the river have changed over the last 50 years due to timber harvest, development, invasion of exotic plants, conversion of one farm crop to another, and the dampening of peak flows at the dams. These changes can influence the amount of shade, organic inputs, and stream channel stability. How has riparian vegetation and land use near the river changed over the last 5 decades?

Findings

- Downstream from Hendricks Bridge, conifer stands were scarce in 1944 and are scarce today. Upstream from Hendricks Bridge, older conifers are less abundant than they were in 1944. In addition, older hardwoods (more than 40 years) are less abundant today than they were in 1944, throughout the study area.

- Downstream from Hayden Bridge, willows are now more abundant than they were in 1944. In this lower gradient segment, it is likely that dampened peak flows have allowed willows to occupy areas that were once kept bare by floods. Hardwood areas were more extensive in 1944 than they are today. Currently, most hardwood stands are less than 40 years old. A range of stand ages existed in 1944.

- Bare gravel bars and sand bars were more common in 1944 than today, especially upstream from Hendricks Bridge. This is probably because back then the river had more high flows that would uproot riparian vegetation. The exotic reed canarygrass had not yet spread across the Willamette Valley in 1944; this grass tends to quickly occupy the fringe of land near the river's edge and bind together the material found on bars or next to the river.

- In 1944, fields and orchards occupied about twice the area that they occupy today. Also, grass and brush were more common in riparian areas than they are today.

Riverfront development

Issues

- Riverfront development can interfere with ecological processes in the river. The removal of large trees to make room for houses and other infrastructure reduces the shade, litter fall, and large wood that would normally enter the river. Reduced shade can reduce the area of cool water pockets on hot days; reduced litter fall can keep much-needed nutrients from entering the river; and without large logs entering the river, preferred fish habitats such as log jams and log-initiated islands are less abundant.

- With houses close to the river, there are more opportunities for spills of toxic materials to enter the river and fecal bacteria to leach into river when drain fields fail. Furthermore, the houses and their contents can become part of the river during extreme flows.

Findings

- Two-thirds of the land parcels next to the river that are zoned as rural residential are developed. In 1944, few houses were located within 500 feet of the river due to the flood hazard. Rural residential development is most intensive between Bear Creek and Deerhorn Bridge (20 houses per mile). Since most of the choice lots are now developed, the current trend is to buy an inexpensive house near the river, tear down the house, and build a larger and more expensive house.

- Over one-third of the riverfront houses were located within 100 feet of the low-flow channel edge and nearly three-quarters were located within 200 feet of the river. Only 8 percent were located a distance of 300 to 500 feet from the river. This was surprising, since over 60 percent of all houses were rated as having a high likelihood of flooding during a 50-year flood. Many houses could have been sited on less flood-prone land simply by locating them back farther from the river.

- Natural vegetation between houses and the river was rated as intermediately or highly disturbed at 85 percent of the house sites, with nearly half of these sites rated as highly disturbed. Presumably, trees and understory plants were removed in order to obtain a better view of the river and allow more sunlight to hit the house site.

Aquatic Insects

Issues

- Aquatic insects are an important part of the aquatic food chain. Their abundance and community structure are indicators of water quality and of the insects' relative importance to various fish species. How do aquatic insect populations vary among tributaries in the McKenzie River subbasin?

Findings

- McKenzie Watershed Council-sponsored monitoring indicates that favored "fish food" insects (mayflies, stoneflies, and caddisflies) are most abundant in tributaries upstream from Quartz Creek. For unknown reasons, favored insects were mostly gone from tributaries farthest downstream in the basin (Mohawk River, Cedar Creek, Camp Creek).

Future trends for channel and floodplain habitats in the study area

Under current zoning and policies, human population growth in the watershed will probably not be a primary driver of change in most portions of the low McKenzie River subbasin simply because there are few opportunities to build. Recent analysis by Lane County indicates that of 3121 parcels within developed and committed exception areas of the watershed (excluding Springfield) only 18% are vacant under current zoning restrictions. Future demand for infrastructure (e.g. sewage treatment and potable water) is not likely to be high with such a low vacancy rate.

Development along the eastern and northern edges of Springfield may be where population growth occurs the most in the next few decades. Here, stormwater disposal, sewage treatment, and encroachment upon floodplains will be important issues.

Uses of the land will likely continue to evolve during the next decades and probably reflect changes already underway. Recreation will probably become an ever-increasing use of the river, and with it, conflicts among the various users of the river. A recent surge in the number of whitewater outfitters using the McKenzie River has highlighted the nature of these conflicts, including the unauthorized use of yards by boaters, litter, noise, and crowded conditions. House construction on now-vacant riverfront lots (one-third are still vacant) and the re-development of occupied parcels will probably be part of the conflict since recent construction has tended toward larger houses with greater disturbance of riverfront trees and vegetation. This kind of riverfront development creates a visual impact that will be greater than that which has been created by older, existing houses.

Recommendations for Conservation and Restoration of the Aquatic Ecosystem

One approach to habitat conservation and restoration is to assume that the best habitat for an organism is the habitat it evolved with. The 1944 aerial photographs help us understand how habitat features have changed during the last 56 years and where the best habitat existed, but in 1944 the river was already changed in many ways. The channel had been cleared of most wood and other obstacles to make log drives more efficient; farm land and pasture already extended into riparian areas; and large, old trees had already been harvested. So we have only a fuzzy picture of the original habitat in the McKenzie River.

An alternative approach to habitat conservation and restoration is to protect the best remaining habitat, determine which types of habitats are in short supply, determine where those limited habitats do exist, and create these important habitat features elsewhere in the river. We have adopted a blend of these two approaches, concentrating on where natural processes once created the best habitat (no matter what condition the habitat is in today), while also focusing on where much of the good habitat remains today.

The following recommendations for conservation and restoration of the aquatic ecosystem are based on this blended approach.

- Focus river habitat <u>conservation</u> efforts first on: a) reaches between Hendricks Bridge and the I-5 Bridge; and b) reaches in the Willamette River downstream from the current confluence where side channel and island habitat are most abundant. In these reaches, the river is unconstrained, the channel meanders widely, and habitat is still complex.

- Focus <u>restoration</u> efforts first on: the reaches downstream from the I-5 Bridge where high quality habitat was once abundant.

- Force channel complexity back into the lower river through restoration actions (spread the river out). Because the dams have reduced peak flows, deliberate action will have to be taken to carry out once-natural processes such as channel meandering and the creation of off-channel features. Excavated or constructed habitat features should be aligned with the main channel so that little sediment is deposited in the new features.

- Encourage the US Army Corps of Engineers to seek funding to modify Blue River Dam, in order to repair the problem of warm water releases in late summer and fall from Blue River Reservoir.

- Continue to identify warm tributary streams and determine which segments of those streams lack shade or have excessive water withdrawals. Focus first on valley-floor stream segments that do not flow through federal or private forest land. Determine the causes of warming for streams already identified as abnormally warm.

- Search out landslide-prone segments of road and repair them before landslides occur.

- Educate landowners and developers about the risks of building homes in historic landslide torrent tracks and in flood-prone areas next to the river (especially between Hendricks Bridge and Hayden Bridge).

- Encourage Springfield to locate sources of fecal contamination coming from stormwater pipes.

- Put special emphasis on protecting areas that currently have high channel complexity (McKenzie River between Hendricks Bridge and Hayden Bridge, Willamette River between the present-day and old McKenzie confluences). Expand channel complexity by opening up plugged side channels and connecting certain ponds to the river.

- Encourage the Oregon Division of State Lands to check if all landowners who are riprapping banks at riverfront homes have the necessary permits. Work with county commissioners to minimize bank riprapping when approving plans for new riverfront house construction. Look for opportunities to assist willing landowners to move the top tier of riprap back from the river and plant the resulting low terrace with trees.

- Retain scarce, older tree stands along the river. Focus conservation and restoration in reaches with abundant gravel bars and willow (indicators of a meander area). Focus vegetation restoration activities on land nearest the river that is currently farmland, grass, and brush. Consider planting Douglas-fir in well-drained locations along the lower McKenzie River, since Douglas-fir once grew there.

- Encourage Springfield not to approve further developments that go right up to the edge of the river (this has already occurred in Reach 11). Encourage county commissioners to adopt the revised riparian corridor rules and to plan for the enforcement of these rules.

- Investigate why many favored aquatic insects are missing from lower basin streams. Initiate a study of aquatic insects in the main channel (using Oregon Department of Environmental Quality methods), in order to understand insect abundance and community structure.

III. Fish Populations in the McKenzie River Subbasin

Eight families of fish, with a total of 23 species, are native to the McKenzie River subbasin. Non-native fish species now present in the river bring the total to 11 families and 31 species. Of all fish species in the subbasin, most studies have focused on those in the salmon and trout family (*Salmonidae*). The following pages discuss the most important issues for the native chinook salmon, rainbow trout, and cutthroat trout. The summary also provides brief descriptions of the status for bull trout, and mountain whitefish, three-spine stickleback and other species. The Technical Report includes full life history descriptions.

Chinook Salmon

Spring chinook are distributed in the mainstem McKenzie River from Trail Bridge Dam to the river mouth. They also use the lower South Fork McKenzie up to Cougar Dam, and lower Blue River up to Blue River Dam. Many tributaries are used by spring chinook, including Horse Creek, Lost Creek, Deer Creek, Gate Creek, and the Mohawk River. The major spawning areas in the watershed include the mainstem McKenzie River, Horse Creek, Lost Creek, 4.5 miles of the mainstem South Fork McKenzie (below Cougar Reservoir), and Gate Creek.

McKenzie River spring chinook have declined over the past several decades, a trend mirrored throughout their range. Many factors have contributed to this decline. Dams at Blue River, Cougar, and Trail Bridge block access to a significant portion of historic habitat. Road-building and timber harvest practices have degraded habitat. Unscreened diversion canals, mainstem channel de-watering below the EWEB diversions (although EWEB has increased minimum river flows significantly in recent years), warm water releases from dams, and competition and hybridization with hatchery salmon have all negatively influenced native wild spring chinook within the watershed. (Unscreened diversions are largely a past problem; EWEB has screened its Leaburg diversion and should complete screening at its Walterville diversion in the next year.) Because McKenzie River chinook must pass through the Willamette River, poor conditions there have also contributed to the decline of wild chinook.

<u>Issues</u>

- Spring chinook have migration barriers and habitat loss due to large dams at Cougar, Blue River, and Trail Bridge. In the fall, the release of warm water from Cougar and Blue River reservoirs changes the timing of chinook egg development. Hatchery-raised chinook compete with wild chinook for food and space, and interbreeding likely occurs between hatchery and wild chinook. Hatchery chinook fry are occasionally released above Cougar Dam. These fry are not marked, and so any that manage to pass the turbines at the dam and join the chinook run in the mainstem McKenzie River are counted as if they were not from a hatchery.

- Rearing habitat for chinook salmon fry and juveniles has declined in the mainstem McKenzie River. The number of islands and side channels has declined significantly since 1944, particularly in Reaches 3 to 5 and Reaches 10 to 15. Studies have shown that these habitats are crucial for fry and juvenile rearing.

Findings

- It is not currently feasible to construct fish passage around the large dams. In the fall, Cougar and Blue River dams release water that is warmer than would occur naturally. The warmer water accelerates the development of chinook eggs, and the chinook fry emerge prematurely from riverbed gravels. When fry emerge too early, they have less chance of surviving. Hatchery-produced chinook have been used extensively in the McKenzie River in an effort to bolster natural production and to provide a continuing sport fishery. Hatchery smolts compete directly with wild juveniles for food and space. When hatchery fish are released, wild fish must use their energy competing with the hatchery fish, or else move out of the area. Hatchery fish have lower overall fitness in the environment, such as lower survival rates from egg to adult, and lower spawning success as adults. When hatchery fish interbreed with wild fish, the offspring have lower fitness compared to purely wild offspring.

- The Oregon Department of Fish and Wildlife's (ODFW) current method of estimating the numbers of wild vs. hatchery chinook passing Leaburg Dam lacks precision. Also, when hatchery fish are counted as wild, agency planners are misled about the true status of the wild chinook run. The agency is planning to refine their process in order to get an accurate picture of wild chinook numbers. Until the counting technique is refined, numbers should be considered speculative.

- Chinook salmon need channel diversity to complete all phases of their life cycle. Rearing habitat would be improved by restoration of a more natural channel pattern that allows the formation of side channels and islands. Areas that would benefit the most include parts of Reaches 3 to 5 and Reaches 10 to 15.

Rainbow Trout

The native rainbow trout in the McKenzie River is formally known as the Columbia River redband rainbow trout. It is a resident fish species, which distinguishes it from the nearly identical hatchery-raised rainbow and sea-run steelhead, which have been introduced into and are still stocked in the McKenzie River.

Resident rainbow trout in the McKenzie River subbasin occur in the mainstem from Tamolitch Falls to the river mouth and in the lower portions of medium and large streams above Leaburg Dam. Rainbow trout are the most abundant game fish in the mainstem, with the possible exception of mountain whitefish. The rainbow trout are absent from headwaters, small streams, and most areas above historical barriers.

Issues

- Native rainbow trout compete with hatchery rainbow trout and non-native steelhead for food and space, and interbreeding likely occurs between wild and hatchery stocks.

- McKenzie River rainbow trout populations may be restricted by the limited amount of rearing habitat for juvenile and adult fish. Studies of habitat use below Leaburg Dam found that side channels were the most preferred habitat type; since 1944 the number of side channels has declined significantly in the lower river.

Findings

- Hatchery rainbow trout have been stocked in the McKenzie River since the early 1900s. Stocking of legal-sized rainbows began in 1947, and stocking of hatchery fingerlings (juveniles) was discontinued in the 1950s. Currently, up to 125,000 hatchery rainbow trout are stocked in the McKenzie River every year. Present-day stocking locations include the mainstem from Bellinger Landing (river mile 19) to Forest Glen Landing near Blue River (river mile 53.5), Leaburg Lake, and Blue River above Blue River Reservoir. In the recent past, hatchery rainbow trout have been stocked at many other locations in the watershed.

- Sea-run steelhead and resident rainbow trout are taxonomically the same species, but steelhead are not native to the McKenzie River. Summer steelhead smolts have been released each year since 1972 from Leaburg Hatchery. The number of smolts released has averaged about 115,000 per year since 1990. During this same period, the catch of adult steelhead has averaged about 1,500 per year. Steelhead spawning has been observed in the mainstem, but is believed to produce few returning fish.

- It is not known what effects hatchery rainbow trout and summer steelhead have on the wild McKenzie River rainbow trout. Competition for food and space can occur during two life stages. At the juvenile stage, hatchery steelhead smolts compete with wild resident juvenile trout. At the adult stage, hatchery rainbows compete with native adult trout. In 1950 about 46 percent of fish caught from the McKenzie were wild rainbow trout, but in 1983 only 11 percent of fish caught were wild. This difference probably reflects a decline in wild stocks, but also shows that hatchery fish are caught more easily. Some interbreeding probably occurs between hatchery and wild rainbow trout, but the extent and effect of this are unknown. Interbreeding with weaker hatchery stock threatens the genetic integrity of the native McKenzie River redband rainbow trout population.

- As is the case for chinook salmon, restoration of a more natural channel pattern, with side channels and islands, would improve rearing habitat for juvenile and adult rainbow trout. Reaches 3 to 5 and Reaches 10 to 15 appear to offer the most opportunity for this type of restoration.

Cutthroat Trout

Cutthroat trout are closely related to rainbow trout. The subspecies in the McKenzie River is the coastal cutthroat trout; these are native to the entire McKenzie River subbasin. Many cutthroat populations are isolated in upper reaches of the watershed.

Coastal cutthroat trout are the most widespread fish species in the McKenzie River subbasin. They are more widespread than rainbow trout because they inhabit many high-gradient streams that rainbow trout avoid. The cutthroat trout occur in most perennial streams, including areas above Tamolitch Falls, and are abundant in the lowest reaches as well. They are most numerous in the smaller tributaries and the upper portions of the mainstem river.

ODFW's "List of Wild Populations" includes 40 populations of resident cutthroat trout in the McKenzie River subbasin. The size of most of these populations is unknown, but as most populations occupy limited and isolated habitat, the numbers are assumed to be naturally small. Although timber harvest, road building, and dams have altered habitat, the population trends of cutthroat are not well known. Most populations are probably not threatened at this time.

<u>Issues</u>

- Habitat degradation in headwater streams can harm the more vulnerable, headwater cutthroat trout populations. Man-made barriers are inhibiting the migration of cutthroat trout between the mainstem and headwater spawning areas. Introduced brook trout compete with native cutthroat trout for food and space. The loss of off-channel habitat (side channels, alcoves, and other backwaters) in the mainstem is detrimental to cutthroat trout and other native species.

<u>Findings</u>

- Brook trout were introduced into the McKenzie River subbasin many years ago, and have been stocked in high-altitude lakes in recent years. Naturalized populations have established themselves in many areas of the subbasin, including Hackleman Creek, the upper McKenzie River from Clear Lake to Trail Bridge Reservoir, and the upper reaches of Horse Creek, Blue River, and the South Fork McKenzie River. In these areas, the native cutthroat trout populations are in jeopardy. Also, brook trout are known to hybridize with bull trout, thereby leading to declines in bull trout populations. ODFW occasionally issues permits allowing the stocking of brook trout in private ponds, in some cases in close proximity to the McKenzie River and its tributaries. Although these ponds may not normally have a direct connection to the river, floods often make a connection, allowing the exotic fish to enter the river.

- Habitat diversity is important for cutthroat trout. Off-channel habitats are important for fry, and for over-wintering juveniles and adults.

Bull Trout

Historically bull trout occurred in 11 Oregon subbasins within the Columbia Basin, plus the Klamath Basin. They were found in much of the Willamette Basin, including the entire McKenzie River subbasin. Today in western Oregon, bull trout are known to exist only in the McKenzie River subbasin, headwater streams of the Klamath Basin, and possibly the Middle Fork of the Willamette River. They have apparently been extirpated from other Willamette tributaries.

Three bull trout populations exist in the McKenzie watershed: the mainstem McKenzie up to Trail Bridge Dam, the mainstem above Trail Bridge Dam to Tamolitch Falls, and the South Fork of the McKenzie above Cougar Reservoir. Sub-adults have been found below Leaburg Dam and downstream to Deerhorn Bridge. Recently a single adult bull trout was caught at the mouth of the McKenzie River.

The bull trout is technically a char, closely related to Dolly Varden, lake trout, and brook trout. Bull trout are commonly classified as either river-dwelling (fluvial) or lake-dwelling (adfluvial). River-dwelling bull trout migrate within their resident river basin, using larger streams for foraging and rearing, and smaller tributaries for spawning and rearing. A river-dwelling population exists in the mainstem McKenzie River and its tributaries, primarily above Leaburg Dam. Lake-dwelling bull trout are adapted to hold and rear in lakes, spawning in small lake tributaries. Lake-dwelling populations have developed above the Cougar, Trail Bridge, and Smith dams as a result of their isolation from the mainstem population.

Bull trout populations in western Oregon have been in decline for the past several decades. The decline has been influenced by various factors, including habitat degradation from timber harvest and road construction, loss of migration corridors, competition with non-native brook trout, and population loss from fishing. Recently, bull trout populations have grown in some areas of the McKenzie River subbasin.

Mountain Whitefish

Mountain whitefish, a member of the trout and salmon family, are native to the McKenzie River subbasin, and are the most abundant game fish in the mainstem. Whitefish are a good sport and food fish, but they are not pursued as often by anglers as are the other members of the trout and salmon family. Little is known about trends in whitefish populations in the McKenzie River.

Three-spine Stickleback

Sticklebacks are common in the sloughs and backwaters of the lower McKenzie River, at least up to Leaburg Lake. As with cutthroat trout, the loss of off-channel habitat (side channels, alcoves, and other backwaters) in the mainstem is detrimental to the stickleback.

Other Species

Other native fish species in the McKenzie River include two species of lamprey, seven species of minnows, two species of suckers, the sand roller, the three-spine stickleback, and four species of sculpin (see the full species list in the Technical Report). Not much is known about the biology of most of these species. Historically lamprey were an important Native American food source, and they are a species of concern in Oregon. But little is known about lamprey populations in the McKenzie River.

Non-native fish species in the McKenzie River include introduced brown trout and brook trout, summer steelhead (discussed in the rainbow trout section), the common carp, two species of bullhead, a mosquitofish, largemouth bass, and bluegill. Of these, brook trout, which compete directly with bull trout and cutthroat trout in the upper watershed, and largemouth bass, a predator in the lower watershed, pose the most serious threats to native species.

Future trends for fish habitats in the study area

The river's dams and hydroelectric facilities will probably continue to operate much as they have in the recent past with the following exceptions. First, construction is underway to provide Cougar Dam with a variable-depth water outlet control that will allow operators to keep the South Fork of the McKenzie River at its natural temperature. This should help improve spring chinook salmon spawning and rearing. Second, a screen will be installed next year at the inlet to the Walterville canal thereby, keeping fish out of the power turbines.

Fish habitat in the main channel will likely experience only modest decreases in quality over the next few decades. The major alterations to habitat (large wood removal, peak flow dampening, and channelization) have already occurred. Future riverfront development on remaining riverfront parcels, the trend towards greater tree removal at house sites, increased demand for safe boating recreation, continued interception of large wood at reservoirs, and wood salvaging from the river will probably prevent any significant recovery of large wood loads in the lower McKenzie River.

We expect that the future trends described above will be moderated by volunteer and mandated activities that improve water quality and fish and wildlife habitat in the McKenzie River watershed.

Recommendations for Conservation and Restoration of Fish Populations in the McKenzie River Subbasin

- Identify areas along the mainstem that could be restored to provide better off-channel habitat. Compare historical maps and aerial photos to current ones to identify the best areas. High-priority areas appear to be in Reaches 3 to 5 and 10 to 15, where restoration of side channel and island habitat could benefit chinook salmon and rainbow trout populations.

- Minimize the introduction of hatchery chinook salmon into the McKenzie River, in order to maintain and expand the wild population. In recent years, over one million chinook hatchery smolts have been released annually into the McKenzie River, and this trend is projected to continue in the near future (Wade, M., ODFW, 2000, personal communication). The precise effect of this practice on the wild chinook is unknown, but may be detrimental (American Fisheries Society 2000)

- Encourage ODFW to continue improving the accuracy of their wild chinook population assessment, and to reduce the introduction of hatchery fish into the river. In addition, ODFW should be urged to consider eliminating the practice of releasing chinook hatchery fry upstream from Cougar Dam.

- Restore vegetative cover along the banks wherever possible. Stream margins with cover appear to be critical for the earliest life stages of chinook salmon.

- Encourage ODFW to examine the feasibility of limiting introductions of hatchery rainbow trout and steelhead into the McKenzie River. It is likely that hatchery rainbow trout and steelhead are negatively influencing the wild rainbow trout population. Also, encourage research on the degree to which wild and hatchery fish compete in the McKenzie River, and on the amount of interbreeding between wild and hatchery rainbow, and between wild rainbow and hatchery steelhead.

- Encourage ODFW to continue their monitoring of brook trout populations within the watershed. Also encourage ODFW to consider discontinuing the stocking of brook trout in mountain lakes, and not to issue permits to private landowners for the stocking of brook trout. It is probably not currently feasible to eliminate brook trout in the McKenzie River subbasin.

IV. Wildlife Species and Habitats of Concern

Priority Tree and Plant Communities and Bird Species of Concern

Issues

- Some tree or plant communities are naturally rare in the McKenzie River subbasin and possibly are becoming increasingly uncommon or fragmented because of human land use patterns. The McKenzie Watershed Council Technical Committee identified oak woodlands, riparian cottonwood forests, and wetlands as particularly critical tree and plant communities. (The oak is *Quercus garryanna* and the cottonwood is *Populus trichocarpa*.) Our analysis of important habitats for bird species of concern confirmed the belief that these are critical plant communities. Conservation planning will be helped by detailed information about the status and locations of these critical plant communities.

Findings for Bird Species of Concern

- We defined 21 neotropical migrant bird species, 6 other migrant bird species, 34 resident bird species, and 2 basin migrant bird species as avian species of concern in the McKenzie River subbasin. One additional species, the osprey, a neotropical migrant, was added to the species of concern list on the request of the McKenzie Watershed Council Technical Committee.

- For these bird species, important habitats in the McKenzie River subbasin include oak savannas and woodlands; grasslands; riparian woodlands; shrub habitats; lakes, ponds, and wetlands; unique habitats; and conifer forests. Some species require special habitat features such as snags, logs, burned areas, flowering plants, seed-producing plants, cliffs/waterfalls, perches for singing, mineral sites, old trees or snags near water, and embankments.

Findings for Oak Savannas and Woodlands

- Oak savannas likely no longer exist in the McKenzie River subbasin, and oak woodlands may be much less common than they once were. In the 1850s, approximately 8,785 acres of woodlands and 5,865 acres of savannas occurred in the lower watershed (Figure 9). These estimates include areas dominated by ponderosa pine or Douglas-fir as well as areas dominated by oaks; this is especially true for woodlands. Loss of oak savannas was likely caused by cutting or succession to more closed-canopy woodlands.

- Closed-canopy oak woodlands are rare on the current landscape. Our aerial survey identified 93 patches amounting to a total of 1,942 acres in the Mohawk watershed and along the McKenzie River floodplain below Camp Creek. Most remaining oak woodlands are located in the Springfield, lower Mohawk, Cedar, and Camp Creek watersheds (Table 2).

- Remaining oak woodlands are being encroached by conifers. Losses of oak savannas and changes of woodlands from historic conditions are likely due to the end of wildfires that were once set by Native Americans. Scattered, large diameter oaks may remain on agricultural lands or in conifer forests; large oaks in conifer stands cannot be observed by remote sensing methods.

Findings for Riparian Forests (including Cottonwood Forests)

- Much of the riparian forest that used to occur along the McKenzie and Mohawk rivers has been lost. Near the McKenzie-Willamette confluence and Springfield metropolitan area, the original riparian forest was an extensive gallery forest. Much of the forest land has been converted to agriculture or developments, and closed-canopy forests generally exist only as isolated patches. Between Quartz Creek and Camp Creek, the loss of riparian forest appears to be mainly due to clearcut harvesting. We estimate that approximately 18 percent of the closed-canopy forests that existed along this section in 1990 have been clearcut since then.

- The North Fork of Gate Creek, Tom Finn, Cedar, Weyhawk, and lower Mill Creek sixth-field watersheds have the most acres of closed-canopy hardwood forest (Table 2). (Sixth-field watersheds are smaller stream watersheds; see the Glossary for more information.) Some of this forest is likely to be riparian woodlands dominated by cottonwoods, ash, or willows, but much of it may be dominated by bigleaf maple and red alder. Some of it may be upland hardwood forests. Many bird species of concern seem to be associated with cottonwood and willow, and these types of riparian forests should receive priority over other types.

- Closed-canopy forests cover 18,863 acres in the study area floodplain. Of this total, 1,013 acres are mature hardwood stands. Along the lower McKenzie floodplain, hardwood forests are most extensive near the Willamette River confluence (Reaches 1 and 2), and between I-5 and the Mohawk River confluence (Reaches 5 to 8) (see Figure 10). Willows occur mostly in the lower third of the study area and in flood-prone areas (see “Riparian Vegetation and Land Use” in Section II).

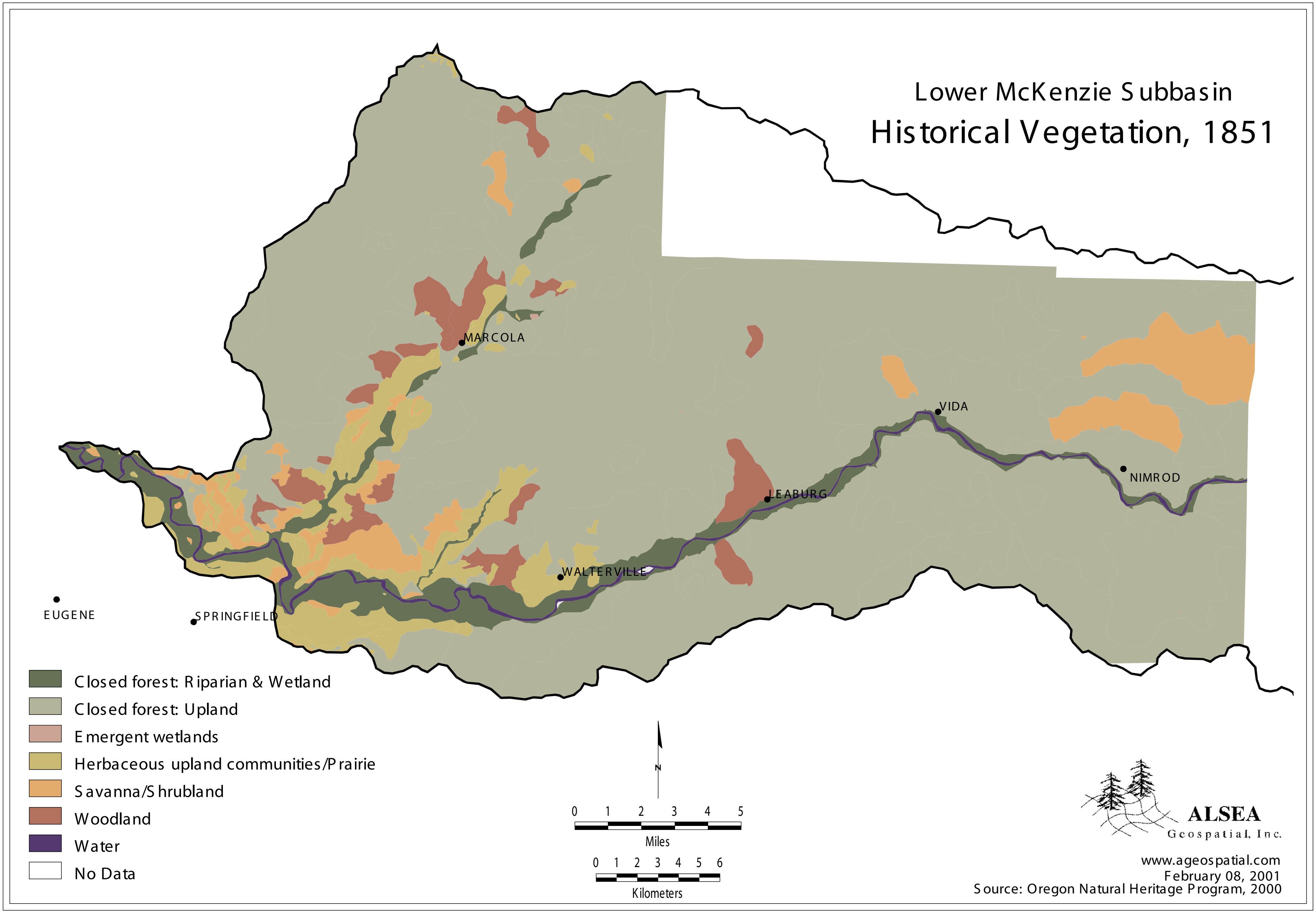

Lower McKenzie Subbasin
Historical Vegetation, 1851
MARCOLA
VIDA
NIMROD
LEABURG
WALTERVILLE
EUGENE
SPRINGFIELD
Closed forest: Riparian & Wetland
Closed forest: Upland
Emergent wetlands
Herbaceous upland communities/Prairie
Savanna/Shrubland
Woodland
Water
No Data
N
0 1 2 3 4 5
Miles
0 1 2 3 4 5 6
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 08, 2001
Source: Oregon Natural Heritage Program, 2000

Figure 5

Findings for Oxbow Lakes, Ponds, and Wetlands

- Many Willamette Valley wetlands have been lost due to agricultural practices and river channelization. Much of the open water that has been lost once occurred in secondary channels, sloughs, ponds, and oxbow lakes.

- Most alcoves, ponds, and side channels are in the lower half of the McKenzie River subbasin. Reach 17 has the most side channel area; in this reach the river's main channel is split by a large island.

- Most remaining wetlands occur in the lower watershed, in the Cedar, Springfield, and lower Mohawk watersheds. In the floodplain, wetlands are most common in Reaches 1 and 2; significant wetlands also occur in Reaches 11 and 17.

- Restoration of ponds and shallow or tree-dominated wetlands will benefit bird species of concern, pond turtles, fish, and many other wildlife species. We recommend that these habitats be conserved or restored wherever opportunities exist.

- The McKenzie-Willamette confluence and Cedar Creek area appear to have the most intact wetlands in the lower watershed; these areas should receive priority for conservation.

- On the McKenzie floodplain, ponds and off-channel aquatic habitats are most extensive near the confluence with the Willamette River. The three reaches in this area contain approximately 30 percent of the floodplain's ponds and off-channel habitats.

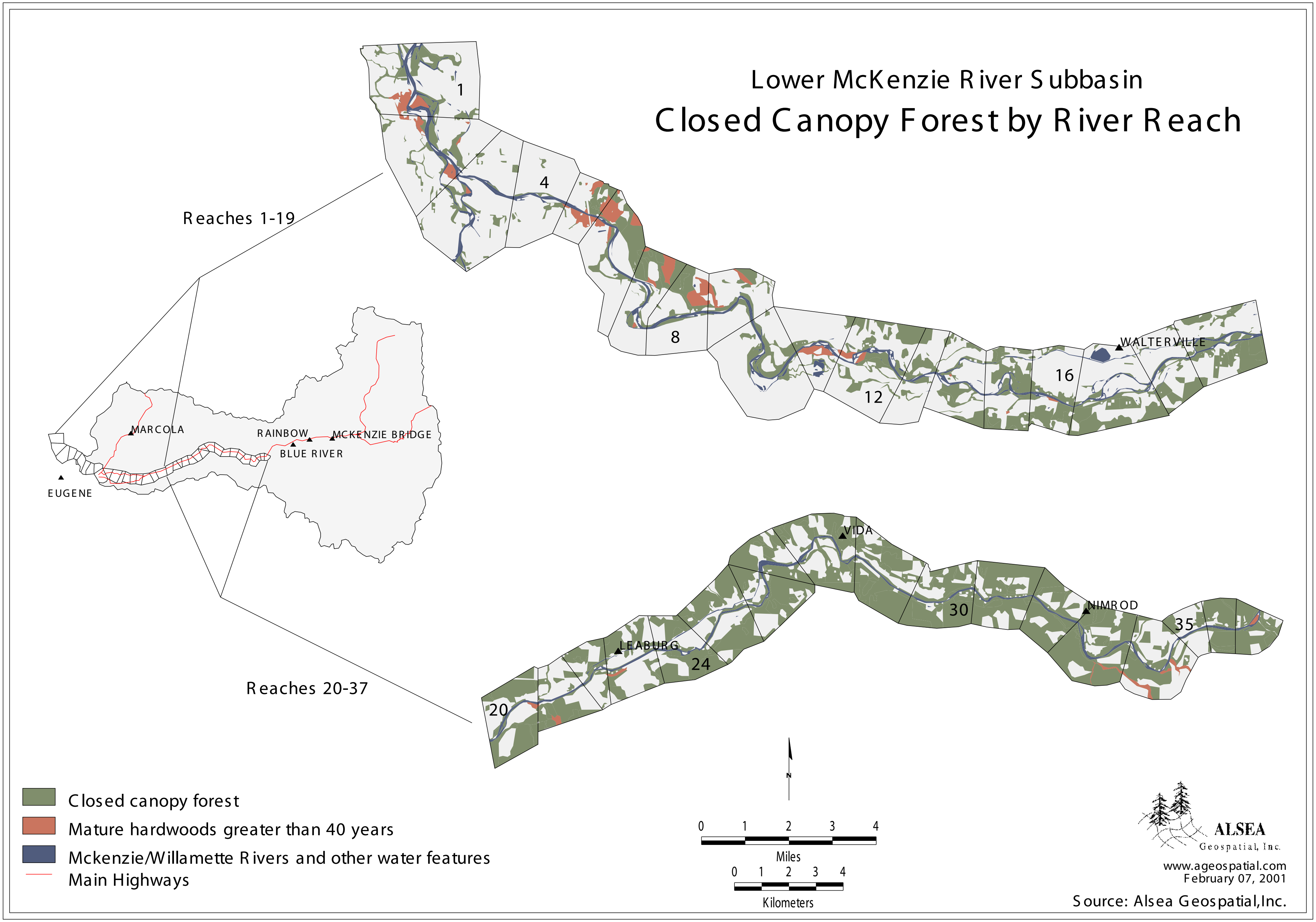
- On the McKenzie floodplain, major shallow and/or tree-dominated wetlands are located near the Willamette River, Mohawk River, and Camp Creek confluences.

Findings for Grasslands

- Prairie habitats once occurred near the lower McKenzie and Mohawk rivers. Because satellite photographs lumped many types of grass cover together or with other cover types such as crops, we were unable to determine how much grassland currently occurs or the locations of grasslands with outstanding potential for conservation or restoration.

- Very little information exists on what species of grassland birds actually nest or winter in the McKenzie River subbasin. A systematic survey of potential grassland habitats is needed to determine which species nest in the basin and to identify additional important characteristics of the grasslands that they use.

- The Cedar, Springfield, and lower Mohawk sixth-field watersheds are the most likely to contain suitable grasslands for conservation or restoration (Table 2). In addition, a population of vesper sparrows, a rare grassland bird species, is known to occur in the area of Coburg Ridge, which includes portions of the Springfield and lower Mohawk sixth-field watersheds.



Lower McKenzie River Subbasin
Closed Canopy Forest by River Reach
Reaches 1-19
Reaches 20-37
1
4
8
12
16
20
24
30
35
WALTERVILLE
VIDA
LEAKBURG
NIMROD
MARCOLA
RAINBOW
MCKENZIE BRIDGE
BLUE RIVER
EUGENE
Closed canopy forest
Mature hardwoods greater than 40 years
Mckenzie/Willamette Rivers and other water features
Main Highways
0 1 2 3 4
Miles
0 1 2 3 4
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 07, 2001
Source: Alsea Geospatial,Inc.

Figure 10

Table 2. Total acres of various potential habitat-types in sixth-field watersheds of the lower McKenzie River subbasin; some habitat types contain coverage of other non-suitable habitat types and are listed below. The highest 5 values for each category are shown in bold type (see Figure 2 for locations of watersheds).

	Oaks	Grassland			Riparian Woodland	Water	
Watershed	Oak woodlands[1]	Pasture/natural/ x-mas tree farm[2]	Bare/ fallow[3]	Field crop[4]	Closed-canopy hardwood	Wetlands[5]	Water
Bear Composite	0	109	8	1	486	5	77
Camp Crk.	**52**	**1623**	**32**	**409**	760	**76**	1
Cartright Crk.	0	207	3	17	190	16	0
Cedar	**335**	**4110**	**153**	**795**	**1472**	**734**	**272**
Deer	0	1	0	0	586	0	0
Drulog	0	749	17	14	737	75	0
Ennis	0	1	0	0	499	0	0
Holden Hagen	0	751	11	**201**	910	16	**88**
Leaburg Canal	0	543	**24**	20	**1350**	58	**85**
Lower Mill Crk.	0	796	10	12	967	65	0
Lower Mohawk	**451**	**3301**	**68**	**662**	876	**486**	5
Marten	0	3	0	0	208	0	0
McGowan	0	318	3	29	412	44	0
Mid-Mohawk	0	**1232**	18	173	303	**96**	0
Mohawk Forks	0	0	0	1	1032	0	1
NF Gate Crk	0	70	12	0	**2078**	0	0
Parsons	0	510	12	43	323	26	0
SF Gate Crk	0	12	2	0	556	0	0
Shotgun	0	37	2	0	412	9	0
Showcash	0	77	1	0	170	4	0
Springfield	**1098**	**2435**	**185**	**721**	880	**486**	**418**
Tom Finn	0	272	9	4	**1815**	10	**90**
Upper Mill Crk.	0	17	0	0	849	0	0
Weyhawk	0	229	11	0	**1451**	2	0
Total	1942	17403	581	3102	19322	2208	959

1) Derived from ODFW coverage of oak woodlands in the Willamette Valley. n/a = no data available for this watershed.
2) Pastures, natural grasslands, and Christmas tree farms would be used by a variety of grassland birds; some species will use only natural grasslands and pastures, thus these habitats may be underrepresented for those species.
3) Bare or fallow fields would be used only by species of grassland birds that use bare ground (killdeer, horned lark, and common nighthawk)
4) This cover class includes cultivated grasslands as well as other field crops such as strawberries and squash. Grassland birds would not be likely to use non-grass field crops.
5) Derived from a combination of NWI data and the wetland data from the McKenzie reach landcover map.

Western Pond Turtles

Issues

- Western pond turtles (*Clemmys marmorata*) are listed in the "Critical" category in the ODFW list of sensitive species (ONHP 1998). This category is reserved for species that may become eligible for the state threatened and endangered species list if immediate conservation actions are not taken to ensure the continued persistence of the species. The McKenzie Watershed Council Technical Committee also has identified the western pond turtle as a species of concern (C. Friesen, personal communication, 2000). The most extensive study of western pond turtles in the Willamette Valley estimated that their historic geographic range in the McKenzie River subbasin extended from the valley floor to approximately Camp Creek (Holland 1994). Most pond turtle populations exist on, or are surrounded by, privately owned lands where biodiversity management is of secondary importance to other land uses.

Findings

- We documented a total of 20 observations of pond turtles between the McKenzie's confluence with the Willamette River, and Blue River Reservoir above Blue River (Figure 11).

- Suitable aquatic habitat for pond turtles is rare along the McKenzie River. Less than 0.5 percent of the water surface area in the study area was classified as being capable of supporting the species.

- Pond turtles also use riparian and upslope areas for nesting and over-wintering. These essential habitats were more available throughout the study area. However, the model we used to map terrestrial habitat did not include some important factors that could modify habitat quality (e.g., soil characteristics, vehicle traffic patterns). If these data were available and could be incorporated into the model, we anticipate that there would be less actual high quality terrestrial habitat for pond turtles than the maps in this report show.

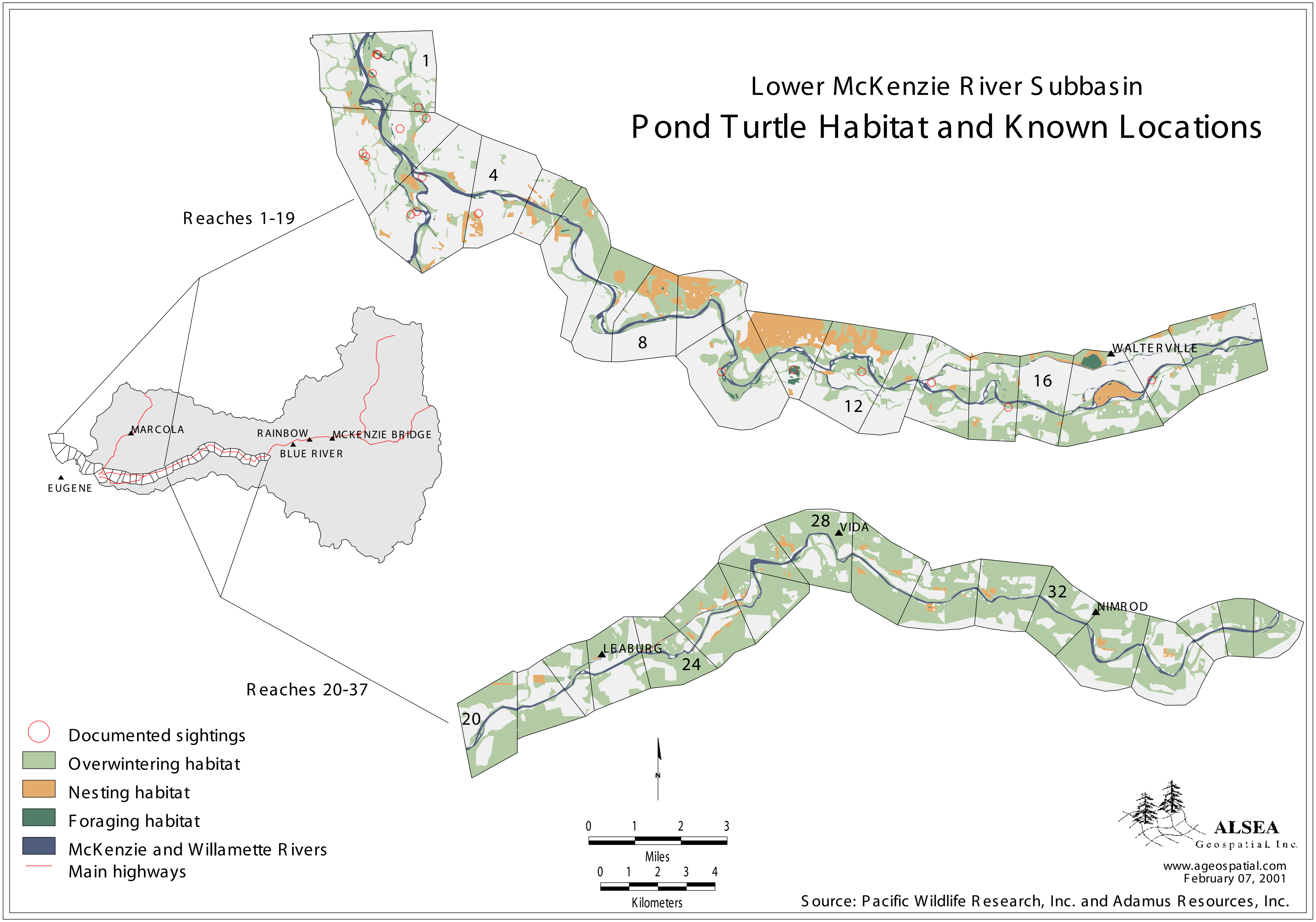

Lower McKenzie River Subbasin
Pond Turtle Habitat and Known Locations
Reaches 1-19
Reaches 20-37
1
4
8
12
16
20
24
28
32
MARCOLA
RAINBOW
MCKENZIE BRIDGE
BLUE RIVER
EUGENE
WALTERVILLE
VIDA
NIMROD
LEABURG
Documented sightings
Overwintering habitat
Nesting habitat
Foraging habitat
McKenzie and Willamette Rivers
Main highways
0 1 2 3
Miles
0 1 2 3 4
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 07, 2001
Source: Pacific Wildlife Research, Inc. and Adamus Resources, Inc.

Figure 11

Future Trends for Priority Tree and Plant Communities, Habitat for Bird Species of Concern, and Western Pond Turtles

The Technical Report has more detailed information on the abundance, distribution, and health of priority tree and plant communities; populations of and habitats important for bird species of concern; and western pond turtles. Future trends will depend on many factors, including the location and extent of development, trends in land-use patterns, and natural disturbances such as fire or floods. In addition, the size and health of populations of wildlife species will be related to large-scale factors. For example, for western pond turtles, their ability to persist in the McKenzie River subbasin will likely depend on the ability of the Willamette River basin, as a whole, to support pond turtles.

Although future trends are difficult to predict, some generalizations can be made.

- Key habitats or turtle strongholds that are near the cities of Springfield and Eugene or along the banks of the McKenzie River are most at risk to be lost, due to development.

- Key habitats in rural areas are less at risk from development, but are not impervious to such risks.

- Remaining groves of cottonwoods and oaks are at risk of being lost, because they are close to areas likely to be developed (near cities or along the banks of the McKenzie River), and they can be lost when land is cleared for other uses such as agriculture, farming, or firewood-cutting.

- Habitats such as oak woodlands and grasslands may be lost as conifers grow into the areas, if the existing areas are not actively managed to keep them as oak woodlands and grasslands.

Recommended Conservation Actions for Wildlife Species and Habitats of Concern

Prioritization

The McKenzie River Subbasin Assessment Steering Committee set priorities for the various issues during the scoping phase of the assessment. The committee defined particular species and vegetation types on which the consulting team was to focus.

Based on the steering committee's objectives and our research, we conclude that some parts of the ecosystem are critically in need of conservation planning if they are to be maintained in the lower McKenzie River subbasin.

Birds most at risk include the western meadowlark, willow flycatcher, yellow-breasted chat, and other bird species associated with lowland habitats. Tables in the Technical Report list bird species that need conservation work in the Willamette Valley and western Cascade lowlands.

Among the priority tree and plant communities, savannas and native grasslands likely no longer exist in the McKenzie River subbasin as functional, fire-maintained ecosystems. Alternative agriculture systems patterned after native valley ecosystems may offer a solution to managing biodiversity while meeting landowners' other objectives. We recommend that the McKenzie Watershed Council further assist this work in the McKenzie River subbasin, to the extent appropriate within the council's mission. The Technical Report lists specific recommendations for restoration, conservation, and monitoring.

Conservation

Conservation approaches include a wide range of possible actions designed to conserve species of concern and also conserve environments capable of supporting these species. Our assessment has identified the locations of priority habitats and sightings of some vertebrate species of concern. The McKenzie Watershed Council has a variety of options to conserve critical components of biodiversity. We propose that the council consider the following actions:

- Encourage Lane County and city governments to manage for native ecosystems in public parks and greenspaces. The McKenzie Watershed Council could foster partnerships among park managers, ecologists, and landscape designers to seek innovative approaches for preserving large-diameter oaks, wetlands, and riparian woodlands, while improving recreational and educational opportunities in parks.

- Identify and contact landowners who own properties with the oak woodlands, wetlands, and pond turtle strongholds that we identified in this assessment. Provide educational programs for owners of properties with habitats at risk. Educational programs should emphasize the ecological significance of their land and teach known methods to maintain crucial elements of biodiversity.

- Sponsor a systematic survey of western pond turtles in the lower McKenzie River subbasin. Identify key aquatic and nesting habitats used by each population of turtles. Determine specific threats to the viability of each population.

- Several bird species need conservation help. These birds are associated with key vegetation types in the McKenzie River subbasin. See the Technical Report for more information. We encourage the McKenzie Watershed Council to take an active role in preserving habitats important for these species.

Restoration

Ecological restoration usually involves the reconstruction of native or semi-natural ecosystems on degraded lands, or the reintroduction of native species. Restoration opportunities exist in the lower McKenzie River subbasin for almost all of the wildlife habitats and priority tree and plant communities we assessed. Some examples of restoration projects include:

- The Bureau of Land Management's Eugene District has already begun an oak woodland restoration program on their lands in the McKenzie area. However, higher quality stands exist on neighboring, privately owned woodlands. The McKenzie Watershed Council could assist oak woodland restoration by encouraging active oak management on neighboring woodlands. Public land managers and private small woodland owners are likely to achieve greater success in restoring large woodlands and reducing woodland fragmentation by working across property boundaries. Potential actions by the McKenzie Watershed Council could include arranging free or low-cost woodland restoration planning to private landowners; this planning would be done by professional foresters with experience in oak silviculture and knowledge of resource conservation incentive programs.

- It is likely that no native grassland-oak savannas remain in the McKenzie River subbasin. It is unlikely that prescribed fires to maintain savannas would be permitted by landowners and concerned parties in the lower watershed. Researchers at Oregon State University, Oregon Department of Fish and Wildlife, and other organizations are identifying agro-forestry methods that may develop agricultural landscapes that function similarly to native savannas for some wildlife species. The McKenzie Watershed Council could encourage landowners to try new agricultural systems by identifying resources such as educational programs, professional consultation, and incentives that reduce the economic uncertainty associated with new approaches to farming and ranching (see “Conservation Partnerships and Educational Opportunities”).

- Western pond turtles have been identified by ODFW as a species in critical need of conservation planning. Our analysis identified the confluence of the McKenzie and Willamette rivers as the area with the greatest potential for establishing turtle strongholds in the lower subbasin. The McKenzie Watershed Council could assist habitat restoration in the confluence area by fostering partnerships between conservation biologists and gravel pit operators. Turtles use flooded gravel pits, but nesting habitat suitability would likely be increased with restoration actions.

V. Putting the Assessment to Work

We synthesized existing data, produced new data through surveys and analysis, and produced new databases and maps in our work. The maps are part of a GIS, or Geographic Information System, and are based on digitized information. There are many opportunities to put this information and the findings to work. Just a few of those opportunities are mentioned briefly in this section.

Conservation Partnerships and Educational Opportunities

In our research we found several other ongoing conservation projects, ecological monitoring studies, and educational opportunities relevant to the McKenzie River subbasin. We recommend that the McKenzie Watershed Council explore the feasibility of partnerships with groups whose goals are similar to the council's goals. The Technical Report lists brief descriptions of existing conservation efforts and educational opportunities that are ongoing, completed, or likely to be active in the future.

Identifying Reaches with High-Quality Existing and Potential Fish Habitat

In this section we present a method for scoring fish habitat quality within reaches of the McKenzie River. We scored habitat quality for 1944 and 2000 conditions, using information obtained from aerial photographs. In addition, we had limited field survey information for 2000. The objective was to identify areas or reaches (by north or south side) that currently have high-quality fish habitat or those that had high quality in 1944. Scoring fish habitat quality can help to identify areas that are high priorities for conservation or restoration.

The study area started at the old confluence of the McKenzie River and the Willamette River, and continued up the McKenzie River about 48 river miles to the confluence of Quartz Creek with the McKenzie River. The 1944 aerial photographs extended only to Leaburg Lake so upstream information was not available for 1944.

In this section we present results of modeling for juvenile chinook salmon, the fish species that was the focus for habitat conservation and restoration in this study.

Method

It can be complicated to characterize habitat quality when more than one variable is involved, because parameters may not be measured in common units and some parameters may contribute more than others to overall habitat quality. One way to address this problem is: 1) transform each parameter or variable to a common scale; 2) assign a weight to each variable; and then 3) add the weighted scores for all variables.

- The first step is often referred to as "standardizing the values of a parameter." For our analysis, the reach with the highest value was assigned a score of 1 and the reach with the lowest value, a score of 0. All other reaches were assigned a value that falls between 1 and 0, in proportion to their place in the original distribution of values. The equation for this calculation is:

$$\text{STANDARDIZED VALUE} = (X-X_{MIN}) / (X_{MAX}-X_{MIN})$$

- In the next step, weights were assigned to a set of variables. Here, we made choices about which parameters were more important than others for overall fish habitat quality. For example, water area within alcoves may be considered a strong benefit to fish and be assigned a weighting of +3; the area of riparian forest more than 40 years old may be considered a less important factor and assigned a weight of +1. Parameters that indicated harm to overall fish habitat quality were assigned a negative weight. For example, riprapped banks may be considered a negative influence on fish habitat quality and were assigned a weighting of –1.

- The third step involved a simple addition of the parameter values after they had been multiplied by their weights. The sum of weighted values was then standardized in order to end up with final scores that range from 0 to 1.

This method of enumerating habitat quality is highly flexible; variables can be added or subtracted as desired, and weightings can be changed as knowledge increases about the contribution of each variable to overall fish habitat quality.

Juvenile Chinook Habitat Quality

In the following analysis, we chose which variables to include and their weights, in order to evaluate habitat quality in the McKenzie River for juvenile chinook salmon. These fish use a wide variety of habitat features during the six to eighteen months that they rear in the river. This selection of variables and their weights also generally applies to rainbow trout and cutthroat trout, but not to mountain whitefish which rear almost exclusively in the main channel. For mountain whitefish and native fish that are not salmonids, a subset of the model parameters and custom weights should be selected, depending on specific habitat needs of the fish species.

Thirteen parameters were included in the model for juvenile chinook salmon, as shown in the table on the next page.

Table 3. Parameters included in the model for juvenile chinook salmon habitat quality

Parameter	Description
Positive indicators:	
Alcove area	Acres of alcoves per 1,000 feet of river
Side channel area	Acres of side channels per 1,000 feet of river
Natural ponds area	Acres of natural ponds (within a 1,000-foot lateral distance from the river) per 1,000 feet of river
Connected gravel pit area	Acres of gravel pit pond (within a 1,000-foot lateral distance from the river) per 1,000 feet of river. Includes only those that have year-round connection with the main channel
Island area	Acres of island per 1,000 feet of river
Main channel area	Acres of main channel per 1,000 feet of river
Rock barbs length	1,000 feet of riverbank with rock bars per 1,000 feet of river
Riffle length	1,000 feet of riffle length per 1,000 feet of river
Bare substrate area	Areas of bare substrate next to the river per 1,000 feet of river.
Older trees length	Acres of trees greater than 40 years old that grow within 500 feet of the river per 1,000 feet of river
Negative indicators:	
Unconnected gravel pit area	Acres of gravel pit pond (within a 1,000-foot lateral distance from the river) per 1,000 feet of river. Includes only those that are isolated from the main channel except during higher flows
Riprap length	1,000 feet of riprapped bank per 1,000 feet of river
Riverfront house density	Number of houses per 1,000 feet of river

- **Alcove area** was included because these sites are used by juvenile chinook for refuge and feeding, especially in winter and spring.

- **Side channel area** was included because of the feeding and refuge habitat side channels often provide. Side channels are usually shallower with lower velocity than the main channel and therefore more likely to support a large population of aquatic insects. Also, side channels are often more sinuous than the main channel and therefore include a variety of habitat features, including complex edges and eddies.

- **Natural pond area** was included because the ponds offer rearing habitat that is periodically isolated from the main channel. If these ponds do not have introduced fish, fish benefit by being separated from large predatory native fish in the main channel. Similarly, gravel pit ponds that have at least seasonal connection to the main channel were considered good habitat for fish. The deep water at pits and lack of flowing water are particularly attractive to young salmon. Chinook salmon have been known to stay in gravel pit ponds for several years. Their growth rate is high in gravel pit ponds, probably because of ample food; they are known to attain a length of twelve inches after two years (Bayley and Baker 2000).

- **Island area** was included since islands increase the wetted margin of the river and provide a more diverse set of microhabitats than does a single channel. Islands are often transient with sediment deposition and erosion occurring in close proximity. As islands are transformed or dissected during high flows, off-channel features develop that are good habitat for fish.

- **Main channel area** was included under the assumption that, where a channel spreads out, a greater variety of habitat types develop. A narrow channel is often a result of bedrock constriction or human constraints on channel meandering.

- **Length of river bank with rock barbs** was also included. Rock barbs are constructed of large, angular rock and extend perpendicularly from the bank for a distance of 20 to 30 feet. Recent fish sampling along the McKenzie River downstream from the I-5 Bridge indicates that juvenile chinook and large trout use barbs more than natural or conventional riprapped banks (Andrus et al. 2000). No rock barbs existed in 1944.

- **Riffle length** was considered a positive indicator of high quality fish habitat. For much of the lower McKenzie River, riffles occur at the downstream end of large gravel deposits in the channel. Multiple channels often form at these locations and provide a wide range of habitat types for both young and adult fish. Since riffles were identified in the field, there is no data on this variable for 1944.

- **Bare substrate area** was also considered to be an indicator of high quality habitat. Much of the McKenzie River channel has a coarse cobble riverbed, but the size of rocks, gravels, and other materials in the riverbed is more diverse at areas with bare substrate. Seining of the McKenzie River in the spring and early summer has indicated that young chinook salmon congregate in areas with bare substrate, especially where diverse velocity patterns occur (J. Ziller, ODFW, 2000, personal communication).

- **The area of older trees** (more than 40 years old) near the river was included because these trees influence the river more than younger trees; effects include shading, dropped leaves in the fall, and their wood volume, if they fall into the river. When older trees grow at the very edge of the river, their large root masses provide a diverse edge effect that allows fish to find pockets of low-velocity water adjacent to fast water for effective feeding.

Three parameters that have a negative influence on habitat were included in the juvenile chinook model. The weighted scores of these variables are negative so their values reduce the total fish score.

- **Riprapped banks** are usually avoided by most fish, especially during higher flows. Also, riprap often results in channel narrowing as the river shifts water flow toward the riprapped bank.

- **Gravel pits that flood** during high water but otherwise have no connection with the river were considered a negative influence on fish. Fish can be trapped within these gravel pits, thereby disrupting their normal migration patterns. These gravel pits usually contain large-mouth bass that eat native fish.

- **Riverfront housing development** was considered a negative influence on fish habitat. Trees growing between houses and the river are often removed to create better views of the river, thereby eliminating a source of leaves and eventually, large wood, into the river, and reducing shade over the river.

Values for “riffle length” and “riprap length” were not available for 1944.

The variable weights we chose for juvenile chinook salmon are listed in Table 4 below.

Table 4. Variable weights of habitat factors for juvenile chinook salmon

Variable	Weighting
Positive indicators:	
Alcove area	+3
Side channel area	+3
Natural ponds area	+3
Connected gravel pit area	+3
Island area	+2
Main channel area	+2
Rock barbs length	+2
Riffle length	+2
Bare substrate area	+2
Older trees length	+1
Negative indicators:	
Unconnected gravel pit area	-1
Riprap length	-1
Riverfront house density	-1

We developed an interactive computer program that allows people to use this model and select their own parameters and their weights. The model displays graphs of habitat scores, the raw data, and aerial photographs of each reach. The model is available for public use, and is available on the Internet at:

http://www.upstreamconnection.com/client/waterwork/mckenzie.cfm.

The model also allows the user to display the index for pond turtle habitat and develop a combined score for juvenile salmon and pond turtle habitat.

Juvenile Chinook Salmon Habitat

Table 5 lists 15 main channel reaches (by north or south side of river) that have the highest scores for juvenile chinook habitat, and therefore would be the best focus for conservation and minor enhancements (Figure 12). Table 6 lists 6 main channel reaches (by north or south side of river) that had high scores for fish habitat in 1944, according to this analysis, but where human or natural influences now limit fish habitat quality and major enhancements would be needed to improve habitat quality.

Table 5. Reaches (by north or south side) that currently have high scores for fish habitat quality and would be the focus for conservation and minor enhancements. Presented in order of decreasing fish habitat score.

Order	Reach	Positive factors	Limiting factors
1	1N	Many alcoves, side channels, ponds, and islands. Flood-prone area not suitable for housing development. Some older hardwoods along bank.	Old McKenzie channel has no summer flow.
2	17N	Many alcoves, side channels, and ponds. Split channel that includes McNutt Island.	Island vegetated mostly by grass. Segment of outer river bank occupied by houses. Some riprap.
3	1S	Many alcoves, side channels, ponds, and islands. Flood-prone area not suitable for housing development. Some older hardwoods along bank.	Includes proposed gravel extraction operation (set back about ¼ mile from main channel).
4	2N	Many alcoves, side channels, ponds, and islands. Flood-prone area not suitable for housing development.	Old McKenzie channel has no summer flow.
5	12N	Many side channels and islands. Some ponds. Portions are flood-prone and not suitable for housing development.	Segment of outer river bank occupied by houses.
6	4S	A number of side channels, alcoves, and bare gravel.	Extensive riprap and gravel pits behind berm
7	7S	Large area in side channel, island, and alcoves.	Extensive riprap and housing along one portion. Further urban encroachment.
8	11N	Meander area as indexed by alcoves, ponds, wide channel, and exposed substrate.	
9	17S	Side channels and ponds. Across river from the highest quality site.	A few houses in flood-prone areas.
10	19S	Includes 2 large islands (Kaldor and Rodman), side channels, and some older conifers along bank.	Segment of houses along major side channel.
11	3N	Side channels and islands.	Future gravel extraction area.
12	7N	Meander area as indexed by alcoves, islands, wide channel, exposed substrate.	
13	15S	Tight bend in river creates extensive meandering and side channels.	River front home located precariously in meander area. Landowner recently opened side channel at base of bend which could cause river to abandon current main channel.
14	2S	Alcoves, side channels, ponds, and islands. County ownership of high-quality segment. Gravel extraction company wildlife set-aside for another high-quality segment.	Some houses along segments of outer river bank and Confluence Island channel.
15	11S	Extensive flood-prone plain with side channels, islands, and Cedar Creek confluence. Older hardwoods.	Industrial settling ponds located within flood plain.
16	14N	Old gravel pit complex now connected to main channel.	Some riprap. Salmon bypass side channel for Walterville canal needs to be maintained.

Table 6. Reaches (by north or south side) that had high fish habitat scores in 1944 but human or natural influences now limit fish habitat quality, and major enhancements would need to occur to improve habitat quality.

Reach	Positive factors	Limiting factors
1N	Many alcoves, side channels, ponds, and islands. Flood-prone area not suitable for development. Some older hardwoods along bank.	Old McKenzie channel does not have summer flow. Enhancement would be to provide regulated flow into the old channel.
2N	Alcoves, side channels, ponds, and islands. Flood-prone area not suitable for development.	Old McKenzie channel does not have summer flow. Enhancement would be to provide regulated flow into the old channel.
3S	Once was part of delta dissected by many side channels.	Intensive diking and riprap. Gravel extraction areas immediately behind dikes. Enhancement would be to provide downstream connection to river for some gravel ponds
4S	Includes islands, alcoves, and side channels. Lower portion once was part of delta dissected by many side channels	Intensive diking and riprap. Gravel extraction areas and processing facilities immediately behind dikes. Enhancement would be to increase extent of side channels and alcoves.
12S	Expansive flood-prone area that includes Cedar Creek. Many ponds and some alcoves.	Major side channel (now a series of ponds) no long has summer flow. Enhancement would be to provide summer flow to side channel.
15S	Tight bend in river creates extensive meandering and side channels.	Riverfront home located precariously in meander area. Landowner recently removed log jam and opened side channel at base of bend which could cause river to abandon current main channel. Enhancement would be to add key pieces of large wood at head of side channel to keep most flow in main channel.

We took the pond turtle habitat suitability scores produced from the pond turtle model, standardized their values, and combined them with the juvenile chinook habitat scores. The two scores were summed with equal weighting assigned for turtle and fish scores. This composite chinook/turtle habitat score was highest downstream from Deerhorn Bridge at Reach 20. Reaches 1 and 2, Reaches 10 to 12, and Reaches 17 to 19 had some of the highest scores in the lower half of the study area (Figure 13).

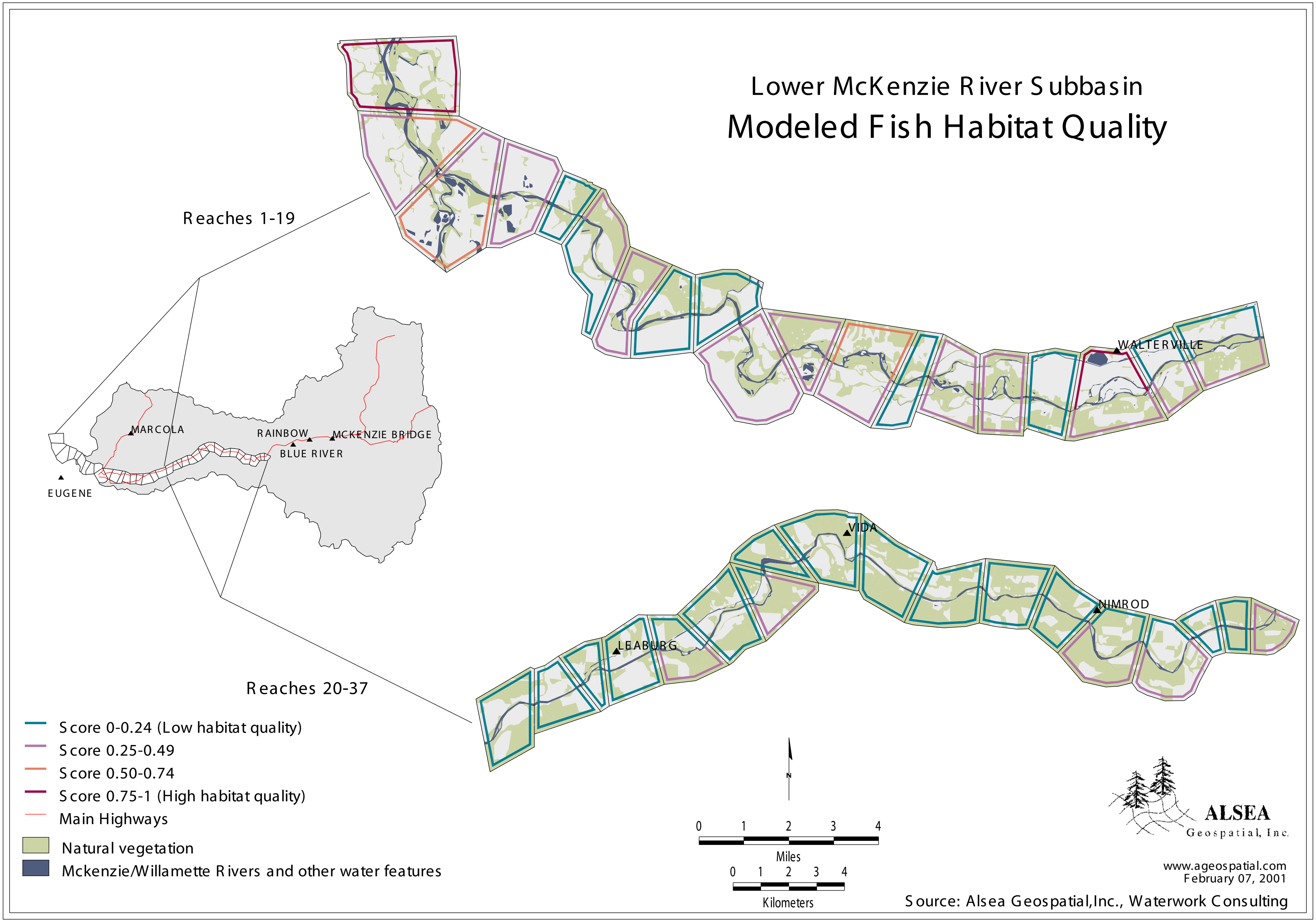
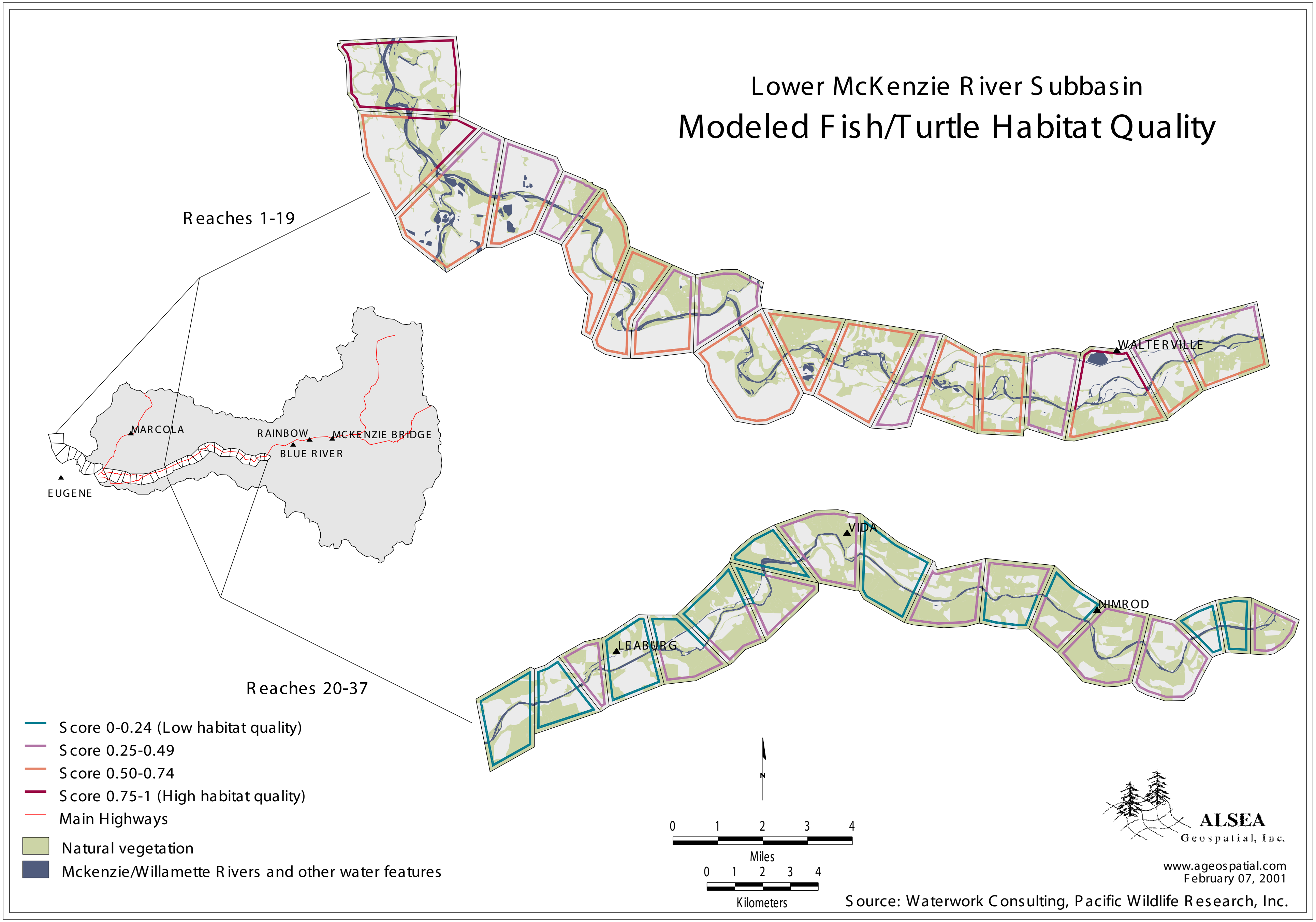

Lower McKenzie River Subbasin
Modeled Fish Habitat Quality
Reaches 1-19
Reaches 20-37
MARCOLA
RAINBOW
MCKENZIE BRIDGE
BLUE RIVER
EUGENE
WALTERVILLE
VIDA
NIMROD
LEABURG
Score 0-0.24 (Low habitat quality)
Score 0.25-0.49
Score 0.50-0.74
Score 0.75-1 (High habitat quality)
Main Highways
Natural vegetation
Mckenzie/Willamette Rivers and other water features
N
0 1 2 3 4
Miles
0 1 2 3 4
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 07, 2001
Source: Alsea Geospatial,Inc., Waterwork Consulting

Figure 12


Lower McKenzie River Subbasin
Modeled Fish/Turtle Habitat Quality
Reaches 1-19
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MARCOLA
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Score 0.50-0.74
Score 0.75-1 (High habitat quality)
Main Highways
Natural vegetation
Mckenzie/Willamette Rivers and other water features
N
0 1 2 3 4
Miles
0 1 2 3 4
Kilometers
ALSEA
Geospatial, Inc.
www.ageospatial.com
February 07, 2001
Source: Waterwork Consulting, Pacific Wildlife Research, Inc.

Figure 13

Using the Assessment

The assessment establishes a foundation for conservation strategy and actions. But in addition to the data, maps, and analysis provided, the assessment also offers flexible tools that can be used for further analysis and project planning. In the previous section, these tools were used to analyze juvenile chinook salmon habitat in the McKenzie River and tributary junctions. This analysis is just one example of the work that can be done with the information gathered for this assessment.

The GIS map layers and datasets can be used to make queries, carry out more analysis, answer new questions, and look at problems from different angles. The data can be updated and expanded.

The existing maps and datasets are available to the public. To read the full *McKenzie River Subbasin Assessment: Technical Report*, go to the McKenzie Watershed Council's website, listed below.

http://www.mckenziewatershedcouncil.org/library.html

A CD-ROM for computers is also available, for those who want to work with the information to do their own analyses. The CD-ROM has the GIS datasets (Geographic Information System) used in the assessment. To obtain the CD-ROM, call Alsea Geospatial, Inc., at 541-754-5034, or go to Alsea Geospatial's website, listed below.

http://www.alseageo.com

VI. References

See the full Technical Report for all references used in the assessment. The references below are only the ones cited in this summary.

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VII. Glossary

Adfluvial	Lake-dwelling
Bypass reach	Segment of the McKenzie River below a water diversion into an EWEB power canal, and before the water is returned to the river downstream.
CFS	Cubic feet per second
Channelization	Simplification of a river into one major channel, by closing side channels, or straightening or deepening main channels.
Confluence	The junction or flowing together of two streams.
DEQ	Oregon Department of Environmental Quality
E. coli	Fecal coliform bacteria
EWEB	Eugene Water and Electric Board
F	Fahrenheit
FERC	Federal Energy Regulatory Commission
Floodplain	The area in a river valley covered by water during floods or with soil deposits from past floods; in this document, the floodplain is defined as all area within 0.5 miles of the river.
Fluvial	River-dwelling
Geomorphology	The study of the forms and shape of the earth, and the processes that affect the surface of the earth.
GIS	Geographic Information System; a computer system that stores and manipulates spatial data; it produces a variety of maps and analyses.
Historic	In this document, “historic” often refers to 1944, when the first aerial photographs were taken of the McKenzie River. In some parts of the document, other historic reference dates are specified.
Lithology	The science of the mineral components and the arrangement of rocks.
Neotropical migrant bird species	Birds that migrate annually to the biogeographic realm that includes South America, the Indies, Central America, and tropical Mexico.
Nonpoint source	Entry of a pollutant into a body of water from widespread or diffuse sources, with no identifiable point of entry. Erosion is an example.
ODFW	Oregon Department of Fish and Wildlife
pH	A symbol for the degree of acidity or alkalinity of a solution.
Point source	Distinct, identifiable source of a pollutant into a body of water, such as a discharge pipe.
Reach	A river segment defined by changes in land forms, land use, stream junctions, and/or cultural features such as dams.
Riparian	Three-dimensional zone of direct influence and/or interaction between land and aquatic ecosystems, such as a river.
Savanna	A grassland with scattered trees.
Sixth-field watershed	Smaller watershed, also considered a subwatershed; examples are North Fork of Gate Creek or Cedar Creek.
Subbasin	The Oregon Water Resources Department has classified 18 major river basins in Oregon; the Willamette Basin is one. The McKenzie River and other major rivers within the Willamette Basin are considered subbasins.
Substrate	The material of the riverbed, such as gravel or cobble; or on land, the layer on which plants grow.
TMDL	Total maximum daily load; maximum amount of pollutants allowed to enter a river. DEQ establishes standards for Oregon rivers.
Turbidity	Turbidity is a measure of the clarity of water. Usually, high turbidity water also has a high suspended sediment concentration.
Watershed	The area within which all water that falls as rain or snow drains to the same stream or river. In this summary, “subbasin” and “watershed” are both used to refer to the McKenzie River subbasin.

McKenzie River 1944 and 2000

Channel and Vegetation Characteristics by Reach
Willamette River to Quartz Creek

www.ageospatial.com

February 07, 2001
/u2/mckz/wa/maps/riv44_00sh.aml