Ashland Watershed Assessment & Action Plan

December, 2007

BEAR CREEK
Watershed Council

Bear Creek Watershed Council
PO Box 1548, Medford, Oregon 97501

Funded by the Oregon Watershed Enhancement Board
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CHAPTER I: INTRODUCTION AND WATERSHED ISSUES

The OWEB Process and Project Team

The assessment of the Ashland and Neil Creek watersheds began June 23, 2004 and concluded with this report submitted December 31, 2007. The area studied lies along Interstate 5 about ten miles north of the Oregon-California border as shown on Map 1. This project, one of many being completed across Oregon with funding from the Oregon Watershed Enhancement Board (OWEB), followed the components and methods outlined in OWEB's Watershed Assessment Manual (July, 1999) supplemented by a later draft chapter to address Urban Issues. The process identifies voluntary individual and community Action Plans and fish-friendly practices that address priority local issues.

The focus of this assessment is to document current and historic conditions; identify social and physical processes within the watershed that affect fish and riparian habitat, water quantity and quality; and current and potential hazards to the urban and rural residential environment. Soil conservation, erosion prevention, and flood protection are important factors in these issues. Most emphasis is on aquatic, hydrologic, and riparian systems. This watershed assessment builds on regional restoration priorities identified previously and provides a framework for the Bear Creek Watershed Council (BCWC) to better identify and prioritize issues affecting this watershed. Recommendations from this assessment help plan, propose and implement watershed restoration and improvement activities.

> A watershed is an area of land that drains to a single point, usually at a confluence with another stream. The water can move by means of an interconnected network of drainage paths that may be above or below ground. Generally these pathways become progressively larger as the water moves downstream. Watersheds can be large or small, and small watersheds together make up larger watersheds. Watershed boundaries generally follow ridgelines around the channels and meet at the lowest downstream point.

The assessment process has included neighborhood meetings and collaboration with many stakeholders and watershed professionals in the City of Ashland and adjacent suburban and rural areas north and south of the city. About half of the 37,150 acres in the project area is public land managed by the Rogue River-Siskiyou National Forest under the Northwest Forest Plan and other plans that address watershed improvement and restoration. This report incorporates information on federal lands but the Action Plan focus is on voluntary activity on private and municipal land.

The Bear Creek Watershed Council (BCWC) is comprised of interested individuals that live or work directly in the Bear Creek watershed. The Council has been working with the people and natural resources of the region since 1994. BCWC received a grant from the Oregon Watershed Enhancement Board to complete this watershed assessment. OWEB is a state agency which administers a grant program funded from the Oregon Lottery and other sources to support voluntary efforts to restore and maintain healthy watersheds. The program supports Oregon's efforts to restore salmon runs, improve water quality, and strengthen ecosystems that are critical to healthy watersheds and sustainable communities.

A team of local and regional consultants familiar with this watershed's processes and people, and with skills necessary to carry out the project were engaged to assist BCWC to assess this watershed and develop an Action Plan. The team comprised the following individuals:

John Ward, Project Manager

John Ward has twenty years of watershed field experience and managed two OWEB assessments prior to the Ashland project. He likes voluntary individual and community work to solve shared problems, and investing time and energy in youngsters. He has ranched in the mountains east of Ashland for 40 years after many years elsewhere in industry and higher education.

Frances Oyung, Community Coordinator

Frances Oyung's role in this project is that of community coordinator and editor. Her passion for natural lands drives her while she also believes we must be able to communicate and work with all stakeholders to find solutions. She is a lifelong westerner and has worked as a program coordinator, teacher, wilderness guide, and field biologist. She has lived in the Rogue Valley since 1992.

Kent Smith, Hydrologic Coordinator

Kent Smith has a Bachelor of Physics degree from the University of Minnesota (1966). He worked for the Umpqua National Forest for 21 years as a journeyman hydrologist and as a land manager. Since 1998 Kent has been doing watershed consulting work for watershed councils, landowners, and the forest industry. He was a contributor to the 1999 Oregon Watershed Assessment Manual.

Jeannine Rossa, Aquatic Biota Coordinator

Jeannine Rossa has a Bachelor's of Science in Wildlife and Fisheries Biology from the University of California, Davis, and a Master's Degree in Stream Ecology from Utah State University. She has been working on and studying fish and streams for over 20 years. For her Master's project, she studied the Jenny Creek sucker in the Cascade-Siskiyou National Monument. Jeannine has worked for federal, state, and private entities, including 15 years for the Bureau of Land Management as a fisheries biologist and program lead. Most recently, Jeannine has been a consulting ecologist in the Rogue Valley. She is a State of Jefferson native.

Lea Light, GIS Support Services

Lea Light is a Geographic Information System (GIS) Specialist living and working in Ashland, OR. She is a 2001 graduate of the SOU Geography program, and has been providing GIS support since 1999 for various regional entities including Jackson County, the Bureau of Land Management (Medford District), and currently for the City of Ashland.

Karen Pierce, Office Support

Karen Pierce has lived in Oregon for over 20 years and gained a great appreciation for the many facets of nature folks enjoy in their everyday lives. By supplying office and computer support for groups that promote and protect these natural assets, Karen fills needs in these organizations and contributes to worthwhile projects.

Watershed Ownership and Neighborhoods

The Bear Creek watershed, located in southwest Oregon in Jackson County, is a hydrologic "5th field watershed" totaling approximately 231,087 acres. Bear Creek enters the Rogue River approximately 127 miles upstream from the Pacific Ocean. Ridges along the western edge of the Cascade Mountains form the north and east sides of the Bear Creek watershed, and the Siskiyou/Klamath Mountains form the south and west sides.

This project studied the Ashland Creek and Neil Creek drainages within the watershed, including the City of Ashland, the Wrights Creek sub-watershed forming the north border, the main stem of Bear Creek forming the east boundary; and the Neil Creek watershed bordering on the south. Ridgelines of adjoining sub-watersheds to the west and south bound the study area including Mt. Ashland, at 7,531 feet, the highest elevation in the Bear Creek watershed. (Map 2) The total project area comprises 37,150 acres and 180 miles of streams.

The project area was subdivided into four "neighborhood areas" to better identify community concerns from households facing similar conditions and issues. Neighborhood residents generally use similar travel routes; the groupings were confirmed with experienced realtors. The four neighborhoods selected were Ashland Creek neighborhood centered on the downtown business area, the Wrights Creek suburban residential area to the north, the Ashland Terrace urban residential neighborhood to the south, and the rural Neil Creek neighborhood further south. Unlike many watersheds in Oregon covered by similar assessments, this assessment covers a heavily urbanized area within the city of Ashland. Urban watershed issues dominate the neighborhoods studied with the exception of Neil Creek which is more rural residential, and agricultural.

Community Involvement and Issues

Community involvement reached residents, tenants, and non-resident landowners throughout the project area, and City of Ashland elected officials, staff, and appointed Commission members. The intent was to reach individuals whose voluntary participation and decisions could affect change on private lands and influence public land decisions.

The community involvement targets were exceeded: 782 households became aware of the project through mailings, over 300 individuals were personally contacted, about 25 individuals volunteered their homes and time for project activities, and it is expected at least ten households will take specific restoration action within one year. Nine community meetings were hosted across the project area, generally in private homes as noted in Table I -1.

Table I-1. Ashland Watershed Community Meetings and Events

Date	Event	Neighborhood	Location
5/14/05	Ashland Creek meeting	Ashland Creek	Fields home
5/14/05	Beach Creek meeting	Ashland Terrace	Forrester home
5/18/05	Clay Creek meeting	Ashland Terrace	Michelsen home
4/11/07	Neil Creek meeting	Neil Creek	Glenyan RV Park
6/7/07	Hamilton Creek Meeting	Ashland Terrace	Battaile home
8/13/07	Roca/ Paradise Meeting	Ashland Terrace	Sloan home
9/14/07	Wrights/ Susan Creeks Mtg.	Wrights Creek	anon. home
11/27/07	Key Findings/ Action Plan Ideas	All Neighborhoods	ACFS Classroom
12/3/07	UU Environmental Action Comm. Action Plan Ideas	All Neighborhoods	Unitarian Church

Comments from eight different neighborhood creek meetings are summarized in Table I - 2; the comment from three creek homeowner associations were noted for invasive plants which was the most frequently mentioned concern. Issues and interests from neighborhood meetings were given to team members to address in their assigned chapters.

Residents in properties directly on or very near Bear, Ashland, Beach, Clay, Clayton, Hamilton, Paradise, Neil, Roca, Susan, Tolman, and Wrights Creeks were mailed individual postcard invitations (see Figure I -1) about one week prior to a scheduled neighborhood meeting in a private residence in that area. Mailing labels were developed from current precinct walking lists and revised when Address Service Request postal returns revealed changes were needed. In many instances invitations by telephone contact were also made.

All comments made by participants are included in Table I - 2 unless the comment was beyond the scope of the assessment, such as trash dumping, or if it was outside the boundary of the project.

Guests signed in and were briefly told the geographic scope of the project and about OWEB's assessment methods. Participants were encouraged to sign Access Permission for Stream Survey (Figure I-2). The group was informally polled about issues and concerns related to watershed health and each comment was recorded on a large flip chart all could see. Questions and information were exchanged, and follow-up arranged for visits or referral to another organization or agency.

At the Action Plan event on November 27, 2007 all households invited to neighborhood meetings were re-invited; participants received the materials in including Key Findings and Action Plan Agenda (Figure I-3), a three-D visualization of the project area, and the Neighborhood Interests and Issues summary from all neighborhood meetings (Figure I-4). These materials facilitated discussion and understanding of the hydrologic complexity of Ashland's urban setting. Participants also received a written summary of draft Action Items developed during the project. Discussion clarified terminology and options, feedback from participants was recorded, and others were to return written comments on the Action Item list.

Project Team met with Ashland's Mayor, John Morrison and at his suggestion, the Conservation Commission, the Planning Commission, and the Tree Commission. Active engagement was maintained with city staff in the Engineering, Parks and Recreation, and Planning Departments to identify issues, comment on draft documents, and gather data and guidance. Team members briefed Commissions, and reviewed and commented on a proposed Riparian Corridor and Wetlands Ordinance and draft Stormwater Management Program. The outstanding cooperation and coordination with the City of Ashland was a major contribution to this project. Background information from the US Forest Service was also very helpful.

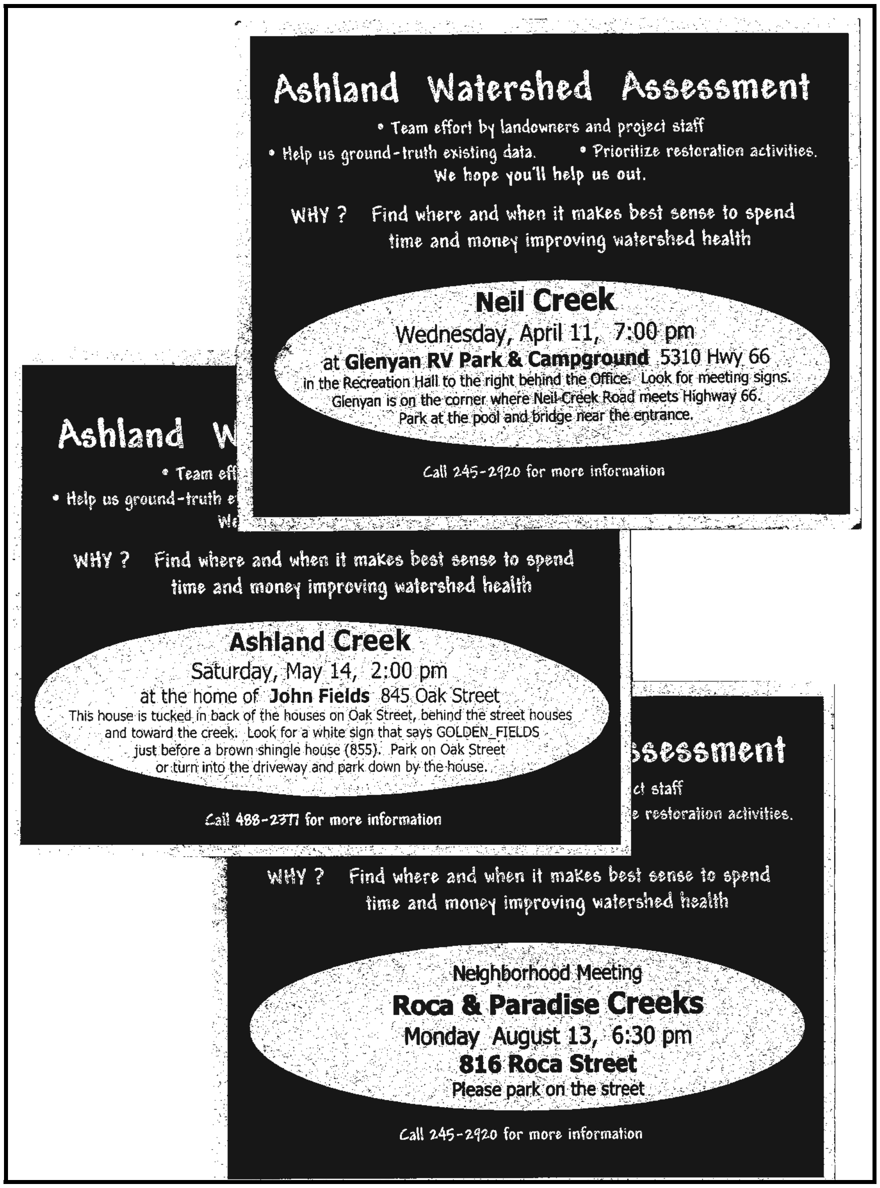

Figure I-1: Sample postcard meeting notices.

Table I - 2. Neighborhood Interests and Issues

Invasive Plants 13 comments

Black berries #1 mention 3 Homeowner 'Associations'
Yellow flag Iris, Star thistle, Tree of Heaven
Crowding out native plants
English ivy killing trees
How to recover my creek?
Need Herbicide workshop

Erosion and Sediment 10 comments

Severe erosion - lost 16 feet, $50,000 repair
- lost 5,000 bulbs
Bank instability, downcutting on creeks
TID canal causes/carries high sediment
Need tech assistance; How to build stepped pools?

Stormwater problems 9 comments

Debris plugs county culverts on Paradise and Wrights Creeks
Consider detention ponds+ Bio-swales

Flooding 6 comments

1964 10,000 to 12,000 cfs
1997 6,000 cfs

Riparian Corridors 6 comments

Riparian Ordinance: When? Where? No fish=Less protection
Dead alders and cottonwoods: Who clears log jams in creek?

Wildfire @ Interface 4 comments

3 wildfires in Wrights Creek drainage
Fireworks a problem

Water quantity 4 comments

Low flow in Neil Creek, Wrights Creek
Wrights Creek was perennial in 1945
but now gets no irrigation some days
Development may reduce water supply

Water quality 4 comments

Fecal coliform a concern
Pesticide runoff to creeks
Oil from streets and parking lots
Magnesium chloride de-icer bad?

Roads and Slides 3 comment

Contractor trackout, construction dirt piled on streets
Debris flow above Interstate 5 on Neil Creek

Trail along Corridors 3 comments

On TID (Ashland lateral) canal
200 people a day @ my place
Use Stream corridors?

Piped Streams 1 comment

Daylight Paradise Creek?

Ashland Watershed Assessment

Access Permission for Stream Survey

Bear Creek Watershed Council asks your permission for trained volunteers to come onto your property between April 15, 2007 and September 30, 2007 to study stream and bank conditions, riparian vegetation, presence of fish or fish barriers, and to gather data on water temperature, flow or other conditions. Your help is invaluable.

Please
- ☐ Come anytime
- ☐ Call before coming
- ☐ Send me a copy of your data

I have a
- ☐ Creek that runs all year
- ☐ Creek that runs seasonally
- ☐ Creek that runs some years

I have
- ☐ A Pond
- ☐ Wetlands
- ☐ A spring or springs How many? ...

Watch out for
- ☐ Dogs
- ☐ Other____________________

I'd like to be involved in
- ☐ Accompanying volunteers on my property
- ☐ Learning to do stream surveys
- ☐ Checking road, culvert and habitat conditions
- ☐ Searching for historic photos, stories and other information
- ☐ Driving volunteers to get field data
- ☐ Telephoning, hosting meetings or other tasks
- ☐ Reporting what happens during storms
- ☐ Taking photos in the field
- ☐ Meeting with other neighbors
- ☐ A stewardship project

I grant permission for Bear Creek Watershed Council volunteers to come onto my land and to include the data they gather in reports on watershed conditions.

Signed______________________________Date______________

Name ____

Address____

Phone______________________E-mail______________________

Stream Name (if known)___________________________________

Please return to BCWC, PO Box 1548, Medford, Oregon 97501

Figure I-2: Access Permission for Stream Survey Form

BEAR CREEK
Watershed Council

KEY FINDINGS and ACTION PLAN AGENDA

Community Review Meeting

Ashland Watershed Assessment Nov. 27, 2007

1. **Welcome** and Introductions
2. **Overview** of Watershed Assessment process and key findings
3. **Goals tonight:** review action plan ideas and get feedback from attendees
4. **Action Plan ideas:**
   a) Habitat Restoration and Function Improvement Sites
   b) Stormwater management
   c) Fish Barriers/Screens
   d) Streamflow
   e) Sediment/Pollutants
   f) Erosion Control Issues
   g) Education
   h) Monitoring
5. **Summary and thanks for participating**

P.O. Box 1548 • Medford, OR 97501 • (541) 840.1810 • email: coordinator@bearcreek-watershed.org

Figure I-3: Key Findings & Action Plan Agenda

REFERENCES

Cascade Earth Sciences. 2006. *Upper Rogue Watershed Assessment*, Prepared for Upper Rogue Watershed Association.

Bear Creek Watershed Council, Rogue Valley Council of Governments, December 2001. *Bear Creek Watershed Assessment, Phase II – Bear Creek Tributary Assessment*.

DEQ, *Bear Creek Watershed TMDL & Water Quality Management Plan*. 2007, Oregon Department of Environmental Quality: Medford.

USDA Forest Service. June 2005.. *Ashland Forest Resiliancy Draft Environmental Impact Statement*. Rogue River-Siskiyou National Forest.

Watershed Professionals Network. 1999. *Oregon Watershed Assessment Manual*. June 1999. Report prepared for: Governor's Watershed Enhancement Board. Salem, Oregon.

PROJECT SUMMARY

Ashland is a venerable village with a postcard-like setting; an urban center stretched along a narrow terrace at the base of very steep ridges and erodible canyons that periodically funnel warm rain and snow melt down from the mile of mountain rising above town. Stormwater from a dozen flood-prone creeks challenges the resources of the City and homeowners as it rushes across the Ashland Terrace. However, the Ashland Watershed Assessment demonstrates that these creeks can be a valued community asset, providing a great opportunity for individual landowners, homeowner associations, and the City to cooperatively improve watershed health and function.

We found that many of the small streams have perennial summer flows due to augmentation from summer irrigation. This condition promotes streamside vegetation that can stabilize stream banks, filter runoff, reduce erosion, and provide riparian corridors, green ribbons of habitat for birds and other urban wildlife connecting Bear Creek's flood plain to the forested slopes above. The associated vegetation canopy helps keep water cool to carry more oxygen for fish and aquatic life. The City recognizes that these streams add value to the watershed and encourages increased landowner participation in riparian corridor and wetland protection.

We found the City has engaged consultants to recommend improved stormwater management practices, to quantify infrastructure needed to address runoff and erosion issues, and to assess the impact from high development areas on existing facilities. A pro-active policy for constructing wetlands that filter stormwater and detain storm surges continues to show favorable results.

We noted coho salmon have been found in several creeks, and steelhead and steelhead fry are present in Lithia Park near City Hall - clear evidence that Ashland's efforts to protect salmonids and remove fish passage barriers has brought results. Stream surveys identified several fish barriers at irrigation diversions and a need for late season flow restoration in Neil Creek.

Action Plan priorities identified in this assessment include 14 habitat and restoration projects, 5 stormwater management projects, 8 fish passage barrier projects, and a series of informational and educational activities. Outreach during the assessment process has shown that there is community interest in practices that control sediment, pollution, and soil erosion; tours and workshops to see what has worked and how to get results, and monitoring to verify progress. These projects and activities help build community commitment and sustained public support while assuring a well-functioning and productive watershed.

CHAPTER II: HISTORICAL CONDITIONS

One of the challenges of understanding the landscape condition is trying to ascertain what went on “before”: before today, before 1900, before Euro-American settlement, etc. By understanding the actions and activities of humans in the landscape, we can tease out what elements of the present condition are the result of natural patterns and what are human-caused.

This chapter uses photographs to briefly describe some of the changes that have occurred to stream systems within the Ashland Watershed Assessment area since Euro-American settlement. Photographs of the 1974 and 1997 floods illustrate some of the ramifications of urbanizing stream corridors. A brief timeline at the end of the chapter provides a chronological context.

In a 2000 report for the City of Ashland, Greg Bennett describes Ashland Creek as a “workhorse,” providing electricity, drinking water, and recreation for the citizens of Ashland. Not only does Ashland Creek “work hard” today, but it has been working hard for Ashland’s citizens since Abel Helman and Robert Hargadine staked the first Donation Land Claims along its banks in 1852. Within three years, Helman and a handful of others, had built a water-powered saw mill, a water-powered flour mill, and given away plots of land near the creek to start a town. Within another year, several businesses had started up and the Plaza was born. Ever since, Ashland Creek has been the economic and recreational center of town (Fig. II-1).

Because of the location of town center, the floodplains and shady banks of Ashland Creek were cleared much earlier than other, smaller streams (Figs. II-2, II-3). Not surprisingly, the flat terrace was also developed first. The hillslopes surrounding town were grazed or developed into orchards (Fig. II-4). However, much of the hillslopes were still covered with chaparral and conifers (Fig. II-5). In Fig. II-5, conifers are growing in what is likely an intermittent stream channel.

Figure II-1: The Plaza, circa 1880's, already 40 years after Helman and Hargadine posted claims. Ashland Flour Mill is at the end of the street, at the entrance to what is now Lithia Park. Flumes brought the water from the creek to the mill, so it was not situated right on the stream. The buildings across from the IOOF hall burned later in a fire. Photo courtesy of Paul Hosten.

The natural pattern of Ashland's ecoregions began to take form long ago, perhaps in the Devonian, as successive plates of marine sediments and magma plunged beneath the edge of an adjacent plate to melt and rise to the surface through volcanic island arcs. Plate tectonics rumpled the arcs, folding and faulting deep magma with oceanic crust, sediments, and volcanics to become the jumbled core of the Klamath and Siskiyou Mountains.

During the next 200 million years west of Ashland a granite pluton rose beneath the crushed island arcs, fracturing the mosaic of sandstone, volcanic ash and flows, mineral rich seafloor and metamorphics. Ice, water, wind and gravity stripped these away leaving a rugged 7,500-foot granite mountain, deep canyons and a dozen tributary streams that washed the debris to form broad terraces above fertile bottomlands and Bear Creek.

The climate was Mediterranean: hot dry summers, mild wet winters. Gene Hickman has noted Bear Creek valley is the driest valley in western Oregon and Washington, ranging from about 18-19 inches average annual precipitation to about 60 inches on Mount Ashland. This is roughly **half** of what the Willamette Valley receives and less than all other interior valleys on the west side as well, giving it a unique environment and ecological setting. Snowfall in the higher reaches provided year-round stream flow, fed springs and artesian wells, and recharged groundwater. The geology, climate and hydrology attracted settlers with oak woodlands, scattered pines, deep sandy granitic though erodible soils, convenient water supply and a gentle climate.

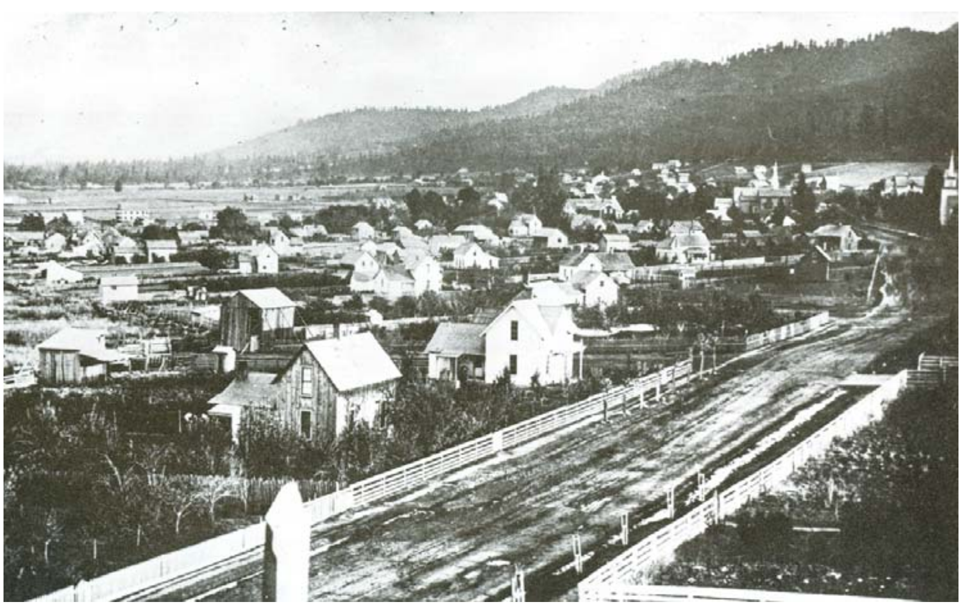

Figure II-2: North Main Street in 1881 (40 years after first Eastern settlers). The little town of Ashland fanned out from Ashland Creek along the terrace. The line of dark trees from Right to Left in the background is Ashland Creek. The tiny row of trees in the far background is probably Roca or Clay Creek. Photo courtesy of Terry Skibby and Glenn Northcross.

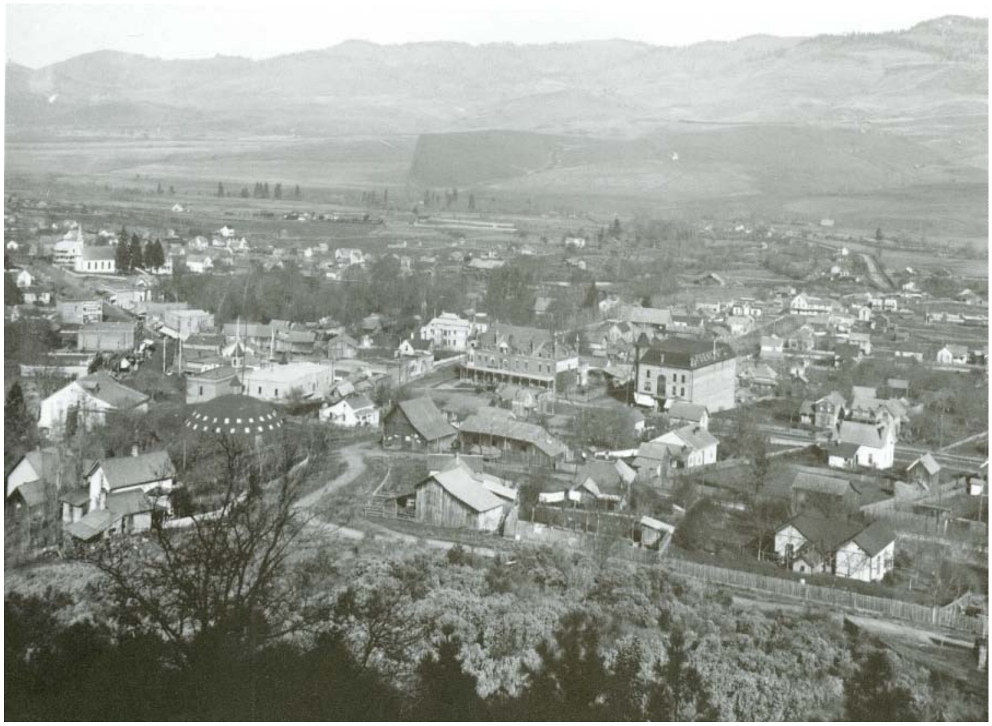

Figure II-3: Ashland circa 1900 (60 years after first Eastern settlers). Note the Chautauqua dome where the Elizabethan theatre now stands. The Ashland flour mill is to the left of the dome, the plaza behind it. Water Street already runs down the stream course and most of the stream's banks are developed. Bear Creek is visible in the top left of the photo and follows the scattered conifers in the background. Photo courtesy of Terry Skibby and Glenn Northcross.

Pre-settlement Vegetation (Pre-1850)

Gene Hickman has researched historic vegetation at the time of European settlement using General Land Office land survey records for the Ashland area. In the 1850's ponderosa pine was the most prevalent conifer and Douglas fir was much less common. On the Ashland terrace, deep highly productive soils with adequate drainage were occupied by ponderosa pine or oak groves. Very high growth rates and large tree sizes resulted from the warm climate, ample soil moisture, or limited seasonal water table. Black oak, white oak and madrone were common with the pine. Incense cedar, hawthorn, lilac and wedgeleaf ceanothus were sometimes present.

Riparian corridors were hardwood mixtures of black cottonwood, Oregon ash, white oak, black oak, willow and white alder with occasional ponderosa pine, incense cedar or fir. Creek corridors extended upland into forested mountains. Shrubby understory was grape vines, nettles, "briars", some hazel or hawthorn.

Grasslands on flat to gentle slopes of the Ashland terrace or valley floor occurred on both loamy and clayey soils, were treeless or had scattered white oak, but sometimes black oak or pine. Seasonally wet clayey swales and small creeks with associated brush, willows, oak or conifer crossed the grasslands.

Prairies in the assessment area were generally between Bear Creek and the 1800-foot contour, below where the railroad is now except near Hamilton, Clay and Cemetery Creeks. Here, Bear Creek touched the base of uneroded sandstone supporting the terrace. Further east along Neil Creek grassland extended nearly to Siskiyou Boulevard where it graded to mixed white and black oak with pine.

Figure II-4: Looking down East Main Street to the Plaza circa 1892. The dark trees behind the Plaza buildings are growing along Ashland Creek, where Guanajuato Way is today. Note the orchards and the mixed chaparral/oak woodlands above. Photo courtesy of Terry Skibby.

Figure II-5: Southern Oregon Normal College in 1909. This was “out of town”, off of what is still called Normal Street. Note the relatively intact mixed chaparral/woodland above, on a slope between Paradise and Clay Creeks (not pictured). The small drainage behind the right tower is probably an intermittent stream. Conifers grow in the channel. Photo courtesy of Terry Skibby.

Above the terrace to about 2,800 feet on droughty soils or southern aspects either ponderosa pine or hardwoods became dominant. Both black oak and white oak were present and madrone was usually included. Douglas fir and incense cedar were minor; some oak woodland and openings were present. Whiteleaf manzanita, wedgeleaf ceanothus, lilac, willow and other shrubs was common understory. At upper elevations on granitic south aspects some sugar pine mixed with ponderosa pine; on north aspects it mixed with Douglas fir. Open canopies, especially on southerly slopes, had grass or bunchgrass.

Native Americans

At the time of European contact, the Shasta were dwelling near the confluence of Ashland and Bear Creek; some professional estimates are that a few hundred Shasta lived in and around the area where the City of Ashland sits today (LaLande, personal communication, 2007). The Takelma lived from approximately Talent to Table Rocks and upstream along the Rogue River and nearby streams (LaLande, personal communication, 2007). The "boundary" between Shasta and Takelma was fuzzy and fluctuated, so some Takelma probably did live in and around Ashland, perhaps for many thousands of years. Most Shasta tribal members lived in what is now northern California.

The seasonal nature of food availability in southern Oregon – and the hot summer weather—meant that local peoples moved around to take advantage of food resources and more comfortable living quarters. Acorns were an important food staple. Beside their semi-permanent winter villages in the valley the Shasta people used the Siskiyou ridge area and the Jenny Creek plateau area (LaLande, personal communication, 2007).

Native Americans used frequent, low intensity fire to maintain relatively open oak woodlands and ponderosa pine forests in the Ashland watershed and other areas by burning grass, duff and forest litter, and to remove seedlings and young fire sensitive understory. Sensenig found chronic fire disturbance from 1700 to 1900; 60% of the decades showed fire scarring. The Karuk and Shasta tribes in northern California burned willow clumps along the Klamath River in order to get new shoots for baskets; however, Lake (2005) determined that the Takelma did not.

Salmon were, of course, an essential part of the Shasta and Takelma's diet and culture. Native Americans throughout southwest Oregon dried salmon on drying racks as well as eating it fresh (LaLande 1995). They held annual rituals honoring the return of the salmon each year (McCowan 2004). The Takelma gathered together during salmon harvest, primarily at easier fishing sites along the Rogue River and Little Butte Creek (Labbe 1994).

Like elsewhere in the west, the Shasta and Takelma struggled to survive after Euro-American settlers arrived. After suffering disease, raids, and battles, the remaining 153 Shasta[1] and 325 Takelma were forcibly marched off in 1856 to the Siletz Indian Reservation, 150 miles north (Fattig, 2007). Some descendants of those exiled have returned to the Rogue Valley—most notably, Takelma great-

[1] See http://www.siskiyous.edu/Shasta/bib/B3.htm

grandmother Agnes Pilgrim. Agnes Pilgrim recently celebrated her 10th salmon ceremony at a sacred site along the Rogue River (Fattig 2007).

Early Settlement Vegetation 1850 to 1900

Settlers began arriving with the 1846 Applegate Wagon Train and subsequently harvested timber near where they settled, and built rough log cabins and farm outbuildings, probably using Ponderosa pine, with incense cedar fences, sugar pine shake roofs, and cord wood for fuel. Within a few years mature timber with easy access had been cut by settlers for local use. In 1850 the Donation Land Claim Act was signed into law, allowing settlers to claim for free up to 320 acres for homesteads in the Oregon Territory. Two years later the first Donation Land Claim along Ashland Creek was approved. That same year, 1852, Helman and Emery built a small water powered sawmill using a dam in Ashland Creek and flume to bring water downhill to run the mill. In 1853-1854 Abel Helman finished the first non-log house in Ashland on East Main Street. In 1855, Ashland population was 23 adults and several children. The lower parts of Neil, Clayton and Tolman Creeks were homesteaded and in 1859 the Siskiyou Mountain Wagon Road was constructed over the Siskiyou Mountains to Ashland, population 50. Orchards were started on the Ashland terrace and along the Wagon Road.

From 1850 to 1900 small scale timber harvesting continued at lower and mid elevations. Horses and oxen delivered logs to sawmills located on Ashland Creek, lower Neil Creek and lower Tolman Creek. In 1898 a second water powered sawmill began operation on upper Neil Creek. After 1900, rough cut lumber was flumed 3 miles down from the sawmill to a box and planning mill located next to the Southern Pacific Railroad linking to San Francisco and Portland markets. A second sawmill was later located upstream on Neil Creek. Steam powered donkey engines began to be used in the woods for yarding logs on steeper slopes. Ashland's population was 3,000 in 1900.

Darren Borgias analyzed John B. Leiberg's 1900 USGS report on a township by township inventory of forest resources within the Ashland Forest Reserve and Ashland Creek Watershed. Leiberg reported much of the forest had been partially logged and that most areas had been burned. For example, he found in Township 39 South, Range 1 East, which includes Ashland and the east and west forks of Ashland Creek, 8,040 acres were forested and 8,040 acres had been logged. In 1899 the first ranger had been hired to oversee protection of the Ashland Forest Preserve, initially to prevent grazing by tens of thousands of sheep within the Preserve, and later for fire suppression.

Vegetation Change after 1900

Scattered selective harvest on public and private timberlands steadily progressed into the 1930's but accelerated when Civilian Conservation Corps improved truck roads during the depression. Improved logging equipment and log trucks made timber hauling practical and widespread prior to World War II. Tractor logging and skyline-cable logging in the post-war lumber boom led to large clear cuts and intensive timber harvest, and, in 1965, a logging moratorium to protect Ashland's Municipal Water supply.

Effective wildfire suppression after 1900 and absence of frequent low-intensity burning by Native Americans has caused a dramatic vegetation change in the assessment area. Present day overstocked vegetation conditions and large areas of high fire hazard have resulted. Fuel reduction near the wildland-urban interface is beginning but dense young ponderosa pine plantations, and mature single and multi-storied stands remain. The competition and moisture stress have resulted in increased stand mortality, and insect infestation.

Fish Population

Historically, Bear Creek was teeming with salmon. The braided, meandering channel, side channels, and beaver dams provided perfect habitat for rearing young fish. Adjacent wetlands and tributaries draining forested slopes provided year-round cool water (TMDL, 2007). The valley bottom stretches of tributaries provided ideal spawning grounds for chinook and coho, while steelhead found miles of habitat further upstream. In the Ashland Watershed Assessment area, the USFS estimates that steelhead were plentiful all the way up Ashland Creek, including the first mile of West Fork and East Forks; 3-4 miles upstream of where Interstate-5 crosses Neil Creek; and within the first mile or so of Hamilton, Tolman, and Clayton Creeks (USFS 1995). Given what we know today, steelhead and coho were probably using the mouths of small intermittent streams like Clay Creek, as well as small perennial streams like Wright's Creek (e.g. Everest 1973; Wigington et al. 2006).

Records of salmon runs were not kept until after 1900, but a few anecdotes illustrate how plentiful fish were near Ashland. The ford across Bear Creek, now North Mountain Street, used to have a sign, recommending that someone had to walk across the stream first to shoo away the salmon – otherwise, all the salmon would spook the horses. Ashland Business College students packed boxes of Bear Creek fall chinook that they caught during the winter months for shipment to San Francisco (Sully 1994).

Some local fish biologists theorize that Bear Creek has always had a small coho population. They wonder if steelhead and chinook dominated Bear Creek's salmonid community, as they do today. However, others point out that lowland streams were historically the most productive (Williams et al. 2006). Bear Creek's habitat would have been ideal for coho: a low-gradient (flattish), valley bottom stream with meanders, side channels, and cool water tributaries (USFS 1995). The Southern Oregon Northern California (SONC) Coho Technical Recovery Team analyzed all the streams within the region. The Team's model, based on the underlying geomorphic and hydrologic characteristics of the landscape, predicted that Bear Creek was historically ideal (Williams et al. 2006). Overfishing, logging, gold mining, urbanization, and agriculture have all reduced and degraded fish habitat in the Rogue Basin (USFS 1995). These factors are discussed in more detail in Chapter IX of this document. Hatcheries may also have played a role, by reducing genetic diversity. Anecdotal information and records collected by ODFW biologist Cole Rivers indicate that fishery managers released 8 million hatchery salmon into the Rogue River in 1904, and 18 million in 1924 (Prevost et al. 1997). Cole M. Rivers Fish Hatchery went into production in 1976, raising chinook, coho, steelhead, and rainbow trout. Some biologists are very concerned that hatchery fish are diluting the gene pool of wild fish (research problem). Others think that hatchery fish may have been critical in populating "underutilized habitat areas in the Rogue Basin…." (Prevost et al. 1997).

Gold Ray Dam counts (Fig. II-6) illustrate both how much anadromous fish stocks fluctuate and how depressed coho stocks have been for almost 70 years. Coho stocks reached all time lows in the 1970's. In 1973, no coho were counted (by eye) passing Gold Ray Dam.

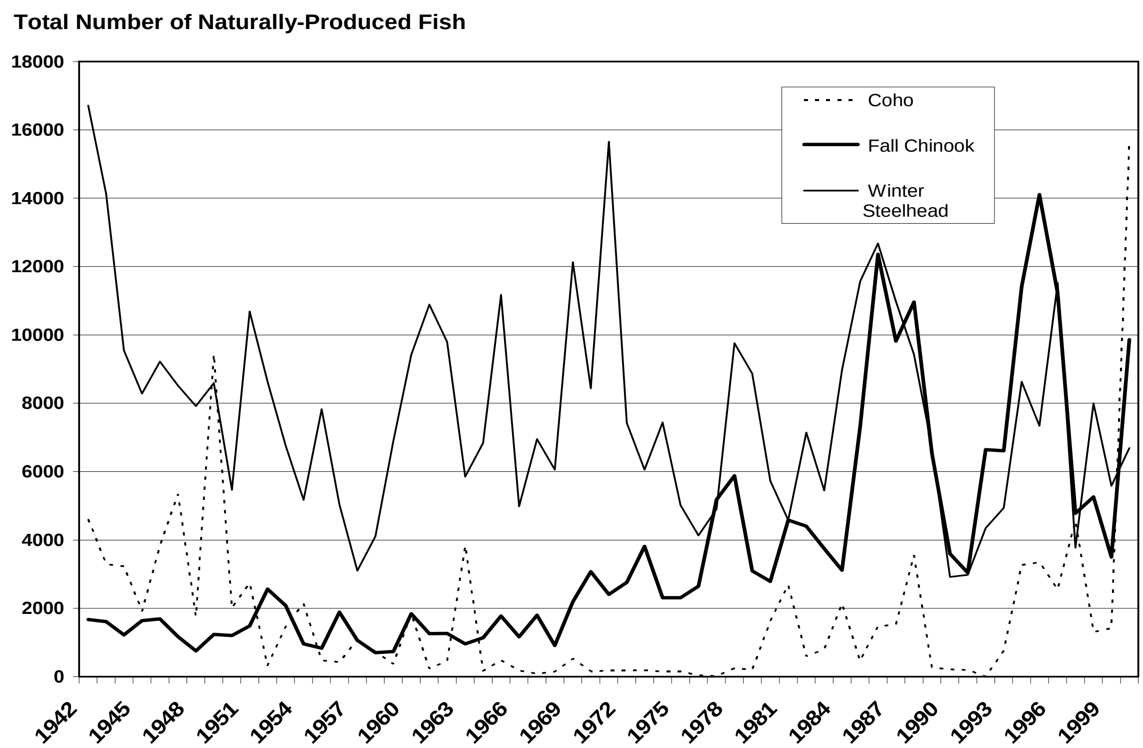

Figure II-6: Fish counts over Gold Ray Dam, Rogue River, and Jackson County, OR. Counts are of naturally-spawned populations, not hatchery fish. Prior to 1992 the count was based on visual (by eye) 8 hour/ 5 days per week counts and expanded to estimate annual counts. From 1992 to present the count has been done with a video camera. Data: ODFW via StreamNet (www.streamnet.org).

Comparing "Before and After" Photos

The City of Ashland has posted aerial photos from 1939 on its website[2]. In 1939, the City of Ashland was still concentrated between Maple and Wightman Streets. Orchards still dotted the hills behind Scenic Avenue. Very few people lived along Clay, Hamilton, or Tolman Creeks. Very few houses had been built

[2] http://www.ashland.or.us/Page.asp?NavID=8995

along Bear Creek, although its floodplain had been cleared for agriculture for many decades.

Although the date seems in the far distant past for some readers, other readers may have been born before 1939 – less than 70 years ago. Eighty years had passed since the first Easterners staked land claims, so the photos are not a record of pre-settlement. However, they are a record of the era before the post-WWII boom of the 1950's and the engineering boom of the 1960's.

In Figures II-7, II-8, and II-9, 1939 aerial photos are compared side-by-side with a 2005 aerial photo of the same location. Aerial photos are taken looking straight down from a camera attached to the belly of an airplane, so they are like a photographic map. Some oblique views – what we normally see when standing on a mountain top – are included to help the reader visually negotiate the photographs.

The photo comparisons illustrate how development over the last few decades has changed stream environments in and around Ashland. The 1939 aerial photos were taken only 15 years after the construction of the first Emigrant Dam, so the channel braiding and wide gravel/cobble bars so historically characteristic of Bear Creek were still intact. Channel braiding creates a lot of habitat complexity for fish, insects, and other aquatic wildlife, created by the interplay of water and stone: the geomorphology of the channel itself. In the 1939 photos, these braided channels can be seen in several locations, on both sides of what is now North Mountain Street Bridge (Fig.II-7); near the mouth of Clay Creek (Fig.II-8); and at the confluence of Neil and Bear Creeks (Fig.II-8.).

An Explanatory Note about Channel Braiding

Because the Bear Creek valley is so flat at the base of the steep Siskiyou slopes, the stream accumulates sediment of all sizes, from sand to boulders. Steep streams flow faster and move rocks more easily, especially during floods. Valley-bottom streams need larger floods to move rocks downstream. Hence, gravel and cobble tend to accumulate in valley bottoms, especially when tributaries drain erosive slopes like the granitic mountain soils above Ashland. Winter floods move that sediment downstream, and redeposit it at bends, obstructions, and especially at tributary junctions. This creates a "braided system:" many small "islands" or bars of cobble and gravel – even sand – with smaller channels in between. The bars are usually in a constant state of flux as is the riparian vegetation growing on them. (See "Chapter 3: Stream Channel Classification" for more information.)

The floodplains along streams in the Ashland Assessment area – with the exception of Ashland Creek – were generally undeveloped in the early 20th century with more side channel and complex instream habitat. Floodwaters could spread out and slow down, which meant that floods caused less damage to banks and property. The change in floodplain development can be seen in Fig. II-7: new housing units have been constructed just off North Mountain Avenue near the bridge. In the 1939 photo, this area is braided channel. More recent (and as yet, uncompleted) development is taking place in the wide, flat area across the creek from Nevada Street and down the hill from North Mountain

Avenue. All of this is much easier to see in Figure II-10, the oblique (normal view) angle of the same location, looking downstream instead of due north.

The photo comparisons in Figures II-8 and II-9 showcase floodplain development along lower Neil Creek. In Figure II-8, one can see that the Ashland airport has been constructed in the floodplain at the confluence of Neil and Bear Creeks. Neil Creek has been channelized with boulder rip-rap along portions of the airport. There are also houses and businesses near the stream (including storage units visible as tiny rectangles in the bottom right of the photo). Again, the oblique photo in Fig. II-11 makes it much easier to see how the Ashland airport is laid out alongside Neil Creek. Rural residential development along Neil Creek is visible in Figure II-9.

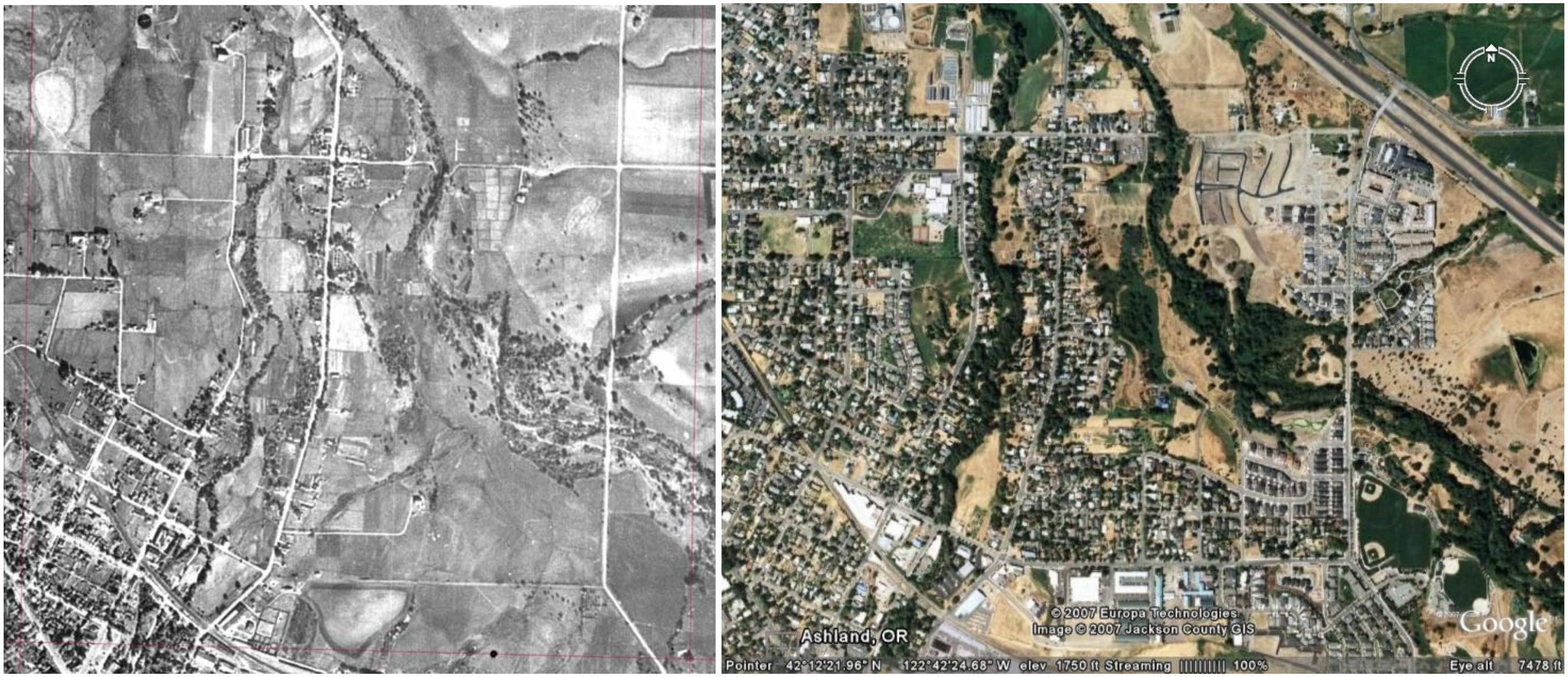

Figure II-7: 1939 aerial photo on the left; 2005 aerial photo on the right. This view is of Bear Creek flowing lower right to upper center, and Ashland Creek flowing from lower left to upper center. The rectangle of streets is Oak Street on the left, North Mountain Street on the right (note North Mountain Park baseball fields in 2005 photo), Hersey Street below; Nevada Street above.

Figure II-8: 1939 aerial photo on the left; 2005 aerial photo on the right. Neil Creek flows from the lower right to the right center of the photo, and enters Bear Creek. Just upstream (to the right) of where Neil and Bear Creeks join is an example of a braided channel with shrubs in the braided channel area. Hamilton Creek flows from the lower center of the photo straight north to the upper center of the photo where it meets Bear Creek (almost under I-5 in the 2005 photo). A little ribbon of green shrubs marks the course of Clay Creek, to the left of and paralleling Hamilton Creek. The road on the bottom is Ashland Street (Hwy. 66). The road on the top in both photos is East Main Street. The recent photo, of course, shows Interstate 5 and the Ashland City airport.

Figure II-9: 1939 aerial photo on the left; 2005 aerial photo on the right. Neil Creek flows from the lower right hand corner through the middle of the photos to the upper right corner. Hwy. 66 almost parallels the stream. Crowson Road and Tolman Creek enter from the lower left and meet with Hwy. 66 and Neil Creek, respectively, in the center of the photos. The 2005 photo shows the Oak Knoll golf course and the blue rectangles of storage units along Neil Creek.

Figure II-10: Oblique view of Bear Creek. North Mountain Avenue runs across the bottom right corner of the photograph. Oak Street cuts diagonally across the top left corner. The brown squares and short dirt roads in the upper right are the beginning of the new housing development off of North Mountain Avenue, and the grey and white houses in the bottom right corner are constructed on old stream channels within the floodplain. The densely situated houses on each side of the photo are located higher up on terraces. Photo © Fred Stockwell, Stockwell Photography.

Figure II-11: Oblique view of Neil and Bear Creeks with the Ashland airport between them. Interstate-5 crosses the top left corner of the photograph and East Main Street crosses I-5 and then snakes alongside Neil Creek. Photo by Fred Stockwell, Stockwell Photography

One of the most obvious changes apparent in the photo comparisons is the amount of land surface that was developed with buildings; most of this development happened after the 1960's. The result was the conversion of rain-absorbing soil and plants into impervious surfaces. Rain water now runs off roofs, parking lots, and streets into storm drains and directly into creeks. In addition to washing oils, chemicals, and other residue into streams, the sudden influx of water from storm drains quickly increases the height and force of water flowing down a stream, which can cause erosion and flooding. Please see Chapters IV ("Hydrology"), VI ("Sediment"), and VII ("Channel Modification") for more information.

Big Floods

Ashland has experienced a very large flood, on the order of a 30- to 100-year return interval, in 1853,1861, 1890, 1927, 1948, 1955, 1964 (the largest), 1974, and most recently, 1997 (City of Ashland, undated). Both the floods of 1974 and 1997 were only 30-year return interval floods. Return interval does not mean that we experience such a flood every 30 years. Floods are like flipping the coin: you still have a 50% chance of getting "heads" if you flipped "heads" last time. When Ashland experiences several inches of rain at the same time that warm air comes in and melts the snowpack, there is a flood. These early winter storms usually come in December or January (see "Chapter IV: Hydrology and Water Use" for more information).

Although only a 30-year event, the 1974 flood interrupted Ashland's domestic water system, destroyed bridges, and caused an estimated $1.5 million in damage to Ashland city property alone (in 1974 dollars). Water poured down Winburn Way (Fig.II-13) and Water Street. Guanajuato Way took the brunt of the damage (Fig.II-13). Peak discharge of Ashland Creek was 1350 cubic feet per second (cfs) (City of Ashland, undated).

The 1997 New Year's Day flood was another 30-year event, but seemed larger. There were $4.5 million in damages in Ashland alone. Ashland Creek completely flooded Lithia Park and all the plaza businesses along the creek (Fig.II-12). There was so much water in Websters that the shelves were tipping over (J. Fields, personal communication, 2007). Ashland Creek poured down

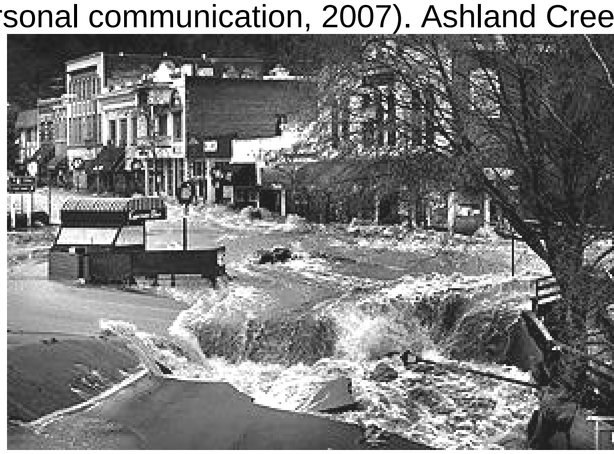

Figure II-12: Ashland Creek roars past the Plaza businesses during the 1997 New Year's Day Flood. Photo: Mail Tribune.

Figure II-13: 1974 Flood. Top Left: Ashland Creek flooding Lithia Stationers viewed from Lithia Park. Top Right: Winburn Way covered with water. Bottom Left and Right: Guanajuato Way from North Main Street. There used to be a walkway on each side, with a playground. Photos © by Connie Battaile.

Water Street (Fig.II-14), finally spreading out onto the fields below the Community Gardens which provided a relief area for floodwaters to spread without causing severe property damage. The smaller mountain streams also raged. A local Ashland resident remembers Hamilton Creek "sounded like a train rushing down the ravine[3]." Southern Oregon University professors Eric Dittmer and Charles Lane calculated Ashland Creek's peak discharge in upper Lithia Park at 3000 cubic feet per second (E. Dittmer, personal communication, 2007).

[3] Quote from on-line forum: www.dailytidings.com/2006/1230/stories/1230_flood.php.

Figure II-14: The 1997 flood, and today. Top: from Water Street Bridge, looking downstream. Bottom: From Water Street looking across empty lot downstream of the Ashland Creek Inn, today. The present-day photo of this bottom pair is not an exact match of the 1997 flood photo, but was taken at the same location (note tree branch shape and trunk angles). Photos on the left © Roger Christianson, on the right by Jeannine Rossa.

Timeline of Human Activities Affecting Streams in the Ashland Assessment Area[4]

Before 1850 - Shasta village situated above the banks of Ashland Creeks near the Bear Creek confluence. The channel itself was braided and brushy (Parker, pers. comm.)
1827 – Peter Skene Odgen arrives; the Hudson Bay Company trappers severely reduce beaver populations.
1852 - First Donation Land Claims filed for land along Ashland Creek. (Note: gold had already been discovered near Jacksonville.)
1852 - Abel Helman and the Emery brothers build water-powered sawmill on banks of Ashland Creek. (This kind of mill needed a small dam to route water through a flume downhill to the mill. The water powered the mill wheel and then flowed back into the stream. Ashland Creek is a pretty large stream; however, it is possible that this and other water-driven mills almost dried up the creek during the summer months.)
1854 - Helman, Emery and M. B. Morris built a (water-driven) flour mill along Ashland Creek at what is now the open lawn at entrance to Lithia Park.
1855 - Abel Helman wanted to establish a town, so he gave away twelve lots around the open space in front of the mills as a nucleus for a permanent town site. A blacksmith shop, meat market, carpenter and cabinet shop, and wagon shop moved in. This area is the plaza today.
1855 - Ashland had 23 adult residents and a handful of children.
1861 – Commercial fishing starts on the Rogue River (Prevost et al. 1997).
1867 - The Ashland Woolen Mills was built on Ashland Creek where the building housing Hanson Howard Gallery/Thai Pepper/ now stand. It made underwear, hosiery, and shawls and blankets. The mill operated day and night six days a week. Everything was made from wool produced locally. (During the late 1800's, tens of thousands of sheep were grazed in mountain meadows in what are now the Rogue River National Forest and the Cascade-Siskiyou National Monument. Although smaller and lighter than cattle, sheep crop vegetation very close to the ground while grazing. Some local plant ecologists believe that sheep grazing was responsible for significant vegetation changes and erosion problems, especially in the soft granitic soils near Mt. Ashland.)
1874 – Ashland population 300 (only Caucasians counted).
1880's - RR line completed (with stream crossings).
1888 - Ashland Electric Power and Light Company obtained water rights from Ashland Creek and built a power plant where the tennis courts are now in Lithia Park.
1891 - Gold discovered in hills above what is now Park Street. Tunnel dug to follow gold in quartz vein. Only about $500,000 gold found. Mine closed 1942 as war-time measure.
1890's – Chautauqua lecture series incredibly popular. People traveled from all over area to camp along banks of Ashland Creek, now Lithia Park.
1900 – Population 3000.
Early 1900's – There was a water-driven sawmill on Ashland Creek, just above the plaza (next to old flour mill?), and another on Neil Creek, south of town.
1904 - City installed a comprehensive sewer system.
1906/7 - President Teddy Roosevelt expanded area of the Ashland watershed designated for city water production via presidential declaration.
1908 - City voted to dedicate old mill site as well as all city-owned property (except not the quarry and a few other spots) forever as a city park: the beginnings of Lithia Park. Old flour mill and adjacent stock pens torn down. Team hitching and watering area had been near old mill. A new hitching rack was provided on Water Street "where will be found cool shade and plenty of water from Ashland Creek..."
1910 – Huge forest fires in the upper Ashland Creek watershed (USFS 1995).
1916 - Auto campground established on the banks of Ashland Creek.

[4] Facts are from O'Hara (1981) except for flood dates and as otherwise noted. Parenthetical commentary provided by chapter's author.

1916 – Talent Irrigation District established to serve commercial orchards. Ashland area orchards shipped thousands of boxes of fruit by train.
1921 – Savage Rapids Dam on the Rogue River is built to divert water for irrigation. Fish ladders are poorly designed and to this day only allow limited fish passage[5].
1924 – Emigrant Dam (smaller concrete version, 110' high) constructed for irrigation.
1928 - Reeder Reservoir constructed. Crowson Reservoir on Terrace Street also constructed as part of same project.
1929 - City and U. S. Department of Agriculture enter a cooperative agreement to conserve and protect the City's water supply.
1935 – The Rogue River closed to commercial fishing (LaLande 1995).
1940 – New Highway 99 constructed from Ashland to California state line (requiring stream crossings at Neil Creek among others.)
1940 - Population 4,744.
Post-war II: To serve the post-war housing boom, almost a dozen family-owned sawmills started up in and near Ashland. (These mills all needed log ponds and big flat areas for lumber yards, so tended to be near streams). Most folded in 1950's when large wood manufacturers moved into Rogue Valley.
1948 - Bond passed to build water treatment and filtration plant and a concrete reservoir on Granite Street.
1949 - Sumner Parker leases to the City the 2600' foot gravel airport runway he developed on his farm near junction of Dead Indian Memorial Rd. and Hwy. 66.
1959 - Large wildfire in Ashland watershed. Burned 5000 acres.
1960 – Ashland population 9,119.
1961 – Emigrant Dam (and lake) reconstructed by U.S. Bureau of Reclamation as part of an effort to increase irrigation water supply by capturing water from the Klamath River system[6].
1963 and 1964 - Mt. Ashland Lodge and ski area constructed.
1964 – Christmas Day, a 100-year flood rages through the area's streams and rivers.
1966 - Interstate 5 opened from Ashland to state line. Construction requires channelizing part of Bear Creek where it crosses under I-5. Culverts to pass Hamilton Creek and Neil Creek cause fish passage and water flow problems to this day.
1968 – City opens new Ashland Airport at site of old gravel runway. Neil Creek channelized as a result.
Early 1970's - Bramble-choked Ashland Creek behind the Plaza buildings became an extension of Lithia Park called Guanajuato Way.
1974 – Another December flood. Although only a 30-year event, water interrupted city's domestic water system, destroyed bridges, and caused an estimated $1.5 million in damage to Ashland city property alone (in 1974 dollars). Guanajuato Way was extensively damaged along with the rest of the low-lying areas of Lithia Park.
1988 – Dissatisfied with a 1978 Federal Emergency Management Agency (FEMA) floodplain study, the City of Ashland conducts its own floodplain study to map the 100- and 500-year floodplains on Ashland and Clay Creeks (City of Ashland, undated).
1993 – Population 16,840 (USFS 1995)
1997 – New Year's Day flood. Another 30-year event in Ashland (severity varied across the region). Ashland Creek completely flooded Lithia Park and all the plaza businesses. $4.5 million in damages in Ashland alone.
2007: Population 21,430 (www.co.jackson.or.us)

[5] See BOR website: http://www.usbr.gov/pmts/sediment/projects/SavageRapids/SavageRapids.htm.
[6] BOR routes water into Emigrant Lake from Keene Creek, a Klamath River tributary, via an intricate system of dams and siphons. See the Talent Irrigation District website: http://www.talentid.org/mn.asp?pg=DistrictHistory.

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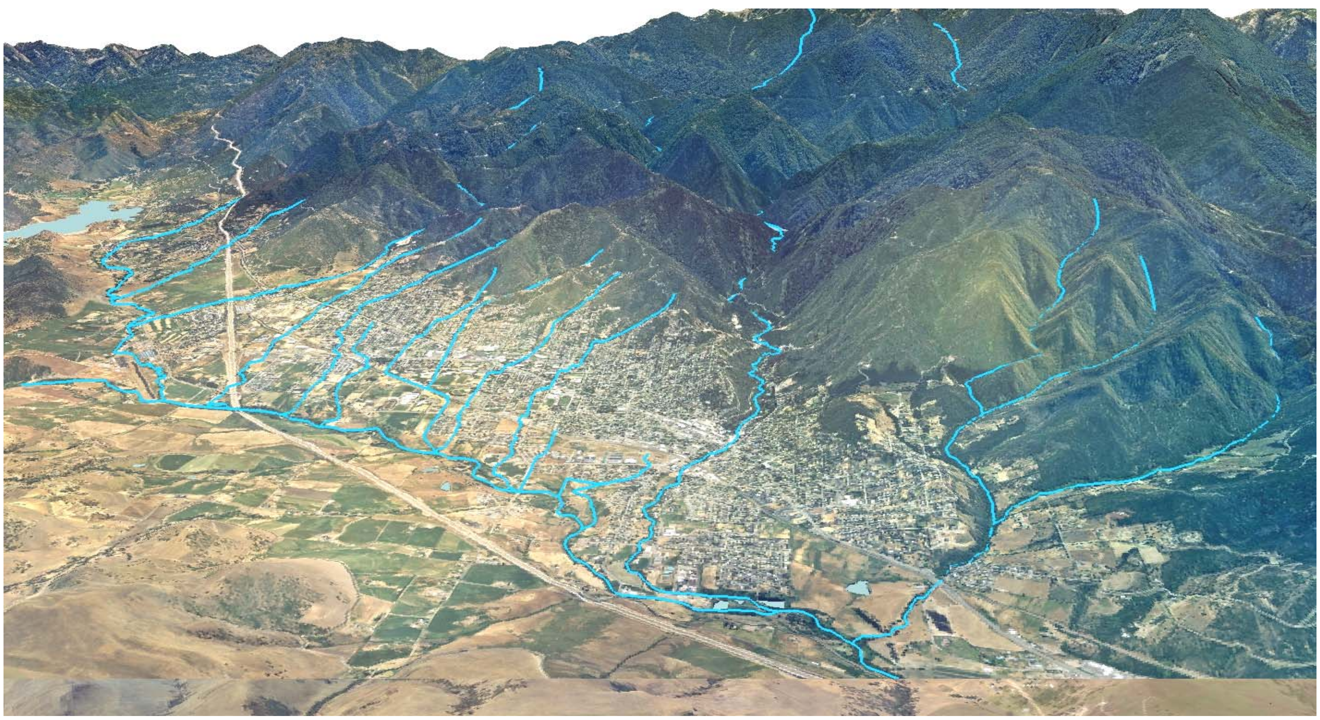
CHAPTER III: STREAM CHANNEL CLASSIFICATION

Introduction

Watersheds drain water. When precipitation falls on a land surface, some of the water usually soaks into the ground, some of it flows downhill. The water moving downhill accumulates to form a stream system that typically has a branching pattern with smaller streams joining to form larger streams. Like tree branches, stream branches can connect to larger branches and likewise, small watersheds can be part of larger watersheds.

Water has an amazing ability to change the surface of the earth. Even relatively small streams can carry large amounts of material. Over geologic time, these streams form valleys and channels, the size of which is determined by their age, amount of water they carry and the underlying geology. Figure III-1 shows the topography of the project area and the various valleys associated with the streams. Map 10 (Streams & Channels) and Table III-1 lists the watersheds that were delineated for this assessment.

Figure III-1: Topography of the Ashland Area



The size, shape and use of streams vary dramatically across a watershed and an understanding of these differences is essential for a thorough watershed analysis. The size and shape of a stream channel at any given location is determined by the patterns of water flowing through the stream. These patterns are influenced by climate and the stream's topography which, in turn, is influenced by the geology of the area. Streams in areas with higher amounts of precipitation and with highly erosive soils and rock will have a different shape and size than sites with low amounts of precipitation and less erosive geology.

Table III-1 Area of selected drainages

	Drainage	Area - Acres
1	Wagner-Wrights S End	981
2	Wrights Ck	2068
3	Wrights-Ashland	495
4	West Fork Ashland Ck	6966
5	Lower Ashland Ck	3777
6	East Fork Ashland Ck	5191
7	Ashland-Clear	40
8	Clear Ck	127
9	Clear-Mountain	23
10	Mountain	400
11	Beach	359
12	Beach-Roca	70
13	Roca	369
14	Paradise	588
15	Paradise-Cemetery	110
16	Cemetery	425
17	Cemetery-Clay	20
18	Clay	953
19	Clay-Hamilton	59
20	Hamilton	539
21	Hamilton-Neil	30
22	Tolman Ck	1702
23	Clayton Ck	2146
24	Lower Neil Ck	1482
25	Upper Neil Ck	8321

Climate

The climate of the Ashland analysis area is heavily influenced by the western Cascade Mountains and the eastern Siskiyou Mountains. This area tends to have high summer temperatures and low annual precipitation, which varies by elevation. At Ashland (elevation approx. 1,800 ft), the average annual rainfall is 18.68 inches, while at the 3,500-foot level about 30 inches of rainfall occurs on average, and at the crest of Mt. Ashland (elevation 7,533 feet), 60 inches of precipitation is recorded. Snow is unusual at lower elevations, but the higher elevations in the watershed have annual snowpacks that supply summer flows to Ashland and Neil Creeks [1]. The hydrology component, Component 4, discusses the relationship between precipitation and streamflow in more detail.

Temperatures in the watershed vary significantly due to elevation, with summertime temperatures at Ashland being 15-25°F higher than mid- and high-elevation areas in the drainage basin [2]. Wintertime temperatures vary with elevation but are typically 15°-20°F warmer at lower elevations than at mid- to high-elevations in the watershed [1].page 97. Additional climate information can be found in the report "Climate of Jackson County" [3] http://www.ocs.orst.edu/county_climate/Jackson_files/Jackson.html

Geology

Map 6 (Geology) and Table III-2 shows the geological features of the assessment area. The underlying geologic formation is the Mount Ashland batholith, which includes granitic rock structures that are readily decomposed and contribute to the typical rounded stream cobbles and coarse sand seen in Ashland Creek. The weathering of granite rocks commonly produces a soil profile with three distinct zones which are easily distinguished by their physical properties. These three zones are: soil, decomposed granite, and disintegrated granitics. The soil surface zone is generally composed of silty sand to sandy silt, and ranges from a few inches to about one foot in thickness [1]. The alluvial valley associated with Bear Creek is composed of loose sand and gravel that forms the flood plain.

Table III-2 Legend of Geology Symbols for Map 6 (Geology)
(Geologic Map of Oregon, Explanation Sheet, USGS 1991)

Kc Classic sedimentary rocks (Upper and Lower Cretaceous) — Locally fossiliferous sandstone and conglomerate; marine fossils indicate Early Cretaceous age.
KJg Granitic rocks (Cretaceous and Jurassic) - Mostly tonalite and quartz diorite but including lesser amounts of other granitoid rocks.
Qal Alluvial deposits (Holocene) - Unconsolidated sand, gravel and silt forming flood plains and filling channels of present streams. Along the Rogue and its tributaries consists of poorly sorted gravel and sand.
Qf Fanglomerate (Holocene? and Pleistocene) When a series of conglomerates accumulates into an alluvial fan, in rapidly eroding environments, the resulting rock unit is often called a fanglomerate.
Qls Landslide and debris-flow deposits (Holocene and Pleistocene) - Unstratified mixtures of fragments of adjacent bedrock. Locally includes slope wash and colluvium. Largest slides and debris flows occur where thick sections of basalt and andesite flows overlie clayey tuffaceous rocks. Unstable and easily saturated topsoils.
Tib Basalt and andesite intrusions (Pliocene, Miocene, and Oligocene?) - Sills, plugs and dikes of basaltic andesite, basalt, and andesite. Mostly represents feeders, exposed by erosion, for flows and flow breccias of units Tba and Trb. Includes a few dikes of hornblende and plagioclase porphyritic andesite, commonly altered, and aphyric basaltic andesite that probably were feeders for parts of unit Tub.
Tmv Mafic vent complexes (Miocene) - Intrusive plugs and dike swarms and related near-vent flows, breccias, cinders, and agglutinate of basaltic andesite, basalt, and andesite; commonly in the form of eroded piles of red, iron-stained thin flows, cinders, and agglutinate cut by mafic intrusions.
Tn Nonmarine sedimentary rocks (Eocene) - Continentally derived conglomerate, pebble conglomerate, sandstone, siltstone, and mudstone containing abundant biotite and muscovite. Dominantly nonvolcanic; clastic material derived from underlying older rocks.
TRPzs Sedimentary rocks - partly metamorphosed (Triassic and Paleozoic)
Tu Undifferentiated tuffaceous sedimentary rocks, tuffs, and basalt (Miocene and Oligocene) - Heterogeneous assemblage of continental, largely volcanogenic deposits of basalt and basaltic andesite, including flows and breccia, complexly interstratified with epiclastic and volcaniclastic deposits of basaltic to rhyodacitic composition.

Stream Channel Classification

Stream segments at different locations within the watershed tend to have different channel characteristics. These characteristics such as size and shape determine how the channels function under different conditions and, in turn, determine how they are used by aquatic life. Classification of stream channels enables one to systematically compare and assess stream channel condition and functionality throughout a project assessment area. There are a number of different channel classification systems that are commonly used to assess the watersheds. The following section lists three; beginning with the most basic.

(1) Classification by channel size:

Channel size is usually the first thing considered when assessing a stream at a particular point. Since channel development is related to flow and the amount of streamflow at a particular point is related to the area of land contributing water to the steam at that point, a measurement of this upslope contributing area provides an indication of the channel at that point. Streamflow is related to the area of uplands contributing water to the stream, a measurement of the upstream contributing area provides a unique value that characterizes the channel at that point.

Table III-1 shows the areas of the subwatersheds (smaller watersheds within a larger watershed) that are delineated in Map 10 and characterizes the channels at the points which they exit the subwatershed. Areas of other points along the channels can be estimated from the map or measured directly using area measurement tools. Another indicator of stream size is to use a map to measure the stream distance to the furthest upstream point.

Stream size should always be considered when comparing streams, evaluating water quality or flow data and when planning any in-stream project or activity.

(2) Stream Transport Classification System

Another stream classification system classifies and defines streams as source, transport, or depositional streams[4]. Source streams are defined as steep gradient (>16%), confined, mountain streams that are void of a floodplain. These streams have high energy and can carry wood and sediment downstream to the lower reaches. Transport streams generally have a moderate gradient (3% to 16%) and are confined to narrow valleys. These streams may have small floodplains and temporarily store wood and sediment but they will eventually transport the wood and sediment to the downstream reaches during higher flow events. Depositional streams are the low gradient streams (<3%) and they have low-energy and tend to store wood and sediment for long periods of time. These streams are typically found in valley bottoms and have large floodplains.

Figure III-2

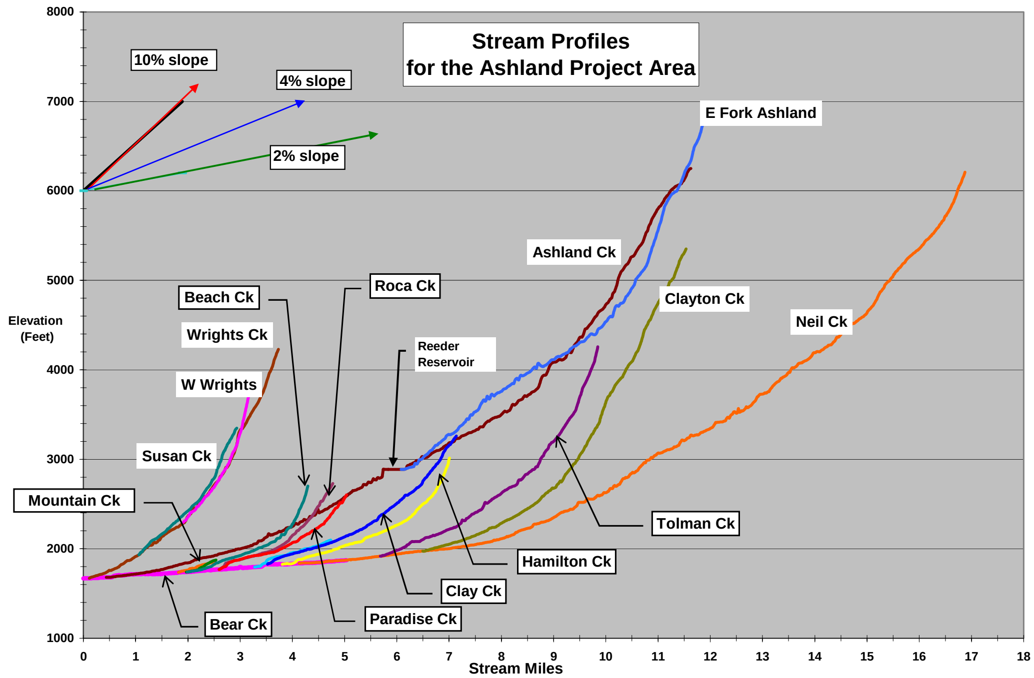


Figure III-2 shows the slope pattern and [Map 3](#) (Deposit, Source and Transport Classification) shows the transport classification for many of the streams in the project area. It should be noted that most of the medium and small streams are in the transport category. This is an indication of a relatively stable channel with a low tendency to meander.

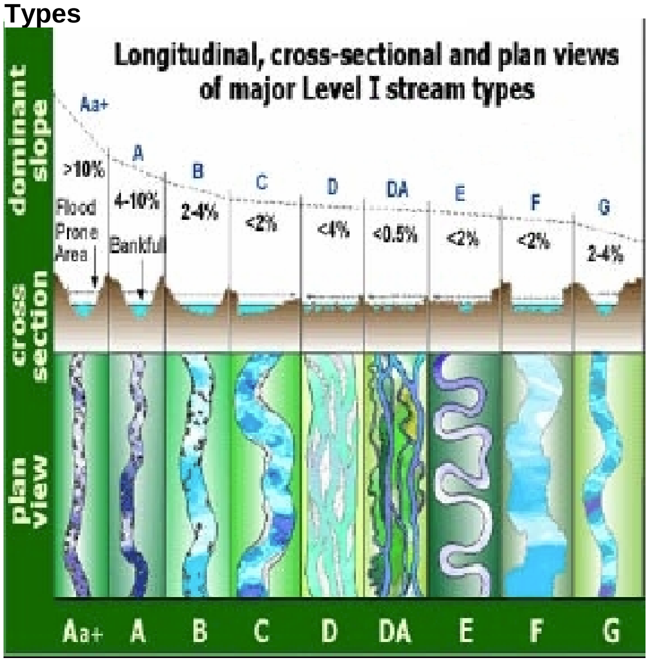
An interesting exception is the artificial channel on the lower portion of East Paradise Creek which is essentially a ditch. It is possible that this segment of stream could have some sediment deposition issues.

(3) Rosgen Stream Classification System

In 1994 David Rosgen published a paper that provided a detailed classification system for natural rivers [5]. This system provides a methodology for classifying a stream into about 150 different categories. A detailed Rosgen classification involves measurements of stream gradient, channel size and shape and bed composition. For the purpose of this study a level I classification was made to provide overview information. A detailed classification is recommended for critical projects. A good overview of the Rosgen stream classification system can be found at this site: http://www.epa.gov/watertrain/stream_class/

Map 4 (Rosgen Stream Classification) shows some level one classifications and Figure III-3 shows some basic characteristics of the classifications.

Figure III-3 Rosgen Level I Stream Types



Urban Stream Classification:

The Ashland urban environment strongly affects the distribution of water in the streams that flow through the city. As a result, these urban streams cannot be expected to have the same characteristics as similar natural streams. Introduced water for irrigation, impervious land surfaces, retention ponds and redirected stormwater all affect the hydrology of Ashland's urban streams. Also, due to the concentrated population, the urban streams are more susceptible to water quality problems.

The classification used for natural streams can serve as a starting point for management of an urban stream, as discussed in components VII and VIII. The urban stream may need to accommodate a significantly altered flow regime. Generally bankfull and flood flows determine the local channel configuration. If the urban modifications are causing these flows to increase, channel instability and increased erosion can be expected downstream of the modifications. Likewise, a reduction in effective flows may result in gradual channel filling. In a natural channel, bankfull flows occur about twice a year on the average. Frequent high flows in an urban channel could be an indicator of potential channel adjustment problems.

Low gradient ditches and detention ponds will generally accumulate sediment and will lose effectiveness unless provisions are made for sediment removal.

General Application to the Ashland Assessment Project

Map 10 (Streams & Channels) shows the streams and watersheds in the project area and Figure III-2 shows the relative slope and length of the main streams. Note that many small streams drain directly into Bear Creek and there are small frontal drainage areas located between these streams that "face" Bear

Creek. These frontal drainages can be easily identified by their hyphenated names in the map legend and in Table III-1.

Bear Creek is the largest stream in the project area and the one to which all other streams drain. It has a drainage area of 168 square miles and the distance from the mouth to the furthest headwater ridge is 20 miles. The flow is influenced and regulated by the Emigrant Creek reservoir. Streams this size have sufficient flow to form a low gradient channel constrained only by major geological features. These low gradient streams will typically have large flood plains and a sinusoidal (“s-shaped”) meander pattern. Their channels tend to be responsive to changes in the flow regime and to changes in sediment loading.

Ashland Creek and Neil Creek represent the medium sized streams in the study area. Ashland Creek has a watershed area of 25 sq miles and a maximum stream length of 11.5 miles while Neil Creek has an area of 21 sq miles and length of 12.7 miles. The mid to lower portion of this type of stream typically has a well-defined channel and is relatively stable with minimal sediment deposition. These channels are usually large enough to support resident and anadromous fish.

There are numerous small streams in the study area, many of which are located within the city limits of Ashland. Small streams have smaller flows and consequently their channels are often not as well developed as those of the large channels and may be more sensitive to increases in the flow regime. Since these channels are relatively steep, they have little sinuosity. Any alteration or “improvement” to the channel should be made with care since it may cause local erosion. Special attention should be made to maintaining channel capacity (the ability of the channel to carry water) and an appropriate channel gradient. If a stream channel is changed to allow more or less water to be carried or if the slope of the stream channel is changed, downstream sites may be affected even though they may be some distance from where the stream channel was initially altered.

Also to be considered are the small incipient channels that are found at the furthest upstream point where the channel is first detected. These channels tend to be ignored because of their small size but are often the first to respond to changes in surface water flow due to project development. For example, a structure or road may be built over an incipient channel without appropriate provisions for drainage. This could result in an accumulation of moisture upslope and a water deficiency downslope. The possible consequences could include gully development, road failure, and dying trees due to the change in moisture regime. It is ironic that these incipient channels receive less attention because, due to the hierarchal nature of the stream network, they are the most common and typically receive more impacts than the larger channels.

The frontal drainages that border Bear Creek are of special interest because they contain small and incipient channels that drain directly into Bear Creek. These channels are particularly sensitive to erosion due to their low gradient and the alluvial (water transported) soils in the area. Also, any problem with contamination or increased sedimentation will directly affect the aquatic resources associated with Bear Creek. These channels also tend to be overlooked or ignored.

Ditches are artificial channels that should also be considered in the incipient category. Ditches often redistribute the water between drainages which causes an imbalance in the natural drainage system. For example, if a relief culvert (ditch drain) dumps extra water into the upper part of a small drainage, the additional moisture will move downslope through the ground and can cause upslope channel migration or even a larger slope failure.

REFERENCES

1. RVCOG, *Bear Creek Watershed Assessment - Phase II, Part I & II*. 2001, Bear Creek Watershed Council: Medford, Oregon.
2. USDA, *1995 Bear Watershed Analysis*. 1995, Ashland Ranger District: Ashland, Oregon.
3. Taylor, G., *Climate of Jackson County*. 2005, Oregon Climate Service: Corvallis, OR. p. 6.
4. Leopold, L.B., *A View of the River*. 1994, Cambridge: Harvard University Press. 298.
5. Rosgen, D., *A Classification of Natural Rivers*, in *Catena*. 1994, Elsevier Science: B.V. Amsterdam. p. 169-199.

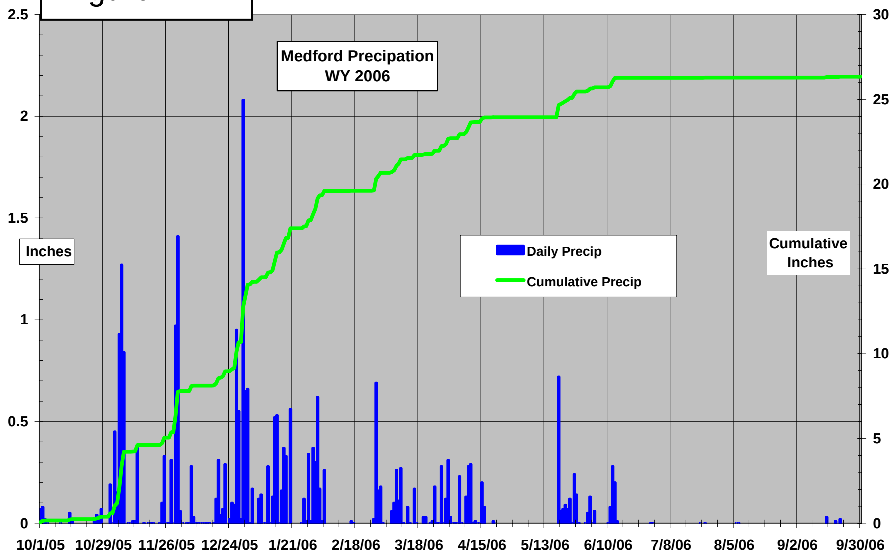
CHAPTER IV: HYDROLOGY & WATER USE

Hydrology is the field of study that includes the movement of water into and through a watershed. The hydrological response of a watershed is driven by the climate, precipitation in particular, as well as the geology of the area which determines the topography and the soil features. The quantity and timing of the water leaving a watershed is dependent upon the net input, storage, and losses associated with evapotranspiration and consumptive withdrawals. Some of these factors can be influenced by human activities thus affecting stream flow. This section looks at the stream flow patterns associated with the drainages in Map 10 (Streams & Basins).

Sources of water

Precipitation

Figure IV-1



Precipitation is the principal supplier of water for the streams and it varies throughout the year and at different locations. Wet winters and dry summers generally define the temporal component and elevation strongly affects the spatial component as discussed in Chapter III. Map 5 (Annual Precipitation) shows how the annual precipitation in the area varies with elevation. Figure IV-1(precip pattern) shows a typical precipitation record as measured at Medford for the 05-06 water year. The cumulative precipitation shows a total of about 37 inches total for the year. Table IV-1 shows the monthly variability for Ashland compared with other locations in the region. Table IV-2 shows the number of days per month that a particular amount of precipitation will be exceeded.

Table IV-1: Average Monthly Precipitation

Precipitation, Monthly and Annual Averages (1971-2000)													
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ashland	2.49	1.92	2.09	1.68	1.55	0.92	0.51	0.61	0.88	1.46	2.85	2.80	19.76
Howard Prairie Dam	4.85	3.86	3.72	2.39	2.06	1.28	0.58	0.72	1.07	2.04	4.79	5.21	32.57
Medford WSO AP	2.47	2.10	1.85	1.31	1.21	0.68	0.31	0.52	0.78	1.31	2.93	2.90	18.37
Prospect 2 SW	6.08	5.03	4.71	3.19	2.61	1.15	0.64	0.87	1.43	3.02	6.70	6.80	42.23
Ruch	3.79	3.10	3.05	1.80	1.27	0.76	0.49	0.53	0.97	1.70	3.98	4.30	25.74

Table IV-2: Precipitation Thresholds for Ashland

Average number of Days with Selected Precipitation Amounts, Ashland, 1971-2000													
Threshold	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
.01"or more	12.8	11.9	13	11.8	9.1	5.5	2.7	3	4.4	7.6	14.3	13.7	109.3
.10"or more	6.1	5.4	6.4	5.7	4.6	2.8	1.4	1.5	2.5	4.3	7.6	7	55.6
.50"or more	1.3	0.8	0.9	0.5	0.5	0.5	0.3	0.4	0.4	0.7	1.5	1.5	9.3
1.00"or more	0.4	0.1	0.1	0	0.1	0	0.1	0	0.1	0.1	0.2	0.3	1.6

Snow Pack

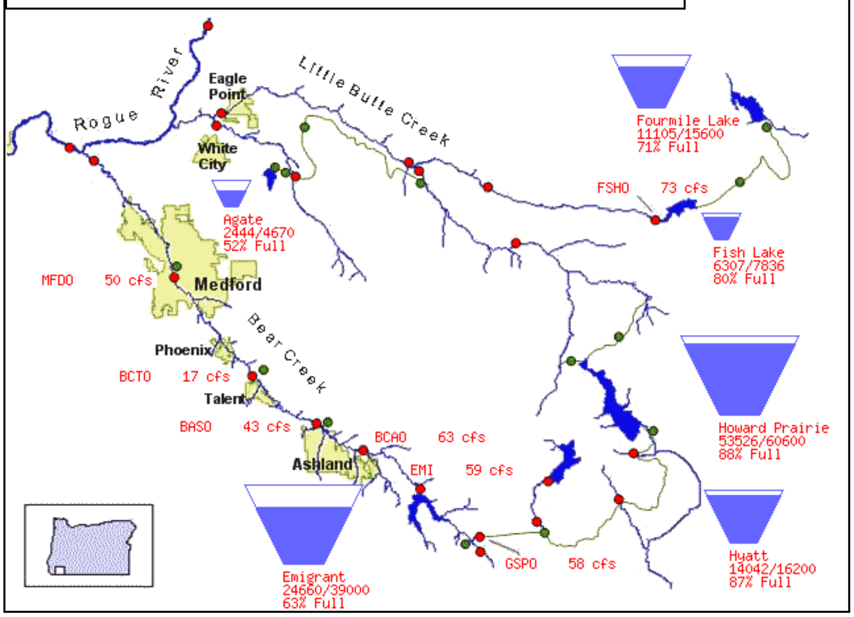
Note from Map 5 (Annual Precipitation) that a significant portion of the assessment area is in the snow zone. Here the water is stored during the winter months and released during the snowmelt-runoff period. Watersheds that contain snow pack typically have higher stream flow during the June – July snowmelt period.

Inter-Basin Transfer and Irrigation

The Ashland lateral delivers water to city users from the TID system that is obtained from the Howard Prairie reservoir. Typical summer flows of 20 – 30 cfs are distributed to users along the lateral until it reaches Wrights Creek located on the west side of Ashland Creek. The Ashland lateral has a gage site (ASHO) located near Greensprings See Figure IV-2 and the current flow data can be accessed at http://www.usbr.gov/pn-bin/rtindex.pl?cfg=rogue . On 9/13/2007 the flow at the point where the lateral crosses Neil Ck Road was estimated at 14.8 CFS while the mean flow measured at the ASHO gage for 9/13/07 was 22.85 CFS. It is expected that the flow reaching the study area would vary, depending upon the usage of the upstream users.

The irrigation system is very complicated as shown in the map. Summer irrigation in the Ashland area has had the effect of augmenting the summer-season streamflow in the small streams that pass through the Ashland urban area.

Figure IV-2 Talent Irrigation District System



Ground Water

Groundwater moves down slope and accumulates in a similar albeit slower manner than surface water. When groundwater has accumulated sufficient energy and volume, it can emerge to the surface. This point is where the stream begins and typically a small channel forms. Stored groundwater supplies stream flow after rain induced runoff has diminished.

Storage

Water stored in ponds and reservoirs also supply water to the streams and the Reeder Reservoir is the primary storage structure in the assessment area (see Map 1). The following material about this reservoir is excerpted from a September, 2005 “Water Supply Update” for the Ashland City Council (Reference [3]). The complete document can be accessed in detail at http://www.ashland.or.us/Page.asp?NavID=8786.

> Reeder Reservoir is relatively small as the maximum storage behind the dam is 860 acre-feet or 280 million gallons of raw water with the overflow weirs in place. Reeder Reservoir is fed from snow melt and watershed rain runoff from Mount Ashland. Typically, the reservoir fills to the top and reaches capacity in April, stays full and spills over the overflow weirs at the dam through the end of May, and then the water level behind the dam slowly starts to fall until the rains begin again usually sometime in October. Theoretical drawdown of the reservoir begins the first of June and goes to "empty" in March. The reservoir never reaches "empty" because of rains that usually start in October. The predicted 50% reservoir level is October 15th. Anytime after October 15th without rains and with the reservoir at or below 50% would cause concern for water supply.
>
> Water use in the summer months is highly dependant upon weather conditions; the warmer the weather, the higher the use. When the late spring / early summer temperatures are in the 70s, the average use is 4-4.5 million gallons a day (mgd). With temperatures in the 80s, water use reaches 5-5.5 mgd, and with temperatures in the 90s, average water use is 6-6.5 mgd. Peak temperatures result in peak water use of about 7.5 mgd. We have had days in prior years with use as high as 8 mgd. The 2001 drought year showed that our community was willing to monitor their use. During the voluntary conservation periods, the average use in August dropped to 5.3 mgd. During September, the month of mandatory curtailment, the average use dropped to 4.1 mgd. As soon as temperatures cooled off in mid October, the average use dropped to 2.0-2.4 and stayed in that range.

Streamflow

Figure IV-3: Daily Streamflow

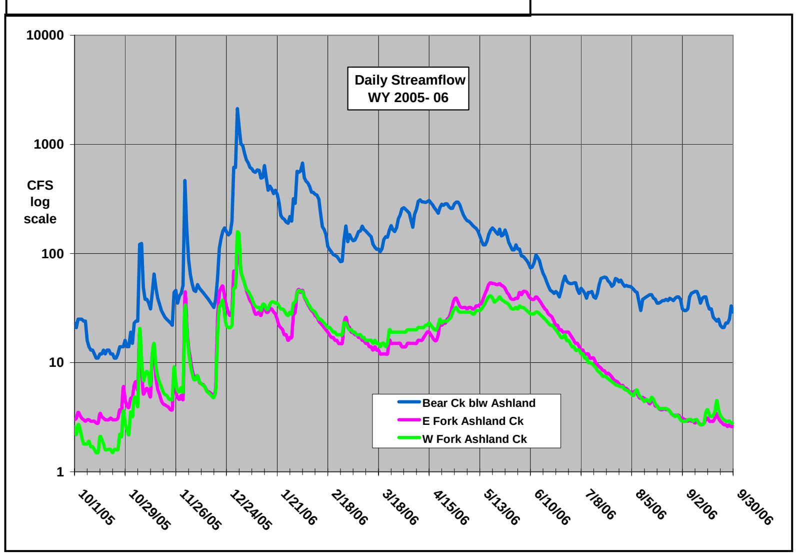


Figure IV-3 shows a typical hydrologic response for three watersheds in the assessment area as they respond to the precipitation pattern shown in Figure IV-1(precip pattern). The Ashland Creek stations are at an elevation of about 2,900 feet and the streamflow at that point is strongly affected by snow accumulation during the winter. The spikes on the graph between October and January indicate that rainfall is dominant in that interval. From January until May the upper Ashland Creeks show reduced flow since some of the precipitation accumulates as snow. Starting in May the graph shows the rate of reduction of flow declining as water is depleted from ground storage and the snow fields.

Mean Annual Flow

It is apparent from Figure IV-3 that stream flow is highly variable. Several different statistics are used to describe streamflow, depending upon the application of the streamflow information. Table IV-3 shows streamflow for the period of record. It is apparent that May and June have the highest average flow in watersheds that are supplied by a snow pack.

Table IV-3: Average Streamflows in Assessment Area

Gage Site	Years of Record	Area square miles	Monthly Mean Streamflow (cfs)												Annual Mean Flow
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
W Fork Ashland Creek	24	10.5	10	12	12	14	20	17	6.6	3.6	3.2	3.5	6.1	9.9	9.8
E Fork Ashland Creek	24	8.14	10	12	12	13	21	20	8.5	4	3.2	3.4	6.1	10	10.2
Bear Ck blw Ashland Ck	17	168	183	134	125	136	128	69	52	48	28	18	36	125	90.1

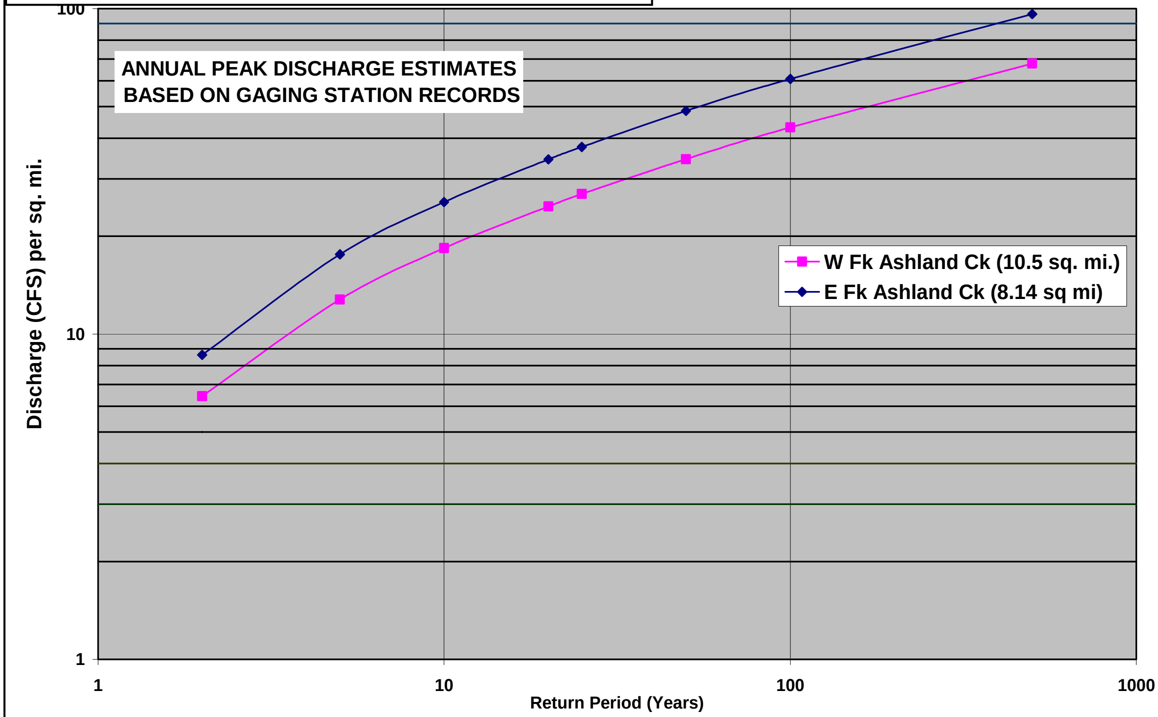
Peak Flows

The term "peak flow" is often used in discussions on watershed management because of its association with flooding and sediment transport. However, every precipitation event, large and small, produces a hydrograph that has a peak value. It is important to realize that the consequences of peak flows that exceed the bankfull condition are very different than those that do not. Consequently, an increase in peak flows associated with small storms does not have the same ramifications as a similar change in large storms.

Bankfull and higher flows are generally of special interest because they are most likely to be channel forming and cause changes in the channel. Changes in the size distribution of the peaks of the less-than-bankfull storms may be relevant in some special instances but typically will not significantly affect channel stability. Estimating the probability and magnitude of large peak flows is essential for channel projects such as culverts and bridges and flood zone delineation.

Flood frequency tables and charts can be developed from records of the annual maximum peak flows which usually exceed bankfull conditions. Figure IV-4 shows flow as CSM which is an abbreviation for cubic feet per second per square mile. The return period denotes the average frequency that the flow is exceeded. A return period of 100 years would represent the 100 year storm. A rough estimate of expected peak flows for a particular watershed in the analysis area can be made by multiplying the CSM value by the area of the watershed (See Map 10 and Table III-1). A more accurate estimate can be calculated by using methods from the Oregon Water Resources Department at http://www.wrd.state.or.us/OWRD/SW/peak_flow.shtml

Figure IV-4: Annual Peak Discharge



If a storm with constant, uniform rain intensity moves across and covers a watershed for an extended period, the flow at the mouth will increase as additional water from the upstream areas arrives. If the storm stays in place long enough and / or the watersheds are small enough, the peak flow will be limited by the net storm input.

For short duration storms or large watersheds, the storm may move on before the water from the upper watershed reaches the mouth and the flow at the mouth never matches the storm input limit point. In this case, modifications that occur within the middle portion of the watershed could affect the storm hydrograph. For instance, a mid-slope road could intercept and route water to the mouth faster and a higher peak would be observed. However, for a larger storm, the peak outflow would be dominated by the storm precipitation intensity [4]

Rain-on-snow events

In the Western Cascade region of Oregon the largest peak flow events are often associated with “rain-on snow” precipitation events. It is generally accepted that areas with elevations that lie between 3,500 and 5,000 feet are in the transient snow zone where rain-on-snow events generally occur (See Map 5 (Annual Precipitation)). Watersheds that have a significant area within the transient snow zone are characterized by dramatically higher peak flows that can result during the relatively rare occasions when a rain-on-snow event occurs. The snow zone that lies above the 5,000 foot elevation does not typically experience precipitation as rain. The area below 3,500 feet does not experience much snow accumulation and is designated as the rain zone.

Table IV-4 shows the rain-on-snow distribution in terms of acres within the various snow zones. Since area equates to water stored, the area values provide a relative index of the potential for rain-on-snow events. It is apparent from the table that Ashland Creek, with

7010 acres in the ROS zone has the greatest ROS flow potential. The Ashland Creek watershed is only 17% larger than Neil Creek but the Ashland Creek ROS component is 44% greater.

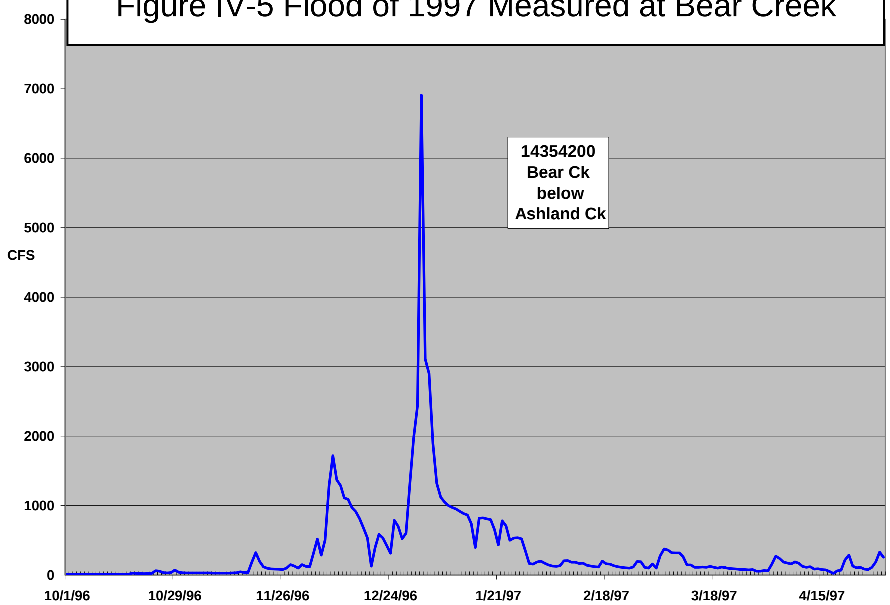
Table IV-4: Rain-On-Snow

	Watershed	Total Acres	Precipitation Zone (Acres)		
			Rain	Rain-on-snow	Snow
	Ashland Creek Wshd				
4	Lower Ashland Ck	3776.8	2325.3	1451.5	
5	West Fork Ashland Ck	6966.2	316.8	3408.2	3241.1
6	East Fork Ashland Ck	5190.6	220.1	2150.7	2819.9
	Total Ashland	15933.7	2862.2	7010.5	6061.0
	Neil Creek Wshd				
24	Clayton Ck	2146.4	1210.8	772.4	163.2
23	Tolman Ck	1702.2	1022.7	679.0	0.5
25	Upper Neil Ck	8240.2	2163.4	3404.1	2672.7
22	Lower Neil Ck	1482.5	1482.5		
	Total Neil	13571.3	5879.3	4855.5	2836.5
	Small Drainages				
1	Wagner-Wrights S End	981.3	981.3		
2	Wrights Ck	2067.8	1714.4	353.4	
3	Wrights-Ashland	495.3	495.3		
7	Ash-Clear	39.9	39.9		
8	Clear Ck	127.5	127.5		
9	Clear-Mountain	22.6	22.6		
10	Mountain	400.4	400.4		
11	Beach	359.2	359.2		
12	Beach-Roca	69.8	69.8		
13	Roca	369.1	369.1		
14	Paradise	587.8	585.2	2.6	
15	Pardise-Cemetery	110.4	110.4		
16	Cemetery	424.8	424.8		
17	Cemetery-Clay	20.3	20.3		
18	Clay	953.2	823.8	129.5	
19	Clay-Hamilton	58.7	58.7		
20	Hamilton	539.5	539.5		
21	Hamilton-Neil	29.6	29.6		
	Total of small drainages	7657.1	7171.6	485.5	

If climatic warming were to occur in this region, the expected effect would be to move the transient zone boundaries upward which would reduce the size of the rain-on-snow zone as well as the snow zone. However, while the magnitude of the rain-on-snow events would be reduced, the effect of the winter rain events would be increased. Since these winter storms are the channel forming events, the upper channels would probably experience increased erosion as the channels adjust to the new flow regime. Likewise, summer flows would be expected to diminish due to the reduced snow pack unless there was a compensating increase in summer precipitation.

The most severe floods occurred in the winters of 1853, 1861, 1890, 1927, 1948, 1955, 1964, 1974, and 1997. The most recent flood (New Years Day 1997- See Figure IV-5) was a 25 to 30 year event (a level or magnitude of flooding that would be expected to occur only once in 25-30 years) [5].

Figure IV-5 Flood of 1997 Measured at Bear Creek



Low Flows

Oregon summers typically are drought periods and small streams tend to go dry or are reduced to a series of small, isolated pools. This annual cycling of the flow conditions tends to severely limit the perennial aquatic life that can inhabit the area. Repeated El Niño and La Nina cycles also influence recurrent drought cycles. Paleoclimatic studies indicate that the Rogue Basin had a number of extensive dry periods that were much more severe than those in our current historical records. Some of these “xerothermic periods” have lasted for centuries. Much of the drought resistant native vegetation in this area is a testament to those times.

The Bear Creek Watershed Assessment - Phase II reports that most serious drought conditions on record were from 1928 through 1935 with the most severe conditions lasting from 1929 – 1931. The most recent extended drought experienced in Oregon (as well as the entire Pacific Northwest) occurred from 1976 to 1995. Several critical drought years have been recorded since 1900, including 2001, the driest year on record. [6]

Figure IV-6 (Annual Precipitation at Ashland) shows over 100 years of precipitation records for the Ashland station. It is apparent that the statistics do not exactly match those for the Bear Creek basin by RVCOG. The discrepancies are due to the different data sources and the methodologies used to develop the drought statistics.

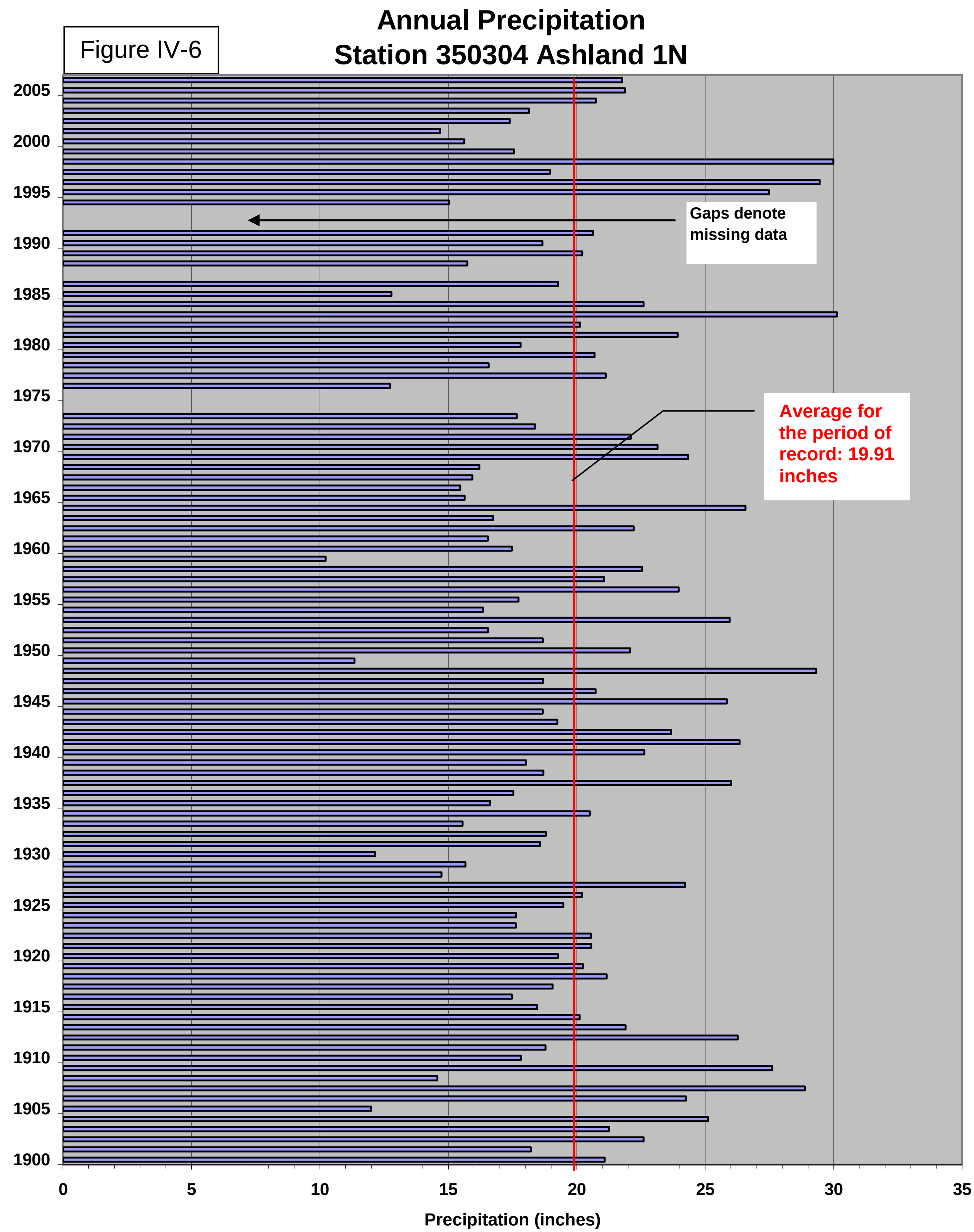


Figure IV-6
Annual Precipitation
Station 350304 Ashland 1N
Gaps denote missing data
Average for the period of record: 19.91 inches
2005
2000
1995
1990
1985
1980
1975
1970
1965
1960
1955
1950
1945
1940
1935
1930
1925
1920
1915
1910
1905
1900
0
5
10
15
20
25
30
35
Precipitation (inches)

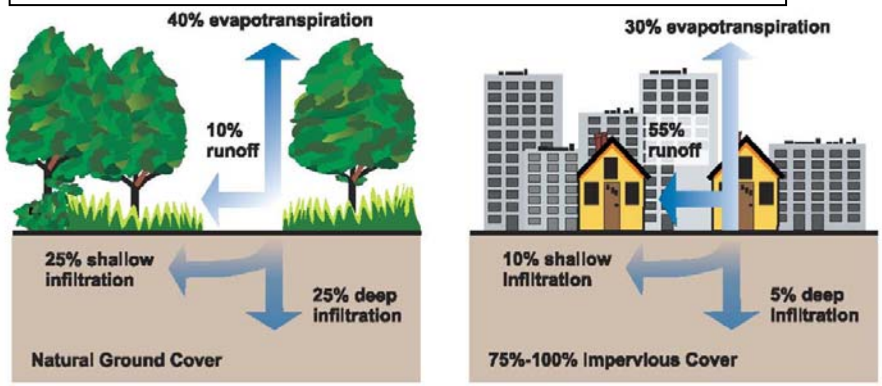
Water shortages also affect Ashland's municipal supply. According to a 2005 news report, the City of Ashland's water storage system is operating at a deficit of its optimal conditions by 650,000 gallons. The immediate need is for emergency use in the event of large fires or failure of the Reeder Reservoir system. To address this issue the City has put a reserve for 1.5 million gallons per day from the Lost Creek Reservoir and has started development of a pipeline (Talent, Ashland, Phoenix pipeline project) to supply the water. Some anti-growth advocates are concerned that the water, when it becomes available, will be used to expedite additional growth and development [7].

Water Losses

Not all of the precipitation that falls into a watershed becomes stream flow as shown in Figure IV-7. In a forested setting, a stream contribution of 10% of the precipitation is typical while, in an urban environment, a contribution of more than 50% is possible.

The relative water yield for a watershed for a 2-year precipitation event can be estimated by observing the size of the corresponding flow event.

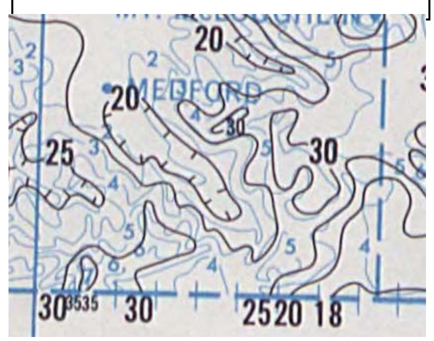
Figure IV-7 Comparison of Runoff Characteristics



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

A discharge of 10 CSM is equivalent to 0.0155 inches/hr of continuous precipitation if there is no water loss or retention. The precipitation map (see Figure IV-8 for a 2yr-24 hr event shows about 3 inches or 0.125 inches/hr. or 81 CSM [8]. However, Figure IV-4 shows the 2-year peak storm event is about 8 CSM. It appears that the runoff component in the upper portion of the Ashland watershed is about 10% of the inflow which is consistent with the EPA graphic for forested watersheds.

Figure IV-8: Two yr-24 hr precipitation in tenths of an inch



Water Withdrawals

Water withdrawals on the larger streams in the Bear Creek basin reduce summer flows and cause a deficiency in summer flows for Bear Creek. Since Ashland Creek and Neil Creek are located at the upper end of Bear Creek, any improvement in water production in these streams would benefit more stream miles on Bear Creek than similar improvement in the downstream tributaries [9] Diversion rights for surface water total 14.04 cfs in the project area and groundwater rights total 0.428 cfs.

Water Use

The Bear Creek Watershed TMDL & Water Quality Management Plan identified the beneficial uses shown in Table IV-5. The document establishes measures to protect the water quality for these uses. See Component 8 Water Quality for more information.

Table IV-5: Beneficial Uses in the Bear Creek Watershed [1]

Beneficial Use	*Bear Creek Mainstem*	*Bear Creek Tributaries*	*Beneficial Use*	*Bear Creek Mainstem*	*Bear Creek Tributaries*
Public Domestic Water Supply[1]		✓	Commercial Navigation & Trans.		
Private Domestic Water Supply[1]	✓	✓	Fish and Aquatic Life[2]	✓	✓
Industrial Water Supply	✓	✓	Wildlife and Hunting	✓	✓
Irrigation	✓	✓	Fishing	✓	✓
Livestock Watering	✓	✓	Water Contact Recreation	✓	✓
Boating	✓	✓	Hydro Power**		✓
Aesthetic Quality	✓	✓			

1. With adequate pre-treatment (filtration and disinfection) and natural quality to meet drinking water standards.
2. See figures 271A and 271B for fish use designations for this watershed.

Map 2 shows that the project area is composed primarily of forested lands, agricultural lands, and urban development. The land use can affect the hydrology of the watershed by affecting its surface - runoff characteristics as well as by the consumption of the available water.

Most of the forested lands are federal and are currently managed to have minimal effect on the hydrology of the watershed. The documentation for their management projects typically contain extensive information about any possible effects relating to the hydrological response of the watershed. Road construction and maintenance, soil compaction, snow storage, riparian management and wildfire management are typical issues that are examined during project planning. As discussed previously, most of the precipitation that falls in the forested regions leaves the watershed through evapotranspiration.

Agricultural use can consume significant amounts of water through evapotranspiration and can also affect soil permeability and runoff characteristics. Water withdrawals, drainage modification, and irrigation amounts and methods can affect flow, runoff, and storage characteristics. Extensive grazing can affect the amount of runoff due to reduced evapotranspiration and increased soil compaction. Riparian areas can also be affected by over-grazing due to changes in riparian vegetation and soil compaction.

Urban use tends to increase the amount of impervious surfaces as shown in Table IV-6. The drainages with greater than 25% impervious surfaces are highlighted for emphasis. It is essential to design the storm drain system for this increased runoff to avoid excessive erosion and local flooding. As previously discussed in the peak flow discussion, the smaller streams in the City would be more vulnerable to short-duration, high-intensity rain events than the larger streams. However, since the associated drainages are relatively small, the

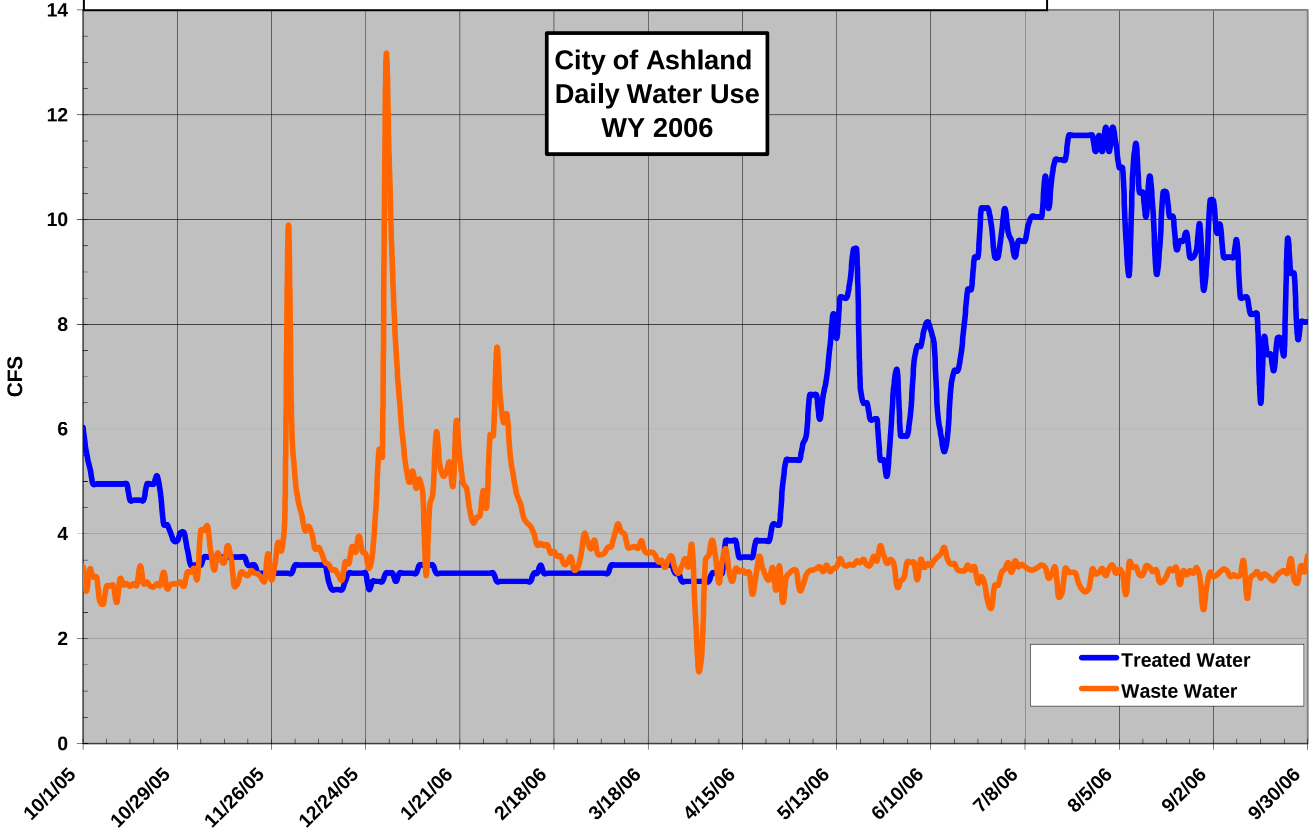
Table IV-6: Impervious Surfaces

Drainage		Total Acres	Impervious Surfaces			Total %
			Street	Buildings	Other	
1	Wagner-Wrights S End	981.3	1.16%	1.18%	1.43%	3.78%
2	Wrights Ck	2067.8	0.72%	0.64%	0.42%	1.78%
3	Wrights-Ashland	495.3	10.65%	12.38%	8.48%	31.51%
4	Lower Ashland Ck	3776.8	1.73%	1.56%	1.13%	4.42%
7	Ash-Clear	39.9	3.50%	6.17%	1.90%	11.58%
8	Clear Ck	127.5	13.62%	16.68%	15.61%	45.92%
9	Clear-Mountain	22.6	0.84%	1.38%	0.65%	2.87%
10	Mountain	400.4	15.70%	15.81%	9.71%	41.23%
11	Beach	359.2	8.53%	10.22%	10.23%	28.98%
12	Beach-Roca	69.8	8.45%	12.41%	12.00%	32.86%
13	Roca	369.1	6.62%	8.16%	8.39%	23.17%
14	Paradise	587.8	5.86%	7.18%	7.52%	20.56%
15	Pardise-Cemetery	110.4	3.75%	5.02%	8.13%	16.89%
16	Cemetery	424.8	8.72%	11.64%	8.31%	28.67%
17	Cemetery-Clay	20.3	1.72%	1.47%	2.22%	5.41%
18	Clay	953.2	2.40%	3.49%	2.45%	8.35%
19	Clay-Hamilton	58.7	8.33%	6.21%	4.74%	19.28%
20	Hamilton	539.5	6.17%	6.86%	7.90%	20.93%
21	Hamilton-Neil	29.6	3.47%	1.61%	0.51%	5.58%
22	Lower Neil Ck	1482.5	4.42%	3.34%	3.07%	10.84%
23	Tolman Ck	1702.2	0.23%	0.23%	0.04%	0.50%
24	Clayton Ck	2146.4	0.00%	0.09%	20.84%	20.92%
25	Upper Neil Ck	8240.2	0.00%	0.10%	0.00%	0.10%

higher flow volume should be manageable. The use of retention ponds can help reduce the risk associated with these events.

Currently, all municipal water for the City of Ashland is from the Ashland Creek watershed. Changes to municipal water usage directly affect the Ashland Creek watershed. During low flow years the City also obtains raw water from the TID by means of the Ashland lateral that it treats for municipal use. The city also has a wastewater treatment plant that discharges the treated wastewater back to Ashland Creek at an outfall near the mouth. Figure IV-9 shows the daily usage for both the municipal and wastewater usage. Note that a base flow of about 3 cfs of treated water passes through the City of Ashland. This can be compared with the approximately 10 cfs summer base flow for lower Ashland Creek as shown in Figure IV-3. The treated municipal water shows higher use during the summer that is probably attributed to lawn and garden irrigation. It should be noted that additional irrigation water is brought into the city through the TID system. The wastewater data shows some spikes that correspond to the larger rainfall events during the early winter period. This pattern is typical of wastewater systems where surface storm water manages to enter the city sewer system. Manholes and leaky lateral lines from homes are typical sources of this inflow contribution.

Figure IV-9: Ashland Water Use: Drinking Water & Waste Water



Map 11 shows that there is an extensive system within the city's Urban Growth Boundary. An unknown amount of water is imported each year via the TID lateral. Most of this water leaves the watershed as evapotranspiration but a significant portion enters the small streams within the city and augments the summer flow. These streams then, in effect, become perennial which very effectively enhances the sustainability of some aquatic species. This situation provides an opportunity for area residents to improve the quantity and diversity of aquatic life in the urban area. Other wildlife and birds would benefit from an improved aquatic and riparian system. Potential projects could be guided by species inventories and monitoring as well as enhancement of the microhabitats for target species.

Proposed actions for the urban area/opportunities for partnership with City of Ashland/data gaps:

- Obtain the raw precipitation data to determine rainfall intensity patterns.
- Identify locations in the city where storm water tends to accumulate. Establish photo points or some other way to monitor the highest water level of the storm.
- Associate the flow levels with the precipitation intensity data.
- Over time, a correlation can be developed and the adequacy of the storm drain system can be established.

- Manage the perennial streams for enriched aquatic habitat. Encourage channel complexity. Provide for cover and refugia. Promote native riparian vegetation. Avoid contamination by pesticides and fertilizers.

Hydrology – Critical Questions

1. *What land uses are present in your watershed?*
   See Map 2 (Land use)

2. *What is the flood history in your watershed?*
   See flood history section, Chapter IV-7.

3. *Is there a probability that land uses in the basin have a significant effect on peak flows?*
   The reservoir system will reduce annual peak flows downstream from the dam. Roads and drainage modification can affect the timing and magnitude of peak flows associated with small storms. Some studies suggest that timber harvest in the rain-on-snow region will cause increased snow accumulation and a higher risk of rain-on-snow flooding. However, the Forest Service typically manages this zone for a minimum of increased risk.

   Channel confinement and obstructions on the floodplain can result in an increase in local flooding.

   Streams supplied by runoff in the highly impervious urban zone may experience higher peak flows for small storms. The city's storm drain system is designed to accommodate these flows.

4. *Is there a probability that land uses in the basin have a significant effect on low flows?*
   Water withdrawals, transfer and irrigation have a significant effect on low flows. Also, channel down cutting tends to lower the water table with a subsequent reduction in low flow.

   The role of riparian vegetation is somewhat uncertain. Transpiration of water by trees should reduce the water available for flow. However, streams often experience an increase in surface flow when riparian vegetation is restored to them.

Water Use - Critical Questions

1. *For what beneficial use is water primarily used in your watershed?*
   Reference DEQ [1]
   See Table IV-5: Beneficial Uses in the Bear Creek Watershed

2. *Is water derived from a groundwater or surface-water source?*
   Most of the water used is derived from surface-water sources.

3. *What type of storage has been constructed in the basin?*
   Reeder Reservoir is the largest impoundment in the basin. There are also numerous diversion structures for water withdrawals.

4. *Is water being transferred in our out of the basin?*
   No water is being transferred out of the basin. An unknown amount of water is being imported from the Howard Prairie reservoir by means of the TID system. This is a data gap. Plans are being made for the City to obtain additional water from Lost Creek by means of the TAP pipeline.

5. *Are there illegal uses of water occurring in the basin?*
   There are no known illegal uses in the basin.

6. *Do water uses in the basin have an effect on peak flows?*
   As discussed in the hydrology section, the elaborate reservoir system tends to reduce peak flows in Bear Creek and in Ashland Creek.

7. *Do water uses in the basin have an effect on low flows?*
   The system is highly regulated with withdrawals and releases. An effort is made to maintain instream flows as specified by ODFW.

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3. Olson, E., *Council Communication - Water Demand Report 9/6/05*. 2005, Ashland City Council: Ashland. p. 1.
4. Linsley, R.K., M.A. Kohler, and J.L.H. Paulus, *Hydrology for engineers*. Second ed. 1975, New York: McGraw-Hill.
5. USDA, *2003 Upper Bear Assessment*. 2003, Ashland Ranger District: Ashland, Oregon.
6. RVCOG, *Bear Creek Watershed Assessment - Phase II, Part I & II*. 2001, Bear Creek Watershed Council: Medford, Oregon.
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9. Meyers, W. and M.E. Prevost, *Bear Creek Flow Study - Observations and Analysis of the Flow Conditions in Bear Creek, Jackson County, Oregon 1007-1998*. 1999, RVCOG: Central Point, OR 97502. p. 27.

CHAPTER V: RIPARIAN & WETLANDS ASSESSMENT

A riparian area is the land adjacent to streams or lakes. The soils have higher water content than the uplands farther from the stream. Because of the differences in the soil water content of these two areas, they host significantly different vegetation and associated habitat. In most regions, the riparian areas of streams and lakes can be seen as the green swath of vegetation following the water's edge. Riparian vegetation performs important functions beyond providing a unique habitat. Streamside vegetation shades stream water, keeping the water cool. Roots hold the stream bank together and allows for the slow infiltration and storage of precipitation, permitting a slower discharge over time. Some streamside trees eventually end up in the stream channel and as instream wood or large woody material. The instream wood promotes complexity of the stream channel by building pools and side channels, provides cover and slower water for aquatic animals, and traps gravel that is used by spawning fish.

Wetlands are also wet areas, though not necessarily associated with lakes or streams. Sometimes surface or groundwater will collect in areas and like the riparian area, the higher water content in the soil will have a different vegetation and associated habitat than surrounding areas and perhaps even the riparian area it is within. Freshwater wetlands provide important functions to the hydrologic system such as a filtration and settling site to improve storm water quality; an area for flood waters to be held and the discharge delayed, thus reducing flood intensity; and a site for groundwater recharge; as well as wildlife habitat.

Riparian and wetland habitats perform vital and unique ecologic and hydrologic roles in the overall landscape. Development, vegetation alteration, and channelization have led to a considerable loss of riparian areas throughout the assessment area and thus the functions and benefits they provide. Most of the streams in the assessment area are highly altered from their natural state; most have summer flows supplemented by irrigation return run off. Any opportunity to maintain and enhance these unique habitats provides a refuge for aquatic and terrestrial species (including humans) and the systems they depend upon. Aquatic ecological diversity can be encouraged and enhanced, even in the urban environment. Humans and the natural environment can benefit each other by a high functioning system in the natural and human built community.

This chapter of the Assessment will deviate from what is outlined in the Oregon Watershed Assessment Manual (1999). While the manual is geared towards riparian areas in mostly undeveloped areas with a potential of returning to a more natural state, the Ashland Watershed Assessment area is mostly urban, rural residential, and developed, so many of the topics covered in the Assessment Manual are not applicable here.

In June 2000, Tetra Tech/KCM Inc. in association with Greenworks, PC submitted to the City of Ashland a Stormwater and Drainage Master Plan. The document is thorough and covers many of the actions and thoughts in this document. This document supports its recommendations. The city is currently updating this plan and incorporating Water Resources Protection Ordinances (also known as Riparian Ordinances). The City of Ashland is encouraged to take action on the 2000 report's recommendations as well as moving forward and incorporating new information. As of this writing, it appears that much remains to be implemented of the 2000 report's actions.

The current existing riparian areas are highly fragmented for the most part and can be grossly placed in three groups: highly developed, mostly with development close to the stream channel; less developed, though still predominantly with an altered habitat reflecting agricultural usage; or piped. In both above ground groups, the riparian area is narrow, with natural or naturalistic vegetation in small sections and unnatural vegetation predominant such as highly managed turf or unmanaged vegetation such as blackberry thickets. Very little riparian areas remain with a more natural vegetation, structure, or size.

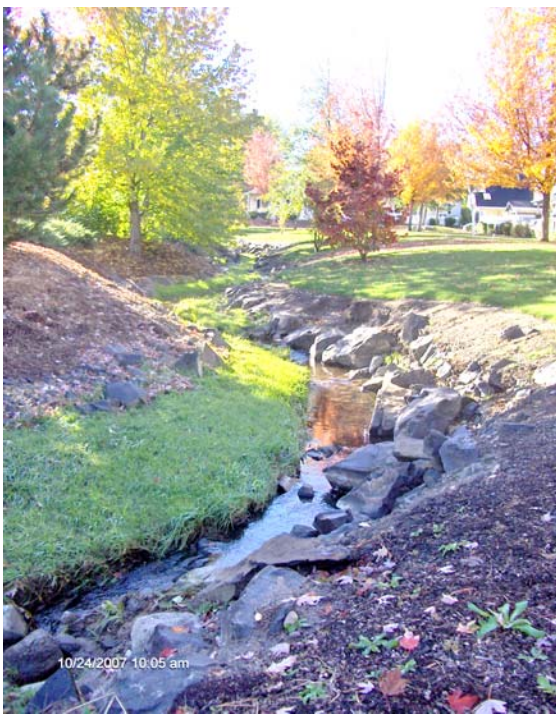

Figure V-1: Cemetery Creek with riprap bank armoring, incised channel, and clipped turf. Homeowner's association property.

Figure V -2: Beach Creek as restored in North Mountain Park. Note wider gravel/cobble channel, diverse naturalized streamside vegetation.

Current conditions of riparian areas in the privately owned portions of the Ashland watershed are composed of a wide range of vegetation from non-existent where the streams are piped under developed areas, to mixed hardwood/conifer or hardwood dominated. In the vegetated riparian areas that remain, the vegetation is composed of a narrow and fragmented strip of small hardwoods, such as, ash, alders, cottonwoods, willows, and big leaf maples as well as non-native species. A narrow riparian area can provide some shade but lacks the structure and size to adequately protect the stream banks from erosion or provide the channel with large pieces of wood. In addition, large wood in the urban stream is a potential liability problem for landowners if they block a neighbor's culvert. The urban and residential development and agricultural fields have severely reduced or eliminated most of the large mature trees. Some of the riparian vegetation within the city is non-native and modified to be structurally un-natural with long sections of some creeks lined or covered by Himalayan blackberry, Vinca, or English Ivy, or other non-native plants. Non-native plants like blackberry out-compete native vegetation and prevent the establishment of species which are valuable for shade and bank stabilization.

There is a lack of mature and late-successional characteristics i.e. few big trees, partially due to the highly developed nature of the landscape. Frequently, there is little room for mature trees if the landowner chooses to build up to the buffer next to a stream or drainage area, though the canopy closure with the current building requirements is approximately 90%-100% along the sections of many creeks.

Section 18.62.050 of the City of Ashland code defines the lands adjacent to streams or drainage areas which are regulated for building. The regulations define where one can build and do not apply to the entire channel, but only to those sections of the designated channels that are identified on City of Ashland planning maps. To identify the regulated areas one needs to refer to the maps, located at the City of Ashland Planning Department. Landowners cannot build within these designated areas, or significantly modify the channel banks, or cut trees larger than 6" DBH, or install fences or other things that might impede flood flows in these flood prone areas. Depending on the stream or drainage area, building along certain areas is restricted to no closer that ten or twenty feet (horizontal distance) from the creek or drainage area.

The natural potential of the riparian condition will never be achieved in areas where development is close to the creeks. Because of development, these creeks cannot reach their natural potential, but these waterways can still provide benefit to biologic and hydrologic systems. With this goal in mind, there are many creeks in the assessment area whose function can be improved. Riparian condition units are not discussed specifically in this assessment because for the most part the streams are highly fragmented due to development. Instead, a broader and more general view is taken.

Under more natural riparian conditions, large woody debris and wood recruitment are important in analyzing a habitat's ability to provide diverse and complex structure to the creek. In the urban riparian environment found in much of this assessment area, large wood and alteration of the existing stream channel may not be practical due to development. But in areas where it is possible for the stream channel to change or meander beyond its existing dimensions/shape, this can be encouraged or allowed. Some creeks which are currently piped may have an opportunity to be brought above ground (called "daylighting"). In some areas of the assessment area there is room for large wood and the creation of diverse stream habitat, and these could be taken advantage of where feasible. Locations where structures and roads are not close to the creek could be possible sites for increased channel complexity or wetland/floodplain creation. Neil, Clay, Hamilton, and Cemetery Creeks are good locations to restore channel and habitat complexity because these creeks have a lower urban density in many sections.

Large woody material to benefit stream complexity and habitat is almost non-existent due to stream cleaning and development, indicating a missing element in a properly functioning and intact riparian ecosystem. Wood is removed by residents to allow storm water to quickly move downstream and through culverts and reduce flood damage liability. The supply of potential coarse wood in streams is virtually zero due to the young age of streamside trees. The narrow buffer limits potential for large wood recruitment and floodplain function. Due to urbanization, the riparian habitat has been simplified due to large wood removal and stream channelization and modification.

Shade is important to maintain cool stream water to benefit fish and is present in many stream sections, even those with narrow riparian areas. The remaining thin riparian areas provide some shade but the vegetation lacks the structure and size to adequately protect the stream banks from erosion or provide the channel with large pieces of wood. Even if there are no fish living in some of the streams within the assessment area, they flow to streams that are important fish habitat and the temperature and other components of the water these streams contribute has an impact on the larger watershed. Stream shading can be implemented even in a highly urban or developed environment. Increasing stream shading is beneficial on a large or small scale and there are numerous opportunities to do so by planting native streamside trees with an eye to bank stabilization and habitat complexity.

In the 2005 *Bear Creek Watershed Riparian Canopy Assessment,* categories of stream shade were assigned for each segment of stream analyzed. High, medium, and low shade categories are based on definitions in the *Oregon Watershed Assessment Manual* (OWEB 1999). The High category has stream shade estimated greater than 70%. Medium shade category is assigned where shade is estimated to be from 40% to 70%. The Low shade category is for shade estimates less that 40%.

Bear Creek as it flows through the assessment area has predominantly low or medium shade and could use the most improvement of the streams with salmonids in the Ashland Assessment area. From the mouth of Neil Creek to Dead Indian Memorial Road shade is varied. Neil Creek from Dead Indian Memorial Rd. to I-5 was assessed to have high shade, though other aspects of the riparian area need improvement. Shade on Ashland Creek is mostly high to medium except for a small area around Calle Guanajuato which was assessed to have low shade. Tolman Creek is assessed to have an area of low shade near the mouth and high shade to I-5. No further upstream shade on Tolman Creek was analyzed. See Map #8.

Table V-1: Ashland Creek Canopy Assessment

Ashland Cr. analyzed for stream shade	28,360 feet	5.78 miles
High shade category	24,853 feet	88% of stream section
Medium shade category	2,342 feet	8% of stream section
Low shade category	1,165 feet	4% of stream section

While much of Ashland Creek flows through Lithia Park which has a higher canopy cover than the other sections of the stream, Table V-1 does show the potential for high canopy cover within an urban landscape, though effective shade has been calculated showing the potential for improvement (i.e. 66%). (*Bear Creek Watershed Total Maximum Daily Load & Water Quality Management Plan (2007))*

Table V-2 shows the existing and potential shade of segments of Neil and Ashland Creek as analyzed in the *Bear Creek Watershed Total Maximum Daily Load & Water Quality Management Plan (2007)*. Overall, Ashland Creek needs to maintain the shade it currently has while Neil Creek has many opportunities to increase shade. Ashland Creek is not 303 (d)[1] listed for temperature, but some analysis indicates that the lower 4.9 miles (mouth to Hosler Dam) has only 66% effective shade.

Table V-2: Neil Ck & Ashland Ck stream segments from Riparian Shade Assessment Report. *Bear Creek Watershed Total Maximum Daily Load & Water Quality Management Plan (2007)*

	Reach Length (ft)	Existing Percent Shade: Reach Weighted Average	Site Potential Percent Shade: Reach Weighted Average	Change in Percent Shade: Reach Weighted Average	Years to Recovery: Reach Weighted Average
Neil Ck	139,593	71	88	17	59
Ashland Ck	229,508	91	94	3	30

While urban development of course has an impact on nearby streams and wetlands, many of the streams and wetlands have a large impact on the development around them as well and their condition must be closely monitored and maintenance performed as necessary. Creeks and wetlands do not need to be managed as liabilities, but as assets requiring special consideration to prevent property damage. By keeping in mind the stream course's function on the landscape, people can provide an attractive built environment as well as a buffer during storm events and high water conditions.

[1] "303 (d) listing" refers to Section 303 (d) of the 1972 Federal Clean Water Act. The EPA or its state delegates are required to develop a list of surface waters that do not meet water quality criteria.

Photo V-3: Paradise Creek brought above ground (daylighted) at Walker School.

Photo V-4: Created wetland in recent development near Hersey St.

Urbanization changes the shape and other physical characteristics of the watershed which impact a watershed's hydrologic form and function. Stream channels are altered. Stream bank armoring has altered the channel's ability to change to absorb high flows which increases velocity. Urban development usually results in large areas draining into a few streams instead of in the natural landscape where water drains first into tiny drainage areas while having a chance to enter the groundwater system and then moving more slowly into progressively larger streams. In developed areas, impervious surfaces are greatly increased which increases the speed and quantity of water flowing into the few larger watercourses which can increase sediment carried to streams and make streams "flashy" i.e. prone to stream flows which rise and fall quickly with higher peak discharges (a steeper and shorter hydrograph). Stream channels can increase in depth or width or both as a result of larger and more intense amounts of runoff. Water withdrawals decrease stream flows when habitats most need them in summer. (See Chapter III & IV).

While the Ashland Assessment area is primarily urban and rural residential, riparian and wetland habitat is still present and performs a vital function to the landscape and wildlife of the area. In the streams where there are no salmonids present, one can still improve the habitat for other aquatic and riparian species such as amphibians and birds. Restoring the connectivity of the floodplain to the riparian areas will allow the hydrologic system to function and provide protection as a buffer during flood events. When considering the impact of the Ashland streams on rest of the watershed, temperature and sediment reduction are the predominant management considerations.

Bird Populations in Riparian Areas

Riparian and wetland habitats in general are known for having more bird species diversity and abundance than surrounding habitats because of the unique qualities found in these environments. In the riparian and wetland habitats of the Ashland Watershed Assessment area this is especially true because these areas are frequently the only contiguous remnants of habitat in an undeveloped state. Many of the streams in the assessment area provide connectivity for wildlife between the mixed-conifer forest and Bear Creek and the valley floor. Where riparian and wetland environments are allowed to thrive and are restored to a more natural composition, a benefit to native bird species will accompany. Because bird species use so many different niches in the ecosystem, generally, when the structural layering and complexity of the habitat are increased, the habitat is improved and insect productivity increases which benefits bird species diversity. In general, habitat improvements that benefit native birds improve ecological systems as a whole. Bird populations can also be an indicator of general ecosystem health and diversity.

The Partners in Flight *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* uses various criteria to designate several species found in diverse riparian habitats as “focal species” in the region. In conjunction with other criteria, these focal species were selected based on their degree of association with important habitat conditions and features. “Although conservation is directed towards focal species, establishment of conditions favorable to focal species also will likely benefit a wider group of species with similar habitat requirements.” The “focal species” listed below are present in the Ashland Assessment area.

- tree swallow
- yellow-breasted chat
- Bullock’s oriole
- yellow warbler
- Swainson’s thrush
- wrentit
- downy woodpecker
- red-shouldered hawk
- Cooper’s hawk

Some of these species are experiencing a significant declining population trend in the region as well.

Several biological objectives for riparian habitats cited in the Partners in Flight Conservation Strategy would benefit the Ashland Watershed Assessment area.

- Institutionalize a policy of “no net loss” of riparian habitat (i.e., discourage loss and conversion of habitat, but when unavoidable, mitigate habitat conversions and natural losses with equal or greater restoration efforts).

- Maintain existing high quality riparian habitat comprised of native species in naturally occurring diversity.

- Improve quality of degraded riparian habitat.

- Initiate actions (e.g., restoration, acquisition) to enhance size and connectivity of existing riparian patches (i.e., reduce fragmentation).

Other habitats found in the assessment area are also targeted for conservation by Partners in Flight. The *Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington* cites mixed-conifer forest habitat in southwestern Oregon as one of two habitat types listed as high priority forest types needing conservation.

Table V-3 and V-4 shows data from *Guide to Birds of the Rogue Valley* collected in four locations within the Ashland Assessment area. Table V-3 has bird species present year round (resident). Table V-4 has bird species breeding (verified or probable) at the sites. The Bear Creek Greenway site was from Oak St. (near Ashland Water Treatment Plant) to Valley View Road and is mostly in riparian habitat on the valley floor. Lithia Park is riparian habitat within a mixed-conifer habitat. North Mountain Park includes riparian habitat and floodplain with created wetlands and ponds. Oredson-Todd Reserve/TID site covers a section of Upper Clay Creek as well as along the TID ditch from Park St. to Clay St. and includes some riparian habitat as well as some oak woodland and mixed-conifer forest habitat.

Species commonly seen in riparian and wetland areas in the Ashland assessment area include:

Table V-3 Bird Species Present Year Round

Bear Creek Greenway	**Lithia Park**	**North Mountain Park**	**Oredson-Todd Reserve/TID trail**
Great Blue Heron	Wood Duck	Great Blue Heron	Red-tailed Hawk
Wood Duck	Mallard	Mallard	Anna's Hummingbird
Mallard	Northern Flicker	California Quail	Northern Flicker
Red-tailed Hawk	Stellar's Jay	Killdeer	Hutton's Vireo
California Quail	Western Scrub-Jay	Belted Kingfisher	Stellar's Jay
Killdeer	Common Raven	Downy Woodpecker	Western Scrub-Jay
Mourning Dove	American Dipper	Northern Flicker	American Crow
Belted Kingfisher	American Robin	Western Scrub-Jay	Common Raven
Downy Woodpecker	Spotted Towhee	Black-capped Chickadee	Black-capped Chickadee
Northern Flicker	Song Sparrow	White-breasted Nuthatch	Oak Titmouse
Western Scrub-Jay	Brewer's Blackbird	American Robin	White-breasted Nuthatch
American Crow	Lesser Goldfinch	Wrentit	American Robin
Common Raven		European Starling	Wrentit
American Robin		Spotted Towhee	Yellow-rumped Warbler
Wrentit		Song Sparrow	Spotted Towhee
European Starling		Red-winged Blackbird	Purple Finch
Cedar Waxwing		Brewer's Blackbird	Lesser Goldfinch
Spotted Towhee		Purple Finch	
Song Sparrow		House Finch	
Red-winged Blackbird		Lesser Goldfinch	
Black-capped Chickadee			
White-breasted Nuthatch			
Bewick's Wren			
Dipper			
Spotted Towhee			
Song Sparrow			
Red-winged Blackbird			
Brewer's Blackbird			
Purple Finch			
House Finch			
Lesser Goldfinch			
American Goldfinch			
House Sparrow			

Table V-4 Bird Species Breeding (verified or probable)

Bear Cr. Greenway	Lithia Park	North Mtn. Park	Oredson-Todd Reserve/TID trail
Anna's Hummingbird	Western Wood-Pewee	Wood Duck	Rufous Hummingbird
Warbling Vireo	Cassin's Vireo	Mourning Dove	Downy Woodpecker
Tri-colored Blackbird	Stellar's Jay	Western Wood-Pewee	Pileated Woodpecker
California Quail	House Wren	Ash-throated Flycatcher	Olive-sided Flycatcher
Northern Flicker	Western Tananger	Western Kingbird	Western Wood-Pewee
Western Scrub-Jay	Black-hearded Grosbeak	Tree Swallow	Pacific-slope Flycatcher
California Towhee		Barn Swallow	Ash-throated Flycatcher
Lesser Goldfinch		Oak Titmouse	Cassin's Vireo
Western Wood-Pewee		Bewick's Wren	Warbling Vireo
Ash-throated Flycatcher		House Wren	Tree Swallow
Tree Swallow		Common Yellowthroat	House Wren
Barn Swallow		Yellow-breasted Chat	Nashville Warbler
California Towhee		California Towhee	MacGillivray's Warbler
Yellow-breasted Chat		Black-headed Grosbeak	Western Tanager
Black-headed Grosbeak		Bullock's Oriole	Black-headed Grosbeak
Oak Titmouse			Lazuli Bunting
Bushtit			Brown-headed Cowbird
House Wren			Bullock's Oriole
Western Meadowlark			House Finch
Brown-headed Cowbird			
Bullock's Oriole			

Other species associated with riparian and wetland habitat in Ashland include: year round residents such as Wilson's Snipe; species present during migration including several warblers (Orange-crowned, Nashville, Yellow, MacGillivray's, Wilson's); species present in winter such as: Ruby-crowned Kinglet, White-crowned Sparrow, Golden-crowned Sparrow, Yellow-rumped Warbler, Fox Sparrow, Dark-eyed Junco. Great Blue Heron, Green Heron, and Belted Kingfisher are present in the assessment area streams and are predatory on fish, indicating the presence of those prey items. Many of the species which reside in riparian areas will be found in few other types of habitats. Some species, such as Great Blue Heron, establish nesting areas which may be used year after year if not disturbed.

Other Wildlife

Unique reptiles and amphibians in the assessment area which have been observed include Western Pond Turtle (*Clemmys marmorata*) associated with Ashland Creek, and Pacific giant salamanders in Ashland Creek.

The riparian areas of Bear, Ashland, and Neil Creek function as wildlife refuges and corridors. Sign or direct observation of species including otter, mink, fox, coyote, skunk, raccoon, and beaver have been made in the assessment area. Blackberry thickets can provide cover for birds and prey species. When blackberries are cleared, other species can reappear and utilize the changed habitat. Even in the limited riparian habitat of Neil Creek, observations have been made of several species: beavers, kingfishers, herons, dippers, red-winged blackbirds, great horned owls, wood ducks, and yellow-legged frogs.

Wetlands

The general characteristics of wetlands in the assessment area are frequently highly modified, though most still provide essential function ecologically and hydrologically. Given motivated landowners, there are opportunities to restore, improve, or create wetlands in several areas on Ashland, Hamilton, Clay, Cemetery, and Neil Creeks and this has already been done in some areas such as on Beach Creek at North Mountain Park, Roca Creek below East Main Street.

The City of Ashland and US Fish and Wildlife Service in the completion of the National Wetlands Inventory have surveyed the assessment area for significant and possible wetlands. See Map 7 Wetlands.

Table V-4: Local Wetland Inventory

City of Ashland Wetland ID	National Wetlands Index Number	Acres	Habitat type	Wetland Type
W1	4a	2.22	Riparian Corridor, Wetlands	PEM
W2	NA	0.64	Possible Wetlands	POW/PEM
W3	5a	1.38	Possible Wetlands	PEM
W4		3.69	Riparian Corridor, Wetlands	PEM
W5	NA	1.15	Pond, Wetlands	PEM/POW
W6	NA	1.98	Wetlands	PEM
W7	NA	3.25	Wetlands, Pond	PEM/POW
W8	4g	0.90	Wetlands	PSS
W9	10b	5.38	Wetlands	PEM
W10	13bc	2.12	Wetlands	PEM
W11	NA	0.85	Possible Wetlands	PEM
W12	NA	1.68	Wetlands	PEM
W13		0.84	Possible Wetlands	
W14	NA	1.16	Wetlands	

City of Ashland Wetland ID number corresponds with Local Wetlands ID number Map 7

Wetland Type corresponds with National Wetland Inventory codes
PEM=Palustrine Emergent; POW=Palustrine Open Water;
PSS=Palustrine Sub shrub

National Wetland Inventory definitions: [P] Palustrine, [EM] Emergent

[P] Palustrine - The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, emergent plants, mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 ppt. Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics:

1. Are less than 8 hectares (20 acres);

2. Do not have an active wave-formed or bedrock shoreline feature;

3. Have at low water a depth less than 2 meters (6.6 feet) in the deepest part of the basin;

4. Have a salinity due to ocean-derived salts of less than 0.5 ppt.

All water bodies visible on the aerial photography that are less than 8 hectares (20 acres) in size are considered to be in the Palustrine System unless depth information is available, or unless an active wave-formed or bedrock shoreline feature is visible.

Description. The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers.

Class describes the general appearance of the habitat in terms of either the dominant life form of the vegetation or the physiography and composition of the substrate. Life forms (e.g. trees, shrubs, emergents) are used to define classes because they are easily recognizable, do not change distribution rapidly, and have traditionally been used to classify wetlands. Other forms of vegetation such as submerged or floating-leaved vascular plants are more difficult to detect. Substrates reflect regional and local variations in geology and the influence of wind, waves, and currents on erosion and deposition of substrate material.

[EM] = Emergent - Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All water regimes are included except subtidal and irregularly exposed.

[PSS] = Palustrine Scrub-Shrub
Includes areas dominated by woody vegetation less than 6 m(20 feet) tall. The species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions. All water regimes except subtidal are included.

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CHAPTER VI: SEDIMENT SOURCE ASSESSMENT

Sedimentation and erosion are natural processes and a healthy aquatic system needs some sediment. Usually, the desired objective is to keep the rate of sediment production within the range of natural variability. It is generally recognized that ground disturbing activities such as road construction and use, and timber harvest can cause an accelerated rate of sediment production. Wildfires, particularly high intensity fires, can also create accelerated sediment conditions. Alterations to stream channels and natural flow regimens can also disturb natural sediment patterns. Excessive sediment tends to upset the aquatic ecology by affecting the channel substrate and filling pools. Suspended sediment affects water quality and limits water use by aquatic organisms as well as humans. Dams and other obstructions can impede the movement of sediment materials through the system.

Geology

Slope stability, erosion and sedimentation are directly related to the geology of an area. Map 6 shows that over 95% of the analysis area is composed of weak geological materials such as sedimentary, granitic, and alluvial rock types. The associated soil is notorious for its high erosion potential after its surface has been exposed to the elements and the landside potential is high on slopes greater than 50% [1]. In addition, the soil is relatively infertile, making reestablishment of vegetation a difficult and prolonged process.

The dominate component of the granitic based sediment is a coarse, gritty sand that fills pools and covers streambeds thereby effectively sealing the stream bed from aquatic use. The beds of these streams are said to have a high degree of embeddedness. Because of its dense nature, it can take many years for sediment produced by a landslide to be transported out of the deposition area.

> ***Detailed description:*** The granitic rock body that covers the large majority of the Upper Bear Analysis Area is referred to as the “Ashland Pluton”. Granitic rock types of the area include quartz diorite, tonalite, granite, diorite, quartz monzonite and granodiorite. Quartz diorite is the dominant rock type exposed in the Analysis Area. Most of the rock outcroppings are heavily weathered, decomposed, and tend to breakdown to smaller sized material rather easily. The granitic rock types form the least stable slopes within the Upper Bear Analysis Area.
>
> The second most abundant group of geologic materials is sedimentary rocks, covering approximately 6.5 square miles of the Upper Bear Analysis Area. These are found in the lowest elevations and cover the vast majority of the City of Ashland from approximately 1,800 to 2,200 feet in elevation. The rock types included in this portion of the Analysis Area mainly include sandstones, mudstones, and conglomerates. The sedimentary rock types are the most stable terrain within the Analysis Area [2]

Sediment production processes

Any exposed soil is a potential sediment source. Exposed cut-slopes associated with mountain roads will erode when subjected to freeze-thaw and other weathering processes. Rain-drop splash on an exposed sloped surface will move soil material preferentially downslope. Associated erosion transports the soil material through the stream system, mostly during high flow periods. When the high flow recedes, material drops to the bed of the stream channel and is stored until higher flows reactivate it. It can take decades for heavy introduced sediment to leap-frog its way through the stream system.

Sediment sources:

Landslides and debris flows

Landslides can carry large volumes of soil material to a stream channel. Occasionally the slide will travel down a channel and scour out much of the bed load and debris, adding to the total sediment load. This mixture of soil, rock and water can move with avalanche speed and these types of debris flows can result in fatalities. Map 9 (Slope instability) shows some identified sources of sediment that includes high risk debris flow areas and landslides.

Roads

There are several mechanisms that produce road-related sediment. Cutslopes on roads present a large steeply sloped face of exposed soil. Surface ravel, raindrop splash and slope failures all cause soil material to be deposited in the ditch and on the road where it will eventually be transported by flowing water. Often the effect is subtle; the material slowly accumulates in the ditch until it is washed away during winter storm events. Freshly created cutslopes will generally produce the most material. Over time, surface hardening and vegetation reduces the rate of production from the cutslope.

Sediment production from a steep cutslope is inevitable but it can be prevented from reaching a live stream by using appropriate cross drains and / or water bars. Sediment also will be retained in vegetated ditches; however serious consequences can result if the accumulated sediment compromises the design capacity of the ditch resulting in a major road washout. Vegetated cutslopes, frequent relief culverts, and periodic ditch maintenance are essential practices on roads with cutslopes.

Traffic on earth-surface and gravel roads during the wet season can also create sediment. The strength of the road surface and bed is reduced. When the road is wet, the surface is likely to become rutted which intercept water and cause erosion. Seasonal closures with adequate barriers can prevent this type of abuse.

Many mountain roads have been constructed using a “cut and fill” design to minimize the amount of soil material that needs to be moved. The problem is that the fill material generally creates an over-steepened slope on the outside edge of the road that is vulnerable to slope failure. These failures often take many years to develop and frequently stress cracks and settling occur indicating a problem. Full bench roads are preferred on steep ground but if fill is used, it should be free of organic material and well compacted.

Catastrophic road failures

Culvert plugging or failure often leads to significant road damage and associated sedimentation. Particularly troublesome are culvert failures that redirect the stream down the road in new direction, resulting in new channel development that may extend for hundreds of feet. The direct consequence is loss of functionality and habitat of the original segment and the sediment production associated development of the new segment.

Woody debris often is a contributing factor in culvert plugging. However, extensive debris removal from the channel is generally not recommended. Loss of the debris associated structure may have severe consequences relating to channel stability and debris-flow events. Removal of small, floatable debris in the immediate vicinity of the culvert entrance may be appropriate, but removal of large structural material from the upstream channel is not recommended.

Mountain roads in particular have potential to create additional sediment from ravel and other erosion processes. This sediment can be transported to the stream system through the ditch drainage system. Good drainage design can minimize this effect. It is essential that the drainage systems for these roads be diligently maintained to operate well at their design capacity. Good design practices include oversized culverts and debris racks or deflectors. Likewise, a road dip will assure that the stream is not diverted down the road. Inspection of the culverts during storm events can prevent problems before they become more serious.

Mountain roads will eventually fail if their drainage system is not self-maintaining. Ditches associated with cut-banks need to be regularly maintained to function properly at their design capacity. Closed roads that will no longer receive maintenance should not rely on ditches as part of the drainage system.

Off Road Uses:

ATV trails, mountain biking paths and even hiking trails can result in significant erosion and sedimentation. Wet weather ATV use can be particularly troublesome, but was not identified as a significant problem in the assessment area. Stream crossings are particularly vulnerable to hiking and mountain bikes. Often the stream banks become damaged at the crossing with subsequent erosion. Small bridges or armored crossings can be very effective and demonstrate good land stewardship. In some cases water barring may also be effective in reducing trail-related erosion.

A survey was conducted by the Forest Service in 2002 to identify unclassified roads on the Rogue River National Forest. As defined, these are roads that are not managed as part of the forest transportation system and include unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail. There are about 6 miles of unclassified road in the National Forest portion of the assessment area.

Road Density

Ashland Creek watershed: 75 miles of road; Neil Creek watershed: 79 miles of road with respective road densities of 3.01 and 3.7 miles per square mile[3]. The urban area naturally has much higher road densities. If there are 12 city blocks per mile, the corresponding road density would be 144 miles per square mile, not counting the alleys. Chapter IV discusses the amount of impervious surfaces in the urban component and its effect on the local hydrology.

Road Maintenance Levels: [2]

Forest Service maintenance levels are defined in Forest Service Handbook (FSH) 7709.58. Briefly, Maintenance Level (ML) 1 roads are closed roads that may be re-opened if needed, ML 2 roads are open to high clearance vehicles, ML 3 roads are maintained for passenger car use, and ML 4 roads are designed for passenger cars and provide a degree of user comfort and convenience at moderate speeds (usually paved).

The 2003 assessment states that road maintenance surveys are typically conducted yearly on roads within the Analysis Area by engineers or District personnel. The amount of annual maintenance work needed can vary depending on the severity of weather conditions, or amount of use a road receives. Maintenance activities could include brushing, down tree removal, surface maintenance, danger tree removal, and/or culvert maintenance. It is not clear whether the unclassified roads are considered for routine maintenance. Also, ditch maintenance is not specifically mentioned. Since it is essential to maintain the functionality of mountain road drainage systems over the long term, steps should be taken to assure that these roads are maintained over the long term or decommissioned in a manner in which the drainage is self maintaining.

The following roads were to be considered for decommission in the 2003 study.
2000195-Currently used to access the drainfield within the Mt. Ashland Ski Area (MASA) Special Use Permit Area. Could be removed from FS system and maintained by MAA.
2060270-Road currently not open and is not likely to be needed for future activities.
2060550-Access to Winburn Ridge fuel break; is not likely to be needed for future activities.
2080050-This is designated Nordic ski trail (part of Bull Gap system). End of road is very lightly used dispersed camp spot. Used in hunting season. Consider changing to Maintenance Level 1.
2080070-Provides for a turn-around area and dispersed camping area. Consider changing to Maintenance Level 1.
2080270-This road leads to remnants of historic CCC Trail Camp Ski Shelter. Future access for planned shelter for Nordic skiers. Consider changing to Maintenance Level 1.
2080280-Mostly overgrown, not passable.
2080300-This is a very steep road in places. Consider at a minimum gating and closing year round. Consider changing to Maintenance Level 1.
2080400-Decision to decommission made as part of Ashland Watershed Trails EA. This road is also part of mountain bike trail system. Consider changing to Maintenance Level 1.
2080410-This road has been decommissioned per Ashland Watershed Trails EA.
2080415-This road has been decommissioned per Ashland Watershed Trails EA.
2080420-This road has been decommissioned per Ashland Watershed Trails EA.
2080500-Dispersed recreation site near road entrance. Road is impassable.
2080590-This road leads into old unit that was part of Eastview TS; not likely to be needed for future access.
2080595-Road leads into old evaluation plantation (1980s). While not developed as such, sometimes used as dispersed recreation site. Most of the road (north half) has been impassable for a number of years.
2080730-This road is largely overgrown.
2080750-Currently blocked. Access to helicopter landing.

Note: Blocked or impassable roads are not being maintained.

Wildfire

Severe wildfire can burn off protective duff and vegetation, exposing the soil surfaces to erosion. This situation had become more critical as forest fuels have accumulated and the potential for severe fire intensity has increased. An active fire management program that includes forest fuel reduction will help reduce this risk.

Mt Ashland Ski Area (This section extracted from Reference [4])

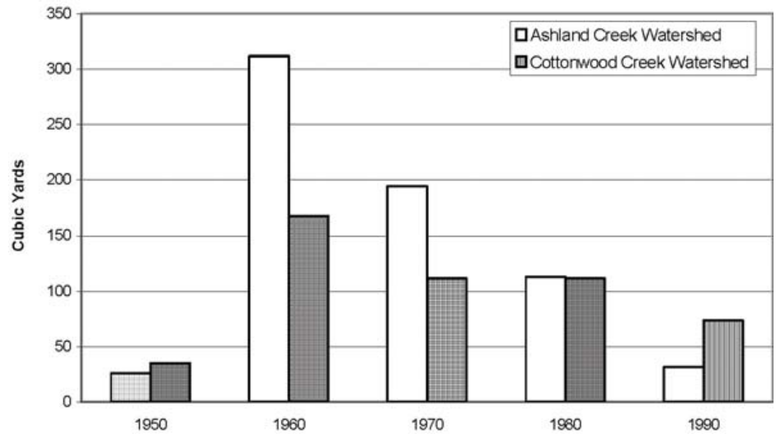

Figure VI-1: Estimated Sediment Yield Per Decade

A history of sediment delivery to the Mt Ashland Ski Area is presented in Figure VI-1. The estimated sediment yield rates were based on identifying soil disturbance areas on four sets of aerial photographs taken in 1966, 1975, 1993 1998 and using this information to run WEPP**1** erosion model simulations. Sediment yields from the WEPP model were obtained for years 1966, 1975, 1993 and 1998. Values were extrapolated to develop a per decade sediment rate estimate. These rates do not include channel or gully erosion.

Prior to the ski area development, background sediment rates were estimated to be less than 50 cubic yards per decade for the Ashland and Cottonwood sub-watersheds. The development of most of the roads and ski runs in the 1960's, increased sediment yields significantly. The largest sources of sediment would have originated within the first and second years of construction. During the 1970's, several ski runs in the Ashland Creek subwatershed were cleared of brush with tractors and access roads continued to be in a poorly maintained state. Pulses of sediment from brush clearing would have contributed increased sediment to Ashland Creek. By the 1980's and 1990's, many disturbed sites had become revegetated and soil cover had increased significantly. Restoration projects were implemented during this time that helped heal gullies and areas of extensive bare soil. In 1988 the parking lot was paved which would have substantially reduced erosion. Restoration work in gullies and redesigning road drainage on the access road to lower Windsor Chairlift further helped reduce sediment yield in this area. By the late 1990's many disturbed sites had reestablished a moderate to high shrub and ground cover.

Urban sediment:

The Ashland urban area is about 6.5 square miles or 11% of the assessment area. Urban sediment consists of both erosion produced sediment as well as material contributed by the storm-drain system. Material from the streets includes road dirt/ dust, and waste products such as plastic and paper containers. This material may be contaminated by materials associated with automobiles such as motor oil, asbestos from brake linings, fuel leaks etc. Urban construction projects typically expose soil that is a potential sediment source. Precautions need to be taken to prevent this material from entering the stormwater system. Water from downspouts and rain gutters has a surprising amount of erosive energy and can produce muddy stormwater. Vehicle washing operations can generate sediment as can muddy roads.

Microbes are almost always found in high concentrations in urban stormwater and sediments, but are highly variable in nature and very difficult to eliminate. Primary sources of

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[1] Water Erosion Prediction Project

microbes include failed septic systems, and waste products from pets, birds, and wild animals commonly found in urban areas.

More information relating urban runoff with water quality can be found in the document "URBAN RUNOFF WATER QUALITY: A SALMONID'S PERSPECTIVE" by Joanne E. Richter [5] http://www.4sos.org/wssupport/ws_rest/Urban-Runoff.doc . Protection measures for urban runoff can be found in the EPA document "Protecting Water Quality from Urban Runoff" at http://www.epa.gov/owow/nps/toolbox/other/epa_nps_urban_facts.pdf .

Oregon DEQ Total Maximum Daily Load (TMDL)

Sediment is regulated by the Oregon Department of Environmental Quality through the TMDL process and the Ashland watershed has a sediment listing as detailed in Table VI-1. The applicable Water Quality Standard (Sedimentation OAR 340-041-0007(13)) states: "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed." Since a USFS Watershed Assessment (USFS 1995) stated that "excessive sedimentation requires periodic sluicing of Reeder Reservoir to provide storage for drinking water supply" it was determined that the "excessive" sediment was adversely affecting public use. However, sediment sluicing is standard practices for most reservoirs and it is likely that natural rates of sediment would also require sluicing.

Table VI-1. Sedimentation TMDL Component Summary [6]

Waterbodies **OAR 340-042-0040(4)(a)**	Ashland Creek Analytical Watershed (HUC-6) draining into Reeder Reservoir above Hosler Dam on Ashland Creek at River Mile 4.2 (19.8 square miles (12698 AC)). (Portion of 5th field HUC 1710030801)
Pollutant Identification **OAR 340-042-0040(4)(b)**	Sedimentation. *Anthropogenic Contribution:* excess inputs of fine sediment and coarse sediments.
Beneficial Uses **OAR 340-0** **42-0040(4)(c)** **OAR 340-041-0007(13)**	Beneficial use affected by sedimentation includes resident fish and aquatic life, salmonid fish spawning and rearing.
Target Criteria Identification **OAR 340-042-0040(4)(c)** **OAR 340-041-0009(1)(a)(A)** **OAR 340-041-0009(1)(a)(B)** **CWA §303(d)(1)**	Applicable Water Quality Standards: Sedimentation OAR 340-041-0007(13) "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed."
Existing Sources **OAR 340-042-0040(4)(f)** **CWA §303(d)(1)**	*Anthropogenic sources of sediment:* • Surface erosion from roads • Road stream crossings
Seasonal Variation **OAR 340-041-0040(4)(j)** **CWA §303(d)(1)**	*Time period of interest:* Year-round. Sediment inputs are dependent on quantity and intensity of precipitation. Winter is the time of maximum sediment input and maximum movement of sediments through the system. Impacts from sediment are yearlong.
TMDL Loading Capacity **CWA §303(d)(1)**	The loading capacity is set to natural background or an erosion rate of 3.62 cubic yards per day total for the watershed. No significant increased delivery of sediment to Reeder Reservoir over that which would occur naturally is allowed.
Allocations **OAR 340-042-0040(4)(e)** **OAR 340-042-0040(4)(g)** **OAR 340-042-0040(4)(h)** **40 CFR 130.2(f)** **40 CFR 130.2(g)**	40 CFR 130.2(h) The TMDL is divided into allocations to point sources (waste load allocations) and nonpoint sources (load allocations). Allocations apply year round. *Waste Load Allocations (Point Sources)*: There are currently no NPDES-permitted point source discharges of sediment within the Ashland Creek Watershed above Reeder Reservoir. *Load Allocations (Nonpoint Sources)*: The Rogue-Siskiyou National Forest and the City of Ashland are both allocated a load of no significant measurable increased delivery of sediment to Reeder Reservoir over that which would occur naturally.
Surrogate Measures **OAR 340-041-0040(5)(b)** **40 CFR 130.2(i)**	The sediment loading capacity surrogate for all streams draining into Reeder Reservoir is that amount of sediment resulting in <33% cobble embeddedness in East and West Fork of Ashland Creek. The monitoring of percent fines using a modified Wolman pebble count method can be used to ensure that fine sediment inputs are not increasing in the system.
Margins of Safety **OAR 340-042-0040(4)(i)** **CWA §303(d)(1)**	Implicit margins of safety in the form of conservative loading capacity assumptions were used where appropriate.
Reserve Capacity **OAR 340-042-0040(4)(k)**	Incorporated into the margin of safety.
Water Quality Standard Attainment Analysis **CWA §303(d)(1)**	The implementation of BMPs to achieve a natural conditions sediment delivery regime will result in meeting the sedimentation standard.
Water Quality Management Plan **OAR 340-041-0040(4)(l)** **CWA §303(d)(1)**	The Water Quality Management Plan provides the framework of management strategies to attain and maintain water quality standards. The framework is designed to work in conjunction with detailed plans and analyses provided in sector-specific or source-specific implementation plans.

Sedimentation History (From reference the TMDL Document [6])

The sedimentation history of the reservoir is dominated by the storm events in 1948, 1955, 1964, and 1974. The 1974 flood yielded the largest volume of sediment, but the 1964 storm may have produced a similar amount. It is important to note that sound, quantitative data regarding sediment volumes is limited to the period from 1976-1987, and to the 1974 storm event. The rest of the information is qualitative and in some cases based on memory or visual observations (USFS, 1987).

- 1927-1947: No major sediment-producing storms occurred during this time period. Deposition was probably dominated by silt with minor sand delivered from Reeder Gulch and when the east and west fork reservoirs were cleaned.
- 1948: A large storm delivered sediment to the reservoir, and the water was unpalatable for a month. This suggests that a large amount of fine sediment was delivered and remained in suspension, but the amount of coarse sediment is unknown.
- 1949-1954: No large sediment influxes, therefore, mostly silt deposition occurred.
- 1955: Flood flows probably delivered considerable sediment to the reservoir. The water was acceptable for domestic use with filtration. Quantitative data regarding sediment volumes apparently does not exist.
- 1956-1961: No large sediment influxes, therefore, deposition was limited to silt.
- 1962: Several large storms occurred this year. In March a slide occurred in the Weasel Creek Drainage.
- 1963: Silt deposition occurred
- 1964: This was a very large sediment-producing storm that closed down the city plant. Though definitive data has not been found, it appears that this storm was less severe than the 1974 event in terms of sediment delivered to the reservoir.
- 1966-1973: City cleanout information indicates that 230,000 cubic yards of sediment were removed from the reservoir. 70,000 cubic yards were sluiced out of the reservoir in 1973.
- 1974: This was a historically unprecedented depositional event in which approximately 130,000 cubic yards of sediment was delivered to the reservoir as determined by surveyed cross sections. City cleanout information indicates that 198,000 cubic yards were removed from 1974 - 1976.
- 1975: Remobilization of alluvial zone sand and silt allowed by reservoir drawdown. Sluicing also moved sediment toward dam and drain (only about 6,000 cubic yards).
- 1976: Remobilization of alluvial zone sediments caused by reservoir drawdown, and subsequent sluicing of about 70,000 cubic yards of sediment. It is interpreted that this sediment represents the balance of the 1974 storm deposits.
- 1977-1981: Silt deposition. It appears that the reservoir was not drawn down during these years. In 1981, cleanout of the east and west fork reservoirs delivered a small amount of sand to the upper part of the reservoir.
- 1982-1985: Silt deposition. A drawdown occurred some time between 1982 and 1984, allowing mobilization of sands and silts in the alluvial zone.
- 1986-1987: Silt deposition. Drawdown in 1986 and sluicing of about 17,000 cubic yards of material.
- 1996-1997. During December 1996/ January 1997 heavy rains released a significant amount of material as debris landslides throughout the watershed. The East and West Forks Ashland Creek and Reeder Gulch all received between 40,000 and 50,000 cubic yards of material that was removed by trucks immediately after the flood (City of Ashland, Personal Communication 1999)
- 1999: The amount of material within the reservoir appears to be within 12,000 cubic yards and did not warrant bringing in a dredge. (City of Ashland, Personal Communication 1999)

It is apparent from this history that the combination of granitic soils, steep ground, and exceptionally large winter storms creates a potential for a large volume of sediment production. Careful road design and diligent ditch maintenance, good grazing and timber management are all required to keep sediment production to a minimum.

Sediment production rates and monitoring:

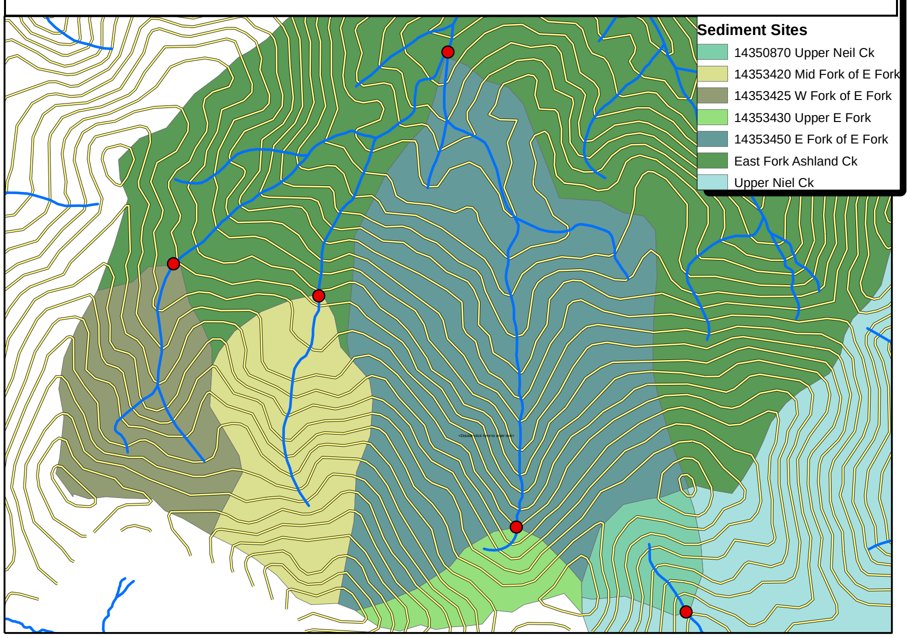
Since these granitic watersheds have a high potential for sediment there has been considerable interest in determining the rate of sediment production. Because most of the sediment tends to occur over a short time period during episodic events, the DEQ established an average daily rate from annual sediment production yields. A natural background erosion rate of 3.62 cubic yards per day was set as the target sediment TMDL for the watershed.

However, since this target is difficult to measure and is of limited value in guiding management activities, the DEQ created a surrogate loading capacity for the East and West Fork of Ashland Creek defined by the amount of sediment resulting in less than 33% cobble embeddedness. A modified Wolman pebble count method can be used to ensure that fine sediment inputs do not exceed this level. Long-term monitoring and the adaptive management nature of this TMDL will be used to evaluate this goal over time [6].

Other Monitoring:

If long-term turbidity and flow data are available at a monitoring site, the ratios of these parameters can, in some cases, be used to detect long-term sediment production trends. This method is used by the Umpqua National Forest on many of its streams. It involves charting the turbidity/flow ratio for the high flow periods on an annual basis. Changes in the ratio correspond to changes in the sediment loading of the system.

Figure VI-2: Sediment Monitoring Sites



Since 2004 the USGS has measured sediment in small streams in upper Ashland Creek (see Figure VI-2). These sites are located, for the most part, in the snow zone in the upper Ashland and Neil watersheds.

Figure VI-3 shows the results of the monitoring. Since the source watersheds for each monitoring site had different sizes as shown in Table VI-2 (Sediment monitoring sites) the rates expressed as tons per day were normalized to tons/day/1000 acres. These values can be compared with the TMDL target value of 3.62 cubic yards per day for a 12,698 acre watershed after it is normalized to 656 lb/day/1000A assuming a density of 85.3 lb/cubic ft. From the chart, it is apparent that most of the sediment in this region is produced during

June and July during the snowmelt period and that the values measured are substantially below the TMDL target value. More information about the USGS sediment monitoring project can be found at http://web10capp.er.usgs.gov/imf/sites/adr06/launch2.jsp .

Figure VI-3

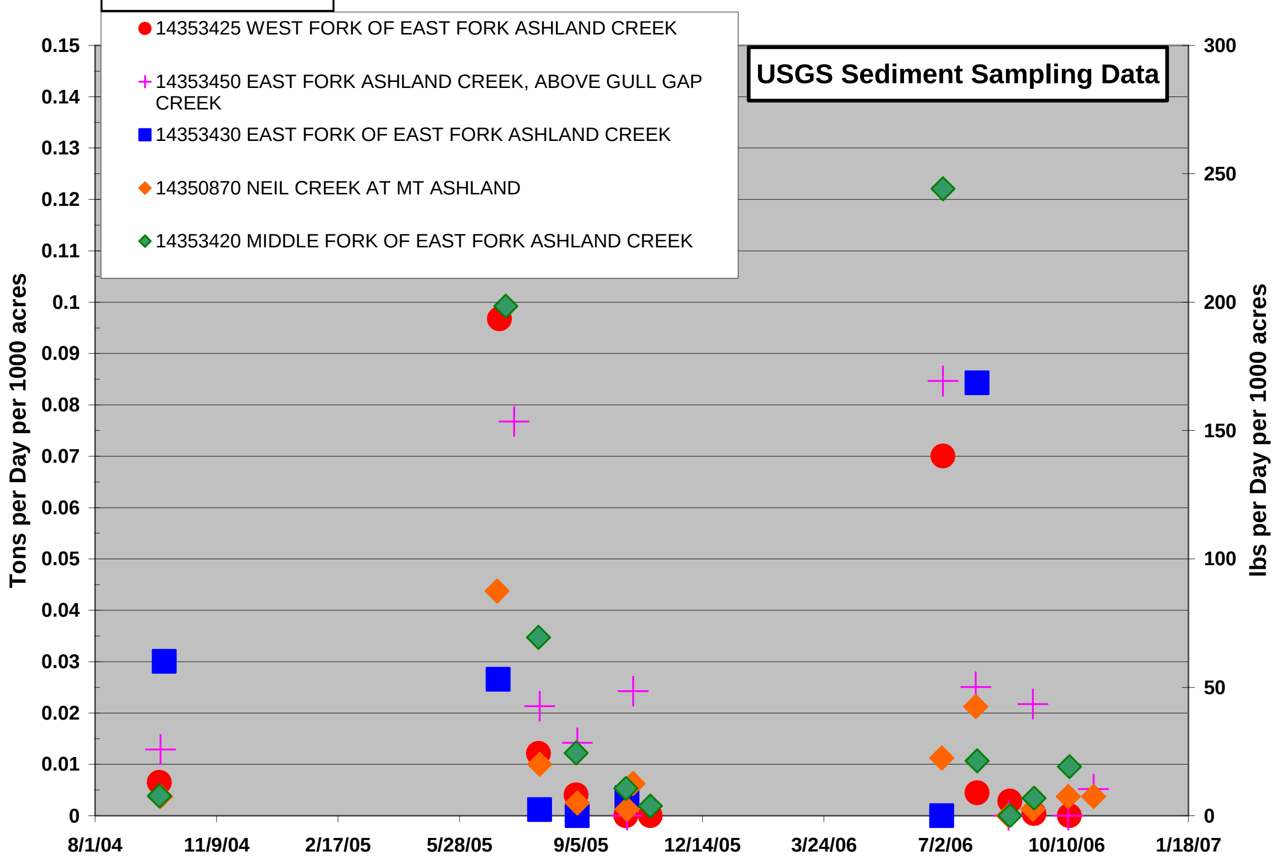


Table VI-2 Ski Area Sediment Monitoring Sites		
Drainage	**Station #**	**Area (Acres)**
W Fork of E Fork	14353425	247
Upper E Fork	14353430	87
Upper Neil Ck	14350870	80
Mid Fork of E Fork	14353420	262
Lower E Fork	14353450	985

The 2001 Bear Ck assessment states that the January 1974 Ashland Creek flood deposited 130,000 cubic yards of sediment into Reeder Reservoir. Typical yearly sediment yields to Reeder Reservoir are on the order of 2,000 cubic yards per year.[6] Between 1976 and 1987, some 10,000 cubic yards additional sediment was deposited (approximately 0.16

cubic yards per acre per year)[2], with the trend declining. Sediment transport has been reduced through greater retention from vegetation growth, road and culvert repair and reconstruction, and perhaps reduced by lower rainfall in 1980s-1990s.

It is obvious that Ashland Creek below the reservoirs will experience reduced sediment input below natural levels. This condition could be an adverse impact on aquatic organisms that are dependent upon the presence of the sediment.

Supplemental Information:

Critical Questions

1. What are the important current sediment sources in the watershed?

The core source of sediment is the granitic land mass that occupies most of the project area (See Map 6(Geology)). This material is highly erodible and difficult to plant with a vegetative cover. As a result, any exposed surfaces can become chronic long-term source areas.

In the low elevation areas the alluvium soil material is also erodible and channel erosion can be problematic.

In general, there is a high awareness of this issue and management practices have been developed to minimize the sediment production.

2. What are important future sources of sediment in the watershed?

Intense wildfires may represent the greatest risk of accelerated sedimentation. Urban expansion with clearing for roads and structures will result in short-term increases in the sedimentation until the protective vegetative cover is reestablished. There will also be long term effects as the watershed adjusts to a new hydrologic regime. The urban storm system will continue to be a source of contaminated sediments with a potentially adverse impact on the aquatic system.

3. Where are erosion problems most severe which qualify as high priority for remedying conditions in the watershed?

A continued effort to minimize the effect of storm runoff would probably have the most benefit. At issue are the chemicals that are inherent in the runoff water that potentially contaminates the entire stream system. Improvement of management practices should also be encouraged. The upcoming Storm Water Management planning process will present an opportunity to address these issues.

[2] Note: To compare with previous discussion, 0.16 cubic yards per acre per year equates to about 1009 lb/day/1000 acres.

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CHAPTER VII: Channel Modification Assessment

Human habitation affects a watershed in many different ways. Since the stream system has developed over geologic time to accommodate the natural flow regime, these more recent human caused changes can affect the stability of the channel system as well as the viability of the aquatic ecosystem that is associated with it. Because there is a direct relationship between channel condition and watershed condition, an optimally functioning channel needs to account for all of the changes in its associated drainage. Attempting to change a channel to "original" condition without allowing for the other changes will likely have less than satisfactory results. Managing for a stable but diverse stream system may be a better management objective. A stable system will minimize erosion and provide an opportunity for micro-ecosystems to become established and prosper. These ecosystems should match the local native systems as much as possible.

This section identifies some of the changes within the Ashland watershed that affect the hydrology and the channel functionality, thus causing potentially detrimental changes in water quality, flow, and aquatic habitat.

Impervious Surfaces

The amount of impervious land alters flow patterns and can increase the "flashiness" of a storm hydrograph as discussed in Chapter IV. Higher flows cause the associated channel to increase its capacity, usually by down cutting or channel widening. Consequently, some channel modification, either natural or man-caused, is to be expected. Studies have shown that converting 10% of a watershed to an impervious condition is sufficient to trigger the channel adjustment process [1].

The City of Ashland limits the amount of impervious coverage by zone: 85% commercial, 90% industrial and downtown, and 55% for single dwelling [2]. Remedial actions include enlarging and reinforcing the channels and storm drains and establishing retention ponds to store storm flow.

Dams

Dams in the project area are identified in the Map 13 Fish Barriers. The merits and disadvantages of dams are discussed frequently and are well known. Generally, the continued existence of a dam implies that its merits outweigh the disadvantages. However, societal values can change over time and the relative merits of an existing dam or a proposed dam may shift, dictating dam removal or new dam construction. With regard to flow, dams with sufficient capacity can provide additional storage during storm flow periods and will effectively dampen the hydrograph response.

Since dams typically trap sediment, the downstream channel may be sediment limited from its upstream source. However, this effect may be balanced somewhat by the sediment from downstream tributaries that is no longer transported through the system as effectively due to the reduction in peak flows. Often channels will become less stable at the mouth of the downstream tributaries as sediment and bedload accumulates in the confluence area. Channel widening and associated bank erosion is a common response to this condition. Sediment management or streambank reinforcement may be necessary to alleviate this situation.

Roads

Roads create an impervious surface and also redirect surface runoff through the storm drain and ditch system. Roads also affect the movement of moisture moving downslope through the soil. In some cases, this groundwater is intercepted by cutbanks on the upslope side of the road and is converted to surface flow. In other cases, the water is impounded behind the road prism, adding moisture to the area. These effects cause the associated channel system to adjust to the new conditions.

Mountain roads in particular have potential to create additional sediment from erosion processes as identified in Chapter VI. This sediment can be transported to the stream system through the ditch drainage system. Good drainage design can minimize this effect. It is essential that the drainage systems for these roads be diligently maintained to operate well at their design capacity.

Storm Drains

Storm drains accommodate the increased runoff associated with the impervious surfaces that were previously discussed. Map 11 Storm Water & Irrigation shows the distribution of the storm drain and irrigation network in the Ashland area. The storm drain system is part of an artificial network that has been constructed to accommodate the urban runoff water and it represents a major deviation from the historic channel network. Consequently the entire system needs to be adapted to accommodate the new flow regimen.

Culverts

Culverts can confine a channel, particularly during flood conditions with the potential of initiating significant changes. Culverts and their associated changes to stream channels and flow can also be barriers to fish passage. Good culvert implementation requires an understanding of the stream channel and flow of the site where the culvert will be used as well as uses by aquatic species. The need for diligent maintenance also applies to culverts.

Irrigation Canals

Irrigation canals typically move water from one drainage to another by means of a mid-slope ditch that gradually moves down across the slope contours. Like roads, they have the capacity to intercept or disrupt the downslope movement of groundwater. The water they carry eventually goes back to the natural system as groundwater or surface water or is lost to evapotranspiration. A consequence is that summer flows may be augmented by the irrigation water. However, this water may contain pollutants such as fertilizers, pesticides, or bacteria that were present on the irrigated plots. Irrigation methods such as drip and sprinkling may result in less contamination than flood irrigation methods.

Stream Cleaning

Historically, stream cleaning usually accompanied settlement in Western Oregon. Woody debris was usually removed from streams in settled areas for aesthetics or flood management. The loss of this structure caused the channels to adjust to a new, usually more simplified, configuration. While channel restoration projects provide some channel structure, it is unlikely that the channels will ever acquire all of the characteristics of the presettlement stream system. In the now urbanized sections of the Ashland Watershed, presettlement conditions would conflict with many current land uses. Appendix F of the Bear Creek watershed analysis provides a detailed comparison of historic and current conditions [2] (See Chapters II, III, V.)

In the upper part of the watershed logging activities may have, in the past, included intensive "stream cleanout." However, this practice has been, for the most part, discontinued and current logging practices have provisions to protect the stream channel area.

Issues Related to Channel Modification

Natural channels

Over geologic time stream channels develop to accommodate the prevailing flow regime. Typically most of the channel development takes place during high flow events – bankfull and flood flows. The resulting channel represents a balance between the erosive flows and the resistance provided by the substrate, banks, bedload and debris. Under this "equilibrium" condition the rate of sediment transport will be at a minimum. Also, the condition typically represents the optimum condition for a stable and diverse aquatic habitat.

Any change that alters this balance will lead to some adjustment in the channel pattern. There are four general deviations: (1.) Too much water for the channel, (2) A reduction in the flow regime and (3) a change in the structural integrity or (4) a change in alignment of the channel.

The first condition is usually the most noticeable and problematic – at least in the short term. Increases in effective storm flow will create this condition. Also, reductions in the channel capacity – the ability of the stream channel to contain a given amount of water - will disturb the balance held by the stream system during flood conditions. Encroachment by roads or other fill has occurred in the past but is less frequent with the more stringent permitting processes. However, since the readjustment process can take decades and even hundreds of years most streams are undergoing some level of readjustment after any alteration.

Careless placement of material in a stream channel will also reduce the flow capacity of the channel and can start a sequence of channel instability. Local readjustment can generate excessive sediment that subsequently reduces the capacity of the channel downstream – setting in motion a long period of channel instability and channel readjustment.

Flow capacity alterations need to consider flood flow capacity. Culverts, bridges, road encroachment and even channel restoration projects can reduce the effective flood flow capacity of the channel, with potentially major effects downstream.

The second deviation, reduced flows, can occur when water is withdrawn or diverted or the effective storage is increased. The consequences of reduced flow are usually less troublesome for the human populace since the active surface flow will diminish and presence of fine sediment deposits will become more noticeable. Usually riparian vegetation will try to occupy the new growing areas. The end result is a change in aquatic habitat that may, or may not, be desirable.

The third deviation, loss of structure, may be the most common and has had the largest net effect to the stream ecosystem. Natural streams that have evolved in areas with wooded riparian zones have a significant quantity of woody material that is an integral structural component of the channel. Woody material in streams is important because it creates habitat for aquatic animals and provides essential structure to the channel. Pioneer accounts talk of log-choked streams and rivers in western Oregon. One of the first tasks of the settlers was often to clear the logs from the streams and rivers. Some of it was for navigation, timber transport, and flood control. The valleys often had the best land for agriculture and they were natural travel routes that encouraged road development.

Reduction of the structural integrity of the channel such as in-stream log removal can result in channel downcutting and the formation of an entrenched channel (i.e. Rosgen type “F”). The end result is a simplified, deep trench with very little habitat value and a lowered water table. Since most of the flood flows are then confined to the channel, the stream banks become vertical and susceptible to erosion by the forceful storm flows. The net result is increased sedimentation, loss of aquatic habitat, and lowering of the water table. Unfortunately this type of channel is difficult to repair and the land users are often not willing restore functionality of the original flood plain, that is, the land users would rather see the stream stay in a deep trench that spread out in a thin wide flood plains. Consequently, it is unrealistic to expect to fully restore all of the streams back to the presettlement “natural” condition. However, mitigation measures can be taken that can compensate to some extent.

There is historic evidence that the present day Bear Creek is very different than the presettlement stream. Historic accounts describe a creek of several channels that meandered “wildly” through a thick morass of trees, brush and swampgrass [3].

It is fortunate that most of the Ashland city streams are small and the associated stream flow can be managed relatively easily. Even though they are all highly modified and are adjusting on their own, they can be monitored and “tweaked” to work with the natural adjustment processes while maintaining local objectives. Erosion areas can be repaired as long as the capacity needs of the channel are met. Likewise, riparian vegetation can help provide channel stability, shade and habitat.

Many of these streams have the benefit of increased summer flows due to the extensive irrigation that takes place in the city. This provides a unique opportunity for more diverse aquatic life as well as riparian habitat. This, in turn can greatly enrich Ashland's urban ecosystem.

Critical Questions:

To evaluate the impacts of modifications to channels in the Ashland urban area it is helpful to address the frontal drainages, small streams, and medium streams separately because they function differently and they have different resource values.

Where are the channelized streams and confined floodplain areas?

In general, the low gradient streams (less than 2%) tend to meander[4] and, since they are associated with ground suitable for agriculture, are more likely to be drastically channelized.

All of the channels have experienced some degree of channelization as a direct consequence of channel cleanout and flood control measures. Removal of woody material is a universally common practice when a watershed experiences extensive development. A consequence of this practice is entrenchment of the streams and a corresponding reduction in the flood carrying capacity of the channel.

Frontal Drainages

The surface gradient of the frontal drainages is typically low and the incipient channels may not be even be recognized as a component of the drainage network. Since they are small they may have been graded or filled as the land surface is modified for the development. However, careless modification can affect the local hydrology with adverse effects affecting both the Ashland and Bear Creek watersheds. These channel areas require careful modification to avoid unwanted flooding and / or erosion. Particular attention should be paid to channels with a high degree of impervious surface identified in Chapter IV.

Small Streams

Most of the streams in the Ashland urban area are in the small stream category. These streams do not have critical fishery values but nevertheless, do support a small aquatic ecosystem that is linked to Bear Creek. The low gradient portion of these streams may be subjected to channel modification to facilitate land utilization. One example of this process is Clear Creek.

The higher gradient portion of these streams is crossed by a network of roads and ditches. In some cases, such as East Paradise Creek, water may be diverted from one natural drainage to another. As mentioned in Chapter IV, this type of diversion changes the effective flow regime in the respective catchments and results in subsequent channel adjustments. On small streams these types of changes can usually be accommodated relatively easily if appropriate attention is paid to the altered flow regime. In particular, assuring adequate flow capacity and providing for appropriate sediment management.

Medium Sized Streams

Ashland Creek, Neil Creek and Bear Creek are all important fishery resources and have been affected by development in the area. Road encroachment and wood material removal are the two major changes. The encroachment has reduced flood flow capacity and the wood removal produces a simplified channel with reduced habitat features. Degradation of the riparian zone and water withdrawals has also affected the functionality of these streams.

Where are reaches of incised channels?

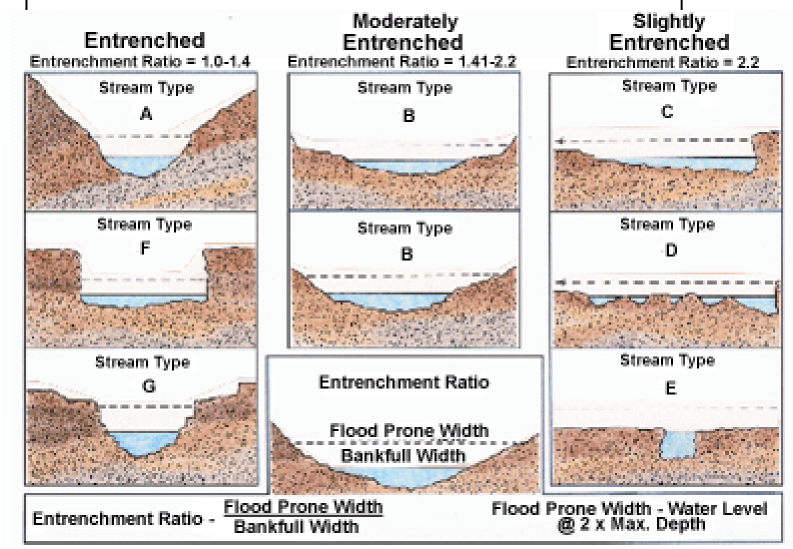
Channels become more incised when flow volume or velocities are increased and the channel bottom is susceptible to erosion. This process frequently occurs in the depositional portion of the stream when flows or the structure of the channel have been altered. It is of particular concern because the downcutting adjustment of the channel creates a large amount of sediment and, since the modified channel now contains more of the flood flow, the process becomes self reinforcing and results in severe damage that is very difficult to repair.

Map 4 shows Level 1 Rosgen Channel classification and Figure VII-1 shows the entrenchment ratio values used by the Rosgen channel classification system to quantify the degree of incision of a channel. Note that the ratio is the flood prone width divided by the bankfull width and that the flood prone width is defined as having an associated depth of twice the bankfull depth.

> The “A” stream types are associated with steep channels and the high entrenchment is an inherent characteristic of this type of channel.
>
> The “F” channels typically are associated with streams with dysfunctional floodplains and often have high erosion rates.

The “G” channels generally have slopes greater than 2% and have very high bank erosion rates and high sediment supply. They are often associated with streams that have been affected by increased flows or structural removal.

Figure VII-1 Rosgen Channel Configurations



Where are areas with habitat or water quality issues?

As mentioned previously, most of the small urban streams do not support a significant fishery resource but they do have the potential to adversely affect Bear Creek and its associated fishery (See Chapter IIX - Water Quality). As discussed, chemicals and other runoff contaminates can be significant. Often the first storms in the fall of the year contain the highest concentration of contaminates.

Concentrations may be highest near storm drain outfalls. The waste water treatment effluent, while meeting standards, may still have some effect on the water quality.

The bulk stream temperatures in the larger streams will approach ambient summer temperatures as high as 80 °F. Since this temperature is well above the tolerance level of the salmonids, thermal refugia areas in the smaller streams and in subsurface recharge areas in the large streams are critical.

Where are the fish barriers?

Chapter IX and X and Map 13 {Fish Barriers} address this issue.

Where are the pipes and ditches located within the urban area?

See Map 1 Storm Water & Irrigation. As discussed in Chapter III, the pipes and ditches produce a highly altered hydrologic condition that directly affects the long term stability of the streams. The time-scale for readjustments to these types of changes are in the order of hundreds of years.

Where are there potential conflicts between channel migration and land use?

Channel migration is most apt to occur in the low gradient (depositional) streams. These streams are also apt to have flood management issues. In the urban area channel migration will probably be controlled with structural features.

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CHAPTER VIII: WATER QUALITY ASSESSMENT

This section discusses (1) the results of the Oregon DEQ Bear Creek Watershed TMDL[1] process as it applies to the Ashland Watershed Assessment area, (2) the quality of the City of Ashland municipal water supply as reported by the City and (3) some general supplemental comments on water quality management. Note: Chapter VI - Sedimentation has additional information on water quality as it relates to sediment.

The Bear Creek Watershed TMDL

The water in the streams in the Bear Creek Watershed is used in many different ways and each use requires its own particular level of water quality. The Oregon Department of Environmental Quality (DEQ) is the lead agency to assure that appropriate water quality standards are met to provide for these uses.

In 2007 DEQ completed an extensive water quality TMDL analysis of the streams in the Bear Creek Watershed with the title "Bear Creek Watershed Total Maximum Daily Load & Water Quality Management Plan[1]." This document can be obtained from the local DEQ office or on-line at
www.deq.state.or.us/wq/TMDLs.
Much of the material in this section was excerpted from the TMDL document.

In the Bear Creek Watershed TMDL the Oregon Department of Environmental Quality identified ten beneficial uses in Bear Creek and twelve uses in the associated tributaries.

Table VIII-1: Beneficial Uses in the Bear Creek Watershed (OAR 340-041-0271, Table 271A)

Beneficial Use	*Bear Creek Mainstem*	*Bear Creek Tributaries*	*Beneficial Use*	*Bear Creek Mainstem*	*Bear Creek Tributaries*
Public Domestic Water Supply[1]		✓	Commercial Navigation & Trans.		
Private Domestic Water Supply[1]	✓	✓	Fish and Aquatic Life[2]	✓	✓
Industrial Water Supply	✓	✓	Wildlife and Hunting	✓	✓
Irrigation	✓	✓	Fishing	✓	✓
Livestock Watering	✓	✓	Water Contact Recreation	✓	✓
Boating	✓	✓	Hydro Power**		✓
Aesthetic Quality	✓	✓			

1. With adequate pre-treatment (filtration and disinfection) and natural quality to meet drinking water standards.
2. See figures 271A and 271B for fish use designations for this watershed.

Temperature TMDL

Two streams in the assessment area were listed for temperature: the entire Bear Creek segment and Neil Creek from the mouth to the I-5 crossing.

Table VIII -2: 2004/2006 303(d) Listings Addressed in the Bear Creek Watershed TMDL

Waterbody Name	River Mile	Parameter	Season	List Date
Bear Creek	0 to 26.3	Temperature	Summer	1998
Neil Creek	0 to 4.8	Temperature	October 1 - May 31	2002
Neil Creek	0 to 4.8	Temperature	Summer	1998

Note that Ashland Creek was not listed but the analysis indicates that the lower 4.9 miles (mouth to Hosler Dam) has only 66% effective shade (effective shade is calculated and has a different value than measured shade).

Sources of excessive thermal input were divided into point sources and nonpoint sources.

Potential Point Sources of Thermal Pollution

The Ashland Wastewater Treatment Facility (WWTF) Background Information

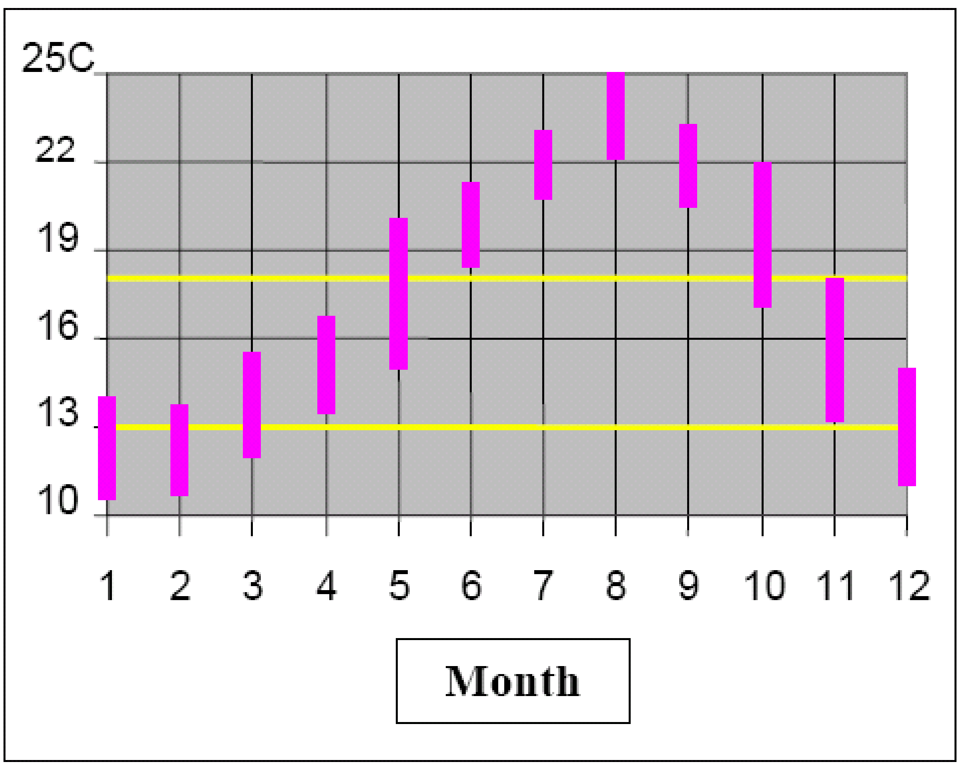
The City of Ashland owns and operates a secondary wastewater treatment facility that discharges treated effluent into Ashland Creek about 1600 feet upstream of its confluence with Bear Creek. The plant's discharge of domestic waste water is regulated under the National Pollutant Discharge Elimination System (NPDES) permit program, specifically DEQ NPDES permit 101609. The NPDES permit for the facility was last renewed on May 27, 2004.

The Ashland WWTF was constructed in 1936 as a trickling filter facility with one primary and one secondary clarifier. Sludge was pumped directly to drying beds. Various modifications have been made over the years, including the addition of a second trickling filter. In 1974, a major upgrade was completed in which the two trickling filters were converted to activated sludge aeration basins, another secondary clarifier was added, and a new chlorine contact basin was constructed. In 1998, the City began construction of additional upgrades to the wastewater treatment plant. The upgrade initially included headworks improvements, replacement of the primary clarifier and aeration basins with two oxidation ditches, rehabilitation of the two existing secondary clarifiers, construction of a third secondary clarifier, and installation of an ultraviolet (UV) disinfection system. The purpose of these upgrades was to eliminate chlorine toxicity and provide adequate treatment during the high flow season. These upgrades were labeled Project A and were completed in 2001. To comply with the requirements of the Bear Creek Total Maximum Daily Load (1992), the City proposed to improve a 840-acre site to allow for irrigation of the treated wastewater and land application of treated biosolids. This was known as Project B. In 2001, the City decided against moving forward with Project B due to considerable public opposition. The City chose instead to install a phosphorus removal system to allow for continued discharge to public waters during the summer months. Phosphorus removal upgrades were completed and the operation initiated July 31, 2002. Additional upgrades including the replacement of the Ashland Creek pump station, construction of an alkaline stabilization facility for sludge, and installation of sludge centrifuges were completed in 2003.

Ashland WWTF Temperature Effects

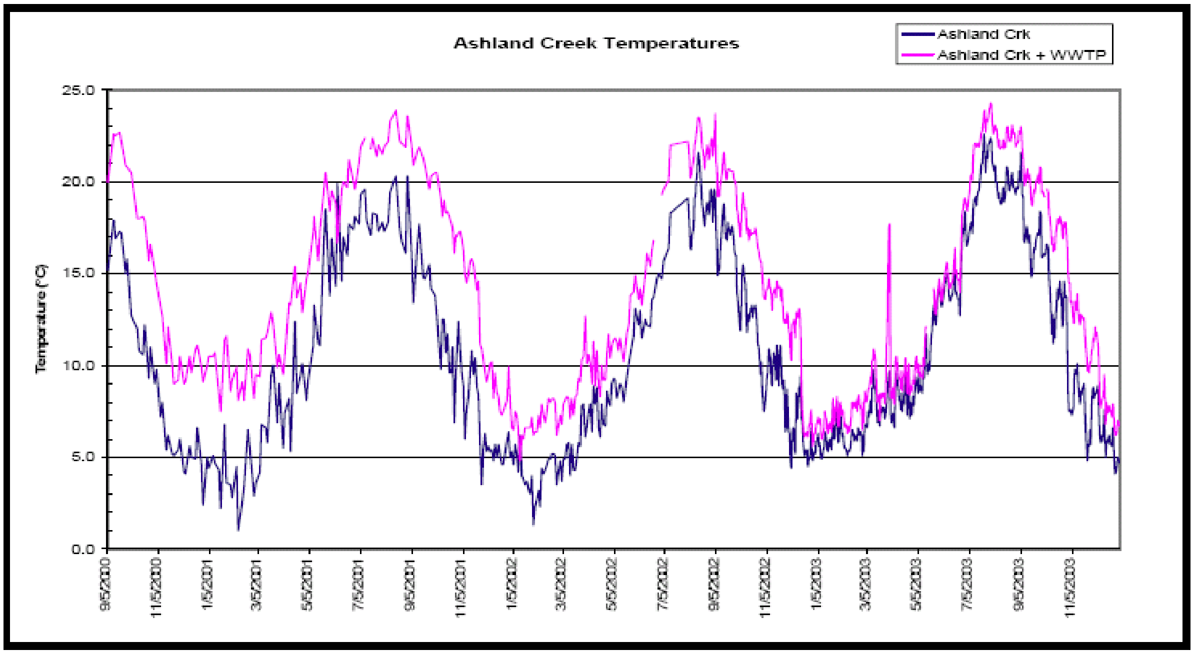
Elevated instream temperatures are detrimental to cold water fish. The temperature standard (biologically based numeric criterion) that applies to Ashland Creek is 13C (55.4F) October 15 through May 15; 18C (64.4F) May 16 through October 14)(Oregon Administrative Rule OAR 340-0041-0028). The City has monitored temperatures both upstream and downstream of the discharge since September 2000 and installed continuous monitors in August 2002. A preliminary review of these data indicate that the temperatures of secondary effluent (7 day mean of daily maximum) frequently exceeds the biologically based numeric criterion (Figure VIII-1) and that there is often a significant increase in temperature from below the WWTF as compared to temperatures above the plant (Figure VIII-2).

Figure VIII-1: Secondary Effluent Temperatures for Ashland WWTF



Source: City of Ashland WWTF September 2000 – December 2004.

Figure VIII-2: Daily High Temperatures in Ashland Creek Above and Below the WWTF



Note: Graphic taken from NPDES Permit evaluation fact sheet. March 8, 2004

Editorial Comments on Figure VIII-2

The data shown represents only the daily maximum value. To fully evaluate the impact on resident fish the entire diurnal cycle needs to be considered.

Also, as shown, the data suggests a thermal "hot spot" at a point near the mouth of Ashland Creek. Forward looking infrared (FLIR) data from DEQ indicates that such hotter and colder spots are typical in streams in western Oregon. The size and importance of this hot zone should be determined in the context of the entire stream profile.

If the effluent were discharged directly into Bear Creek the effluent would probably be lower than the water temperature of Bear Creek, providing a thermal "refuge." Some of the thermal "impacts" could be reduced if it were possible to discharge only during the night portion of the daily cycle.

Point source TMDL

Table VIII-3 provides the waste load allocations and permit limits that account for seasonal variability and future attainment of the applicable standard under the worst case conditions as represented by the average 7-day flows that are exceeded every ten years (7Q10 flows) and the WWTF discharging at normal rates (design flows).

Table VIII-3: Ashland WWTF Waste Load Allocation – Current Outfall into Ashland Creek

Month	Applicable Criterion °C	Dry Weather Design Flows CFS Q_{PS}	Receiving Water 7Q10 CFS[1] Q_R	Human Use Allowance °C HUA	WLA (MW)[2] H_{WLA}	Effluent Temp Limit °C T_{WLA}
May 16 – Oct 14	18C	3.65	1	0.1C	.055	18.13
Oct 15 – May 15	13C	3.65	3	0.1C	.079	13.18

[1] Seasonal 7Q10 flows are taken from DEQ, 2004.
[2] Note: 1 MW-hr = 859845.2 Kcal-hr

Non-point sources of thermal pollution

For non-point sources the DEQ Heat Source model will be used to establish the "site potential effective shade" which will serve as a surrogate target to meet the TMDL thermal load allocation for non-point sources.

Table VIII-4: TMDL Shade Targets

Creek	Current (Percent Effective Shade)	TMDL Shade Target.[1] (Percent Effective Shade)	% Change
Bear Creek Mainstem	15	54	39
Ashland Creek[2]	66	82	16
Neil Creek	71	88	17

1: TMDL shade target is the calculated percent effective shade provided when riparian vegetation reaches site potential.
2: Ashland Creek as shown represents the average shade from the base of Hosler Dam to the mouth (mouth to river mile 4.9). If all of Ashland Creek is included in the average (both East and West Forks), average percent effective shade from the mouth to the head waters currently is 91%, site potential shade is 94%.

Bacteria TMDL

The presence of bacteria associated with fecal contamination are considered to indicate the potential for adverse affects the on the beneficial use of water contact recreation. Table VIII-5 shows the listed streams in the assessment area.

Table VIII-5: 2004/2006 303(d) bacteria listed waterbodies in the assessment area

Waterbody Name	River Mile	Parameter	Season**
Ashland Creek	0 to 2.8	Fecal Coliform	Fall/Winter/Spring
Ashland Creek	0 to 2.8	Fecal Coliform	Summer
Bear Creek	0 to 26.3	Fecal Coliform	Summer
Bear Creek	0 to 26.3	Fecal Coliform	Fall/Winter/Spring
Bear Creek	0 to 26.3	*E. coli*	Summer
Bear Creek	0 to 26.3	*E. coli*	Fall/Winter/Spring

Background on the presence of bacteria in streams

(TMDL section III, page 12).

Bacterial Die-off

Fecal coliforms, of which *E. coli* is a subset, are found in the intestines of warm blooded animals. This environment provides warm constant temperatures and nutrients which are conducive to bacterial growth. Once excreted from an animal host, however, these organisms encounter limited nutrient availability, osmotic stress, large variations in temperature and pH, and predation (Winfield and Groisman, 2003). However, bottom sediment can serve as a reservoir for fecal indicator bacteria, complicating the link between sources and bacteria concentrations in the water column.

Once excreted from their host, fecal bacteria typically have a limited ability to survive in the water column (EPA 2001). Death rates can be influenced by temperature, salinity, predation and sunlight. However, it is usually considered sufficient to approximate the die-off rate with an exponential decay which is dependent on concentration and temperature. Low survival rates of *E. coli* in waterbodies have been well documented with an approximate half life of 1 day (Winfield and Groisman 2003). Anecdotal evidence suggests that coliform exposed to polluted waters may survive for long periods of time and reproduce. The fate of *E. coli* in sediment, though, is not clear and has been the topic of many studies.

Bacterial Re-suspension

Fecal indicator bacteria can adhere to suspended particles in water which then settle causing an accumulation of bacteria in the bottom sediment (Davies et al., 1995). Numerous studies have found fecal indicator bacteria at greater concentrations in the sediment than in the overlying water in rivers, estuaries and beaches (Stephenson and Rychert, 1982, Struck 1988, Obiri-Danso and Jones, 1999, Byappanahalli, et al. 2003, Whitman and Nevers, 2003). Concentrations in the sediment can range from 10 to 100 times greater than in the overlying water. Re-suspension of bottom sediment has been shown to increase fecal indicator bacteria concentrations in the water column. (Sherer et.al., 1988, and Le Fever and Lewis, 2003).

The higher concentrations of fecal indicator bacteria in sediment are attributed to much slower die-off rates when compared to overlying water (Gerba and MeLeod, 1976, LaLiberte and Grimes, 1982, Burton et. al., 1986, Sherer et. al., 1992, Davies et. al. 1995,). Davies et al. (1995) found that the usual exponential decay model is not appropriate for fecal coliforms in sediment. Particle size distribution, nutrients and predation were hypothesized to influence survival rates; however, no quantitative correlation of survival rates with environmental factors was presented.

Two recent field studies have indicated the possibility that fecal indicator bacteria can form a stable, dividing population in sediment in a temperate environment (Whitman R.L and M.B. Nevers, 2003 and Byappanahalli, et al. 2003). Whitman and Nevers (2003) concluded that "more research into the environmental requirements and potential for in situ growth is necessary before *E. coli* multiplication in temperate environments can be confirmed, but this study provides initial data supporting that hypothesis."

Editorial Comment on bacterial background

It appears that identification of the sources of bacterial contamination is difficult, in part, due to the fact that bacteria can accumulate in bottom sediment and reenter the water column when the bottom sediments are disturbed by physical agitation or from high stream flows.

Since recreational water contact is the ultimate concern, sampling high use sites during actual use should be recommended.

TMDL Bacteria Load Allocations

In Table VIII-6, load and waste load allocations are presented as well as percent reduction targets needed to reach the standard. It is important to note that although fecal coliform data is used to determine the percent reduction targets, actual TMDL allocations are all based on *E. coli* numbers. This was done in order to use the best, most robust data sets available. Percent reduction targets in fecal coliform directly translate to *E. coli* percent reductions and provide a realistic measure of how much improvement is needed to meet the standard. In the sections that follow individual load and waste load allocations are discussed.

Table VIII-6: Bear Creek at Medford: Load Allocations and Percent Reduction Targets (Fecal Coliform)

	Range of Bear Creek Flow				
Allocations	**High Flow** (Above 266 cfs)	**High Medium** (71 to 256 cfs)	**Mid-Range** (39 to 70 cfs)	**Low Medium** (12 to 38 cfs)	**Low Flow** (Below 12 cfs)
Allowable Loading Capacity (Fecal Coliform Standard)	8.51×10^{13}	5.56×10^{13}	1.41×10^{13}	7.82×10^{12}	5.38×10^{10}
Current Load (Fecal Coliform Org./day)	2.15×10^{14}	2.62×10^{14}	9.17×10^{13}	2.26×10^{13}	6.46×10^{10}
Percent Reduction (Fecal Coliform) [1]	60.5%	78.8%	84.6%	65.4%	20.0%

[1] An explicit 10% margin of safety was incorporated into these TMDL percent reduction targets since human contact recreation has the potential to occur under most flow conditions. Percent reductions shown are averages of percent variance from the standard at each data point and therefore cannot be directly compared to the allowable and current loads shown in the table.

For the Bear Creek tributaries, percent reduction targets were calculated based on the difference between fecal coliform loading and loadings that meet the 200 CFU/100 ml for each sample taken. The percent reduction calculations are based on tributary data collected between February 1995 and October 1998 (Note: all percent reduction targets are based on fecal coliform samples (Table VIII-7).

Table VIII-7: Percent Reduction Surrogate Targets for Primary Tributaries (fecal coliform)

Tributary Name	% Reduction Target[1, 2]
Neil (n=47)	55
Ashland (n=41)	38

[1] percent reduction surrogate targets based on Fecal Coliform Loads (CFU/Day).
[2] An explicit 10% margin of safety was incorporated into this TMDL, since human contact recreation has the potential to occur under most flow conditions.

Sediment TMDL

The Bear Creek 2007 TMDL gives the following reason for listing the Reeder Reservoir for excessive sediment:

Deviation from Water Quality Standards and 303(d) Listings

Reeder Reservoir is included on the 2004/2006 303(d) list for sedimentation due to a USFS Watershed Assessment (USFS 1995) that stated “excessive sedimentation requires periodic sluicing of Reeder Reservoir to provide storage for drinking water supply.”

As indicated in the sedimentation component, the Ashland Watershed, having erodible granitic soils, will characteristically have large sediment loads during extreme storm events that will tend to fill the reservoir. Since the reservoir stores water for the municipal supply, the excess sediment needs to be removed periodically to assure sufficient storage capacity.

TMDL Loading Capacity

Loading Capacity: *The loading capacity is set to natural background or an erosion rate of 3.62 cubic yards per day total for the watershed. No significant increased delivery of sediment to Reeder Reservoir over that which would occur naturally is allowed.*

Monitoring of stream cobble embeddedness or percent fines (through Wolman pebble count method) and monitoring that continues to incorporate macroinvertebrates as trend indicators for sedimentation in the East and West Forks of Ashland Creek is requested.

Surrogate Measures

Although the loading capacity is set to natural background or an erosion rate of 3.62 cubic yards per day total for the watershed this target is difficult to measure and is of limited value in guiding management activities needed to solve the water quality problems of sedimentation. For East and West Forks of Ashland Creek an allocation of surrogate measures, as provided under EPA regulations (40 CFR 130.2(i)), is appropriate to determine the impact of management measures over time.

The surrogate loading capacity for all streams draining into Reeder Reservoir is that amount of sediment resulting in less than 33% cobble embeddedness in East and West Fork of Ashland Creek. A <33% embeddedness target has been used in other TMDLs in the region (Applegate, 2003) and has been recommended by USFS Fish Biologists, as an appropriate indicator of fine sediment impairment to salmonids (the most sensitive "resident biological community"). In addition the monitoring of percent fines using a modified Wolman pebble count method can be used to ensure that fine sediment inputs are not increasing in the system. Long-term monitoring and the adaptive management nature of this TMDL will be used to evaluate this goal over time.

The US Forest Service has developed a Water Quality Management Plan that may be sufficient for most of the area that supplies the reservoir. The City of Ashland manages about 170 acres in the vicinity of the reservoir that will require a management plan.

1992 Bear Creek TMDLs

Other water quality issues were address in the 1992 TMDL

What are the Existing Bear Creek TMDLs:

In the early1990's DEQ developed TMDLs to address the non-attainment of pH, aquatic weeds and algae and dissolved oxygen (DO) standards in the Bear Creek watershed. These initial TMDLs, among the first in the state of Oregon, were approved by the USEPA on December 12, 1992.

Deviation from Water Quality Standards and 303(d) Listings

Once a watershed has an approved TMDL, waterbodies that were listed as impaired are removed from the state's 303(d) list and are place on the integrated report under the category "TMDL Approved." Table VIII-8 lists those streams in the Bear Creek watershed that are covered in the 1992 TMDL.

Table VIII-8: Impaired Waterbodies in the Bear Creek Watershed with Approved TMDLs

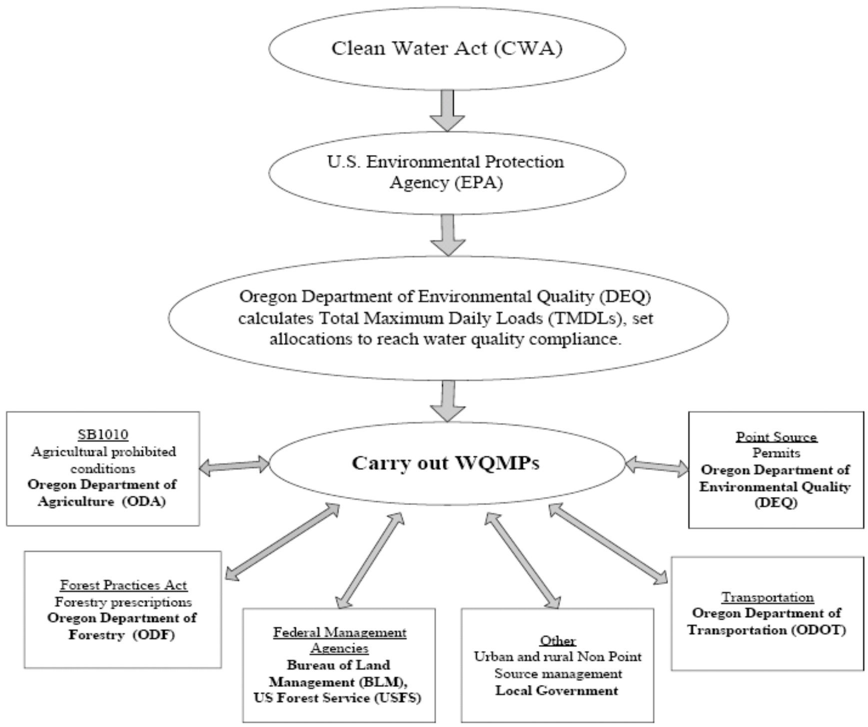
Waterbody Name	River Mile	Parameter with Approved TMDL	Season
Ashland Creek	0 to 2.8	Ammonia	Spring/Summer/ Fall
Ashland Creek	0 to 2.8	Phosphorus	Spring/Summer/ Fall
Bear Creek	0 to 26.3	Aquatic Weeds & Algae	Undefined
Bear Creek	0 to 26.3	Dissolved Oxygen	October 15- May 15
Bear Creek	0 to 26.3	Phosphorus	Spring/Summer/Fall
Neil Creek	0 to 4.8	Dissolved Oxygen	October 1 – May 31
Neil Creek	0 to 4.8	Dissolved Oxygen	Summer

TMDL Implementation and Designated Management Agencies

TMDL Implementation

After the TMDLs are established, Water Quality management plans will be developed and implemented by Designated Management Agencies (DMAs) as shown in Figure VIII-3.

Figure VIII-3: TMDL/ Water Quality Management Plan Implementation Schematic



Listed below are the areas of responsibility for the municipalities in the Bear Creek watershed.

DMA: Jackson County, Cities of Ashland, Talent, Phoenix, Medford, Central Point, Jacksonville.

Land Use: Urban/Nonresource land uses in the Bear Creek Watershed

- Urban/Nonresource land uses will be covered in the Implementation Plans for Jackson County, Cities of Ashland, Talent, Phoenix, Medford, Central Point, Jacksonville to the extent of their authority.
- All urban, nonagricultural, nonforestry-related land uses including transportation uses (road, bridge, and ditch maintenance and construction practices)
- Sewer and septic systems as related to human habitation
- Designing and siting of housing/home, commercial, and industrial sites in urban and rural areas
- Golf Courses
- Other land uses as applicable to the TMDL

Quality of Ashland's Drinking Water

Many of the residents in the assessment area obtain their drinking water from the City of Ashland. A high level of water quality for Ashland's domestic supply is assured by water treatment processes managed by the Department of Public Works. Constant monitoring and strict controls assures that the water provided to consumers is consistent with EPA drinking water standards. The City provides annually a report that summarizes the monitoring results for the designated year.

The following section is excerpted from the City of Ashland – 2006 Water Quality Report [2] The entire document can be viewed at:
http://www.ashland.or.us/Files/2006%20water%20quality%20report.pdf

Water Quality Analysis Results

The US Environmental Protection Agency requires that water systems report annually on contaminants that have been detected in their water supplies. The City of Ashland monitors for over 100 contaminants, including coliform bacteria, micro organisms, herbicides, organics, inorganics, and pesticides. The City of Ashland collect samples from the watershed, plant, distribution system, and at customers' taps. Ashland's water supplies meet or surpass federal and state drinking water standards.

Table VIII-9: Lead and Copper

VARIABLE	90th PERCENTILE VALUES	# OF SAMPLES EXCEEDING ACTION LEVELS	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMINANT
COPPER	0.3505 parts per million	0 of 31 samples collected.	Exceeds Action Level if more than 10% of homes tested have copper levels greater than 1.3 parts per million	1.3 parts per million. Treatment Technique required	Corrosion of plumbing systems
LEAD	0.0016 parts per million	0 of 31 samples collected.	Exceeds Action Level if 10% of homes tested have lead levels greater than 0.015 parts per million	Zero	Corrosion of plumbing systems

Lead and copper tests were conducted in 2005—next due in 2008. Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the Safe Drinking Water hotline (800-426-4791).

Table VIII-10: Inorganics

VARIABLE	UNITS	ASHLAND'S DETECTED LEVEL	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMIN-ANT
BARIUM	Parts per million	0.0051	2	2	Erosion of natural deposits

Test for Barium was conducted in 2004—next due in 2013.

Table VIII-11: Control of Disinfection By-Products Total Organic Carbon (TOC)

VARIABLE	UNITS	ASHLAND'S DETECTED LEVEL	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMINANT
TOC RAW	Parts per million (ppm)	Average: 2.7 Range: 1.7-5.9	TT	None	Naturally present in the environment
TOC FINISHED	Parts per million (ppm)	Average: 1.3 Range: 0.7-2.2	TT	None	Naturally present in the environment

There are no negative health effects from TOC; however, TOC provides a medium for the formation of DBP's which may lead to adverse health effects as described under TTHM's and HAA's. DBP = Disinfection By-Products, TTHM = Total Trihalomethane, HAA = Haloacetic Acids

Table VIII-12: Turbidity

VARIABLE	UNITS	MAXIMUM AMOUNT DETECTED	ASHLAND'S DETECTED LEVEL	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMIN-ANT
TURBIDITY	NTU	.06	Average 0.02 Range 0.02-0.06 100% of the samples within limits	0.30	N/A	Soil erosion and stream sediments

Turbidity, or cloudiness of the water, can be caused by many things: fine clay silt suspended in the water, bacteria, algae, etc. High turbidity levels can interfere with disinfection and provide a medium for microbial growth. High turbidity may indicate the presence of disease-causing organism like viruses and parasites that can cause nausea, cramps, diarrhea, and associated headaches. Turbidity is measured in NTUs (nephelometric turbidity units), a measure of water clarity.

Table VIII-13: Asbestos

VARIABLE	UNITS	ASHLAND'S DETECTED LEVEL	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMINANT
ASBESTOS	Mean fiber concen-tra-tion (MFL)	0.40	7.0	7.0	Decay of asbestos cement water mains

Some people who drink water containing asbestos in excess of 7.0 MFL over many years may have an increase of developing intestinal polyps. Asbestos is tested every 9 years. The next test is due in 2012.

Table VIII-14: Disinfection By-Products

VARIABLE	UNITS	ASHLAND'S DETECTED LEVEL	MAXIMUM CONTAMINANT LEVEL	MAXIMUM CONTAMINANT LEVEL GOAL	SOURCE OF CONTAMINANT
TOTAL TRIHALO-METHANES	Parts per billion (ppb)	Average: 39 Range: 20-57	80	N/A	By-products of chlorination used in water treatment
HALOACETIC ACIDS	Parts per billion (ppb)	Average: 36 Range: 3-52	60	N/A	By-products of chlorination used in water treatment

Some people who drink water containing trihalomethanes in excess of the Maximum Contaminant Level (MCL) over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer. Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer.

Supplemental Information

The TMDL process is based on established standards and serves as a warning system to assure that the key beneficial uses are not put at significant risk. However, it is likely that trace contaminates are present and their effect on users may be subtle and indirect. For example, it is thought that anadromous fish find their way back to their original spawning area by detecting the chemical signature of the home stream.

There are many sources of pollutants that can contribute trace amounts of contaminants to the aquatic system. Pesticides, sewage, industrial and domestic waste, and storm runoff are the most common. It is difficult to test for these trace chemicals and even more difficult to establish their societal effects. However, epidemiological studies suggest that environmental factors are affecting our health and well being in unexpected ways. Therefore it seems prudent to try to minimize trace contamination of the natural water system. Toward that end the following general management practices are recommended:

1. Minimize pesticide and fertilizer use. In particular, avoid runoff contamination.
2. Manage urban storm water to minimize contamination. Water Quality Monitoring and public education may be useful.
3. Wastewater effluent may still contain trace contaminates. If that is the case, using the effluent for irrigation may be a viable alternative. Streamflow could be maintained if an equivalent amount of untreated irrigation water were released.

REFERENCES

1. DEQ, *Bear Creek Watershed TMDL & Water Quality Management Plan*. 2007, Oregon Department of Environmental Quality: Medford.
2. *City of Ashland, Oregon - 2006 Water Quality Report*. 2006, Department of public Works: Ashland, Oregon. p. 11.

CHAPTER IX: Fish & Other Aquatic Wildlife: Populations and Habitat Conditions

Introduction

When the watershed management goal is to preserve or restore "natural" aquatic systems when possible and acceptable, native species are preferred over introduced (non-native) species because native species retain the function of the natural stream ecosystem. However, not all native species are treated to equal amounts of attention. Aquatic species with sport and commercial value are counted, tracked, aided, protected, and managed much more closely than other native animal species. Because of this, there is often a limited understanding of the local distributions, life histories, and ecosystem roles of non-game species. Ashland Watershed Assessment strives to compile all the extant data on aquatic and riparian-dependant species regardless of commercial and social interest. It is hoped that it will provide a more thorough understanding of the rich and interesting aquatic ecosystems in our area. Original documents are cited in the reference section. Recommendations for filling data gaps are included in Chapter 11.

Included in this Chapter are two special sections. The different riparian buffers applicable to federal and private lands are explained (Map 12). The widespread problem of migration barriers are discussed and illustrated with photos and Map 13.

Below, the fish, rare insect, and crayfish species found in the Assessment area are briefly discussed. The roles of fish, insects, and crayfish in the aquatic ecosystem are explained. Each species' life history, distribution, and population data are briefly explained and the known distribution of native fishes delineated in Maps 14 and 15. Biologists concerns about streams in urban settings are explained. Aquatic habitat information for each major stream in the assessment area is summarized.

A Note on Anadromy

Anadromy (the adjective being "anadromous") is a life-history pattern for some fish. Anadromous fish hatch from eggs in freshwater and migrate out to sea to grow before returning to freshwater to spawn. Most readers are familiar with salmon and steelhead, but the Pacific lamprey is also anadromous. Why are some species anadromous and others not? It comes down to reproduction: for fish, the bigger you are, the more eggs or sperm you can make. Northwestern streams are quite cold for about 7 months of the year, and don't produce enough food to grow large fish (Quinn 2005). Northern oceans, on the other hand, teem with food sources, and fish can follow a current with a constant temperature environment. Consequently, anadromous fish can grow larger and faster in the ocean than in northwestern streams, rivers, or lakes.

What is interesting – and sometimes confusing – about anadromy is that it is not an "all or nothing" matter for salmonids. Salmonids evolved in a chaotic environment: streams flood regularly; earthquakes and wildfires cause huge landslides of rock, mud, and trees; even volcanoes erupt occasionally. Subsequently, salmonids are very flexible. Most young salmon migrate to the ocean, but if they can't, they will stay in the stream and slowly grow until they reach adulthood at a much smaller size than if they had migrated to the ocean (Quinn 2005). For example, Kokanee are naturally-landlocked sockeye salmon (*O. nerka*) usually growing to adulthood in lakes and migrating into nearby streams to spawn. Steelhead and rainbow trout are actually the same species – one is the ocean-migrating form and the other stays in streams. However, sometimes rainbow trout juveniles "choose" to migrate seaward, and a percentage of steelhead stay in the stream (Quinn 2005). All of this flexibility ensures that a portion of the offspring stay alive to reproduce later.

Salmonids are also flexible when it comes to "homing." Most readers are familiar with the concept that adult salmon return to their birth streams to spawn. This is true; however, a small percentage of each year's adults will "stray" or wander around and investigate new streams. Approximately 5% of the returning southwest Oregon steelhead stray (Prevost et al. 1997). The tendency to stray is just as important for salmon and steelhead survival as homing because it protects a portion of each year's offspring from extreme changes in their "home" habitat. It also ensures that salmon will reinhabit restored streams. Without the migratory flexibility inherent in anadromy, salmon and steelhead would have been extinct from our streams long ago.

Aquatic Species Found in the Ashland Watershed Assessment Area

Fish

Salmonids are fish belonging to the family Salmonidae[1]. All salmonids are classically "fish-shaped" (long and cylindrical) and "salmon-like," meaning that they look like a salmon and are very flexible in their ability to use a wide variety of habitats to spawn, grow, and survive. In the Ashland Watershed Assessment area, there are have five native salmonids:

1. coho salmon (*Oncorhynchus kisutch*),
2. chinook salmon (*O. tshawytscha*),
3. steelhead (an ocean-going trout) (*O. mykiss*)
4. rainbow trout (also *O. mykiss*), and
5. cutthroat trout (*O. clarki*).

Coho salmon within the Ashland Assessment area are part of a population that was listed as Threatened under the Endangered Species Act in May, 1997. No other salmonids in the Assessment area are listed or under review for listing at the time of publication. There are no introduced salmonids (e.g. Eastern brook trout, German brown trout) in the Assessment area.

[1] Scientific nomenclature is an organized method of naming all the species of plants, animals, and insects on the planet. All species are grossly divided into Kingdoms, then further into Phyla, Classes, Orders, Families, Genera and finally, Species. The species that make up a Family usually look and behave like relatives. Therefore, the Family name is often used when discussing an entire group of species. For example, salmonids are members of the family Salmonidae which includes all the salmon and trout species.

Lamprey are an ancient, anadromous, eel-looking fish. They have been given little attention because they are not considered a game fish. The Pacific lamprey, *Lampetra tridentata* spawns and rears within the Assessment area.

Catostomids are suckers, from the family Catostomidae. There is one native sucker in the study area: the Klamath smallscale sucker (*Catostomus rimiculus*). There are no introduced suckers.

Cyprinids are minnows and carp belonging to the family Cyprinidae. There is only one native cyprinid, speckled dace (*Rhinichthys osculus*), in the Assessment area. There are three known introduced cyprinids: the fathead minnow (*Pimephales promelas*), redsided shiner (*Richardsonius balteatus*), and golden shiner (*Notemigonus crysoleucas)*.

In the Assessment area, there is a small (about 4-5 inches in length), large-mouthed, bottom-dwelling, predatory native fish called a reticulate sculpin (*Cottus perplexus*). Sculpin are members of the Cottidae family. There are no introduced sculpin in the Assessment area.

Finally, several members of the sunfish family Centrarchidae have been introduced to Bear Creek: smallmouth bass *(Micropterus dolomieu)*, large-mouth bass (*Micropterus salmoides*), pumpkinseeds (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus)*, and green sunfish (*Lepomis cyanellus*). Recent surveys have found the latter two in Bear Creek within the Assessment area (Broderick 2000; Maxwell, in preparation).

A brown bullhead (*Ameiurus nebulosus*) has also been found in Bear Creek within the Assessment area. It belongs in the Ictaluridae family. It is introduced.

<u>Crayfish</u>

Non-crustacean specialists tend to think of “crustaceans” as crabs, shrimp, etc. In reality, the subphylum “Crustacea” is much broader than that, including unusual organisms like seed shrimp, barnacles and wood lice. Rather than discuss all crustaceans found in the project area streams, this report will just discuss crayfish (or “crawdads”) because they are a very visible and important crustacean component of stream ecosystems.

There is one crayfish native to local waters: the signal crayfish, *Pacifastacus leniusculus* (Figure IX-1). Unfortunately, the Rogue Basin has been invaded by the ringed crayfish (*Orconectes neglectus)* (Fig. IX-2). Both are found in streams within the Ashland Assessment area (Maxwell, in preparation).

<u>Rare and Unusual Aquatic Macroinvertebrates</u>

Aquatic macroinvertebrates are insects, crustaceans, worms, and other small (but not microscopic) spineless organisms that spend all or part of their lifecycle in fresh water. In the last 15 years, a number of aquatic macroinvertebrate specialists have been contracted by the U. S. Forest Service and Bureau of Land Management to sample streams throughout southwest

Oregon. During the course of these surveys, 25 rare or unusual taxa[2] have been discovered in streams within the Ashland Watershed area (Table 9-1).

Figure IX-1: Signal crayfish, *Pacifastacus leniusculus*. Photo: MdE (Wikipedia-de)

Figure IX-2: Ringed crayfish*, Orconectes neglectus.* Photo: © Garold Sneegas.

Figure IX-1 link: http://commons.wikimedia.org/wiki/Image:Pacifastacus_leniusculus_2.jpg
Figure IX-2 link: http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=2267

Roles in the Aquatic Ecosystem

An entire book could be written about all the roles that fish play in stream ecosystems. In this assessment, two will be briefly mentioned: transportation provider and food source. Food web relationships between different fish species, crayfish, and aquatic insects will also be briefly discussed.

A little-known, but important role for many fish species is to transport mussels upstream[3]. Freshwater mussels can be found buried in the sand and silt in pools where they filter food out of the water. Mussels cannot swim, so without some way to get back upstream, winter flows would eventually tumble them all the way down to the ocean. Fish are the key. When mussels spawn in the spring, males release sperm into the water. Females take the sperm and fertilize their eggs. The eggs develop into an intermediate larval stage called "glochidia." The female releases the glochidia into the stream, where they float in the current and hope to attach to a fish – usually a fish of a specific species. Glochidia are so tiny, that as the fish "breathes" water through its gills, the glochidia get sucked in and attach. The fish then migrates upstream to spawn with a bunch of little hitchhikers. When the fish reach their spawning grounds, the glochidia detach and settle down on the bed of the stream to grow into mussels. The mussel found in local waters, *Margaritifera*, is a salmonid obligate. It doesn't take a

[2] Ideally, all aquatic macroinvertebrates would be identified to species. However, sometimes this is impossible, due to sample damage, or sometimes because scientists have not yet worked on species identification of a particular insect group. Therefore, the word "taxa" is used to indicate the most accurate identification of a macroinvertebrate possible: to species, genera, family, or even order.

[3] For a east-to-read summary of freshwater mussels, see: http://www.dgif.state.va.us/wildlife/freshwater-mussels.asp.

Table IX-1: Rare or unusual taxa collected in benthic aquatic macroinvertebrate surveys within the Ashland Watershed Assessment area, 1993-2000. Sampling was completed under contract for the U. S. Forest Service by Aquatic Biology Associates (Corvallis, OR), and Utah State University Bug Lab (Logan, UT). Taxa descriptions are from summary reports submitted by Aquatic Biology Associates. Citations for these sampling reports are included in the reference section of this document. "Sp." stands for "unknown species" and indicates that the insect or other macroinvertebrate has been identified to genus, but cannot yet be identified to species.

Taxa	Description	Stream	Sample Location	Date
Anagapetus sp.	Caddisfly.	East Fork Ashland Ck.	200 m upstream of Reeder Resv.	10/11/1995
			Section 17, near ski area	11/13/2000
Allocosmoecus sp.	Caddisfly.	East Fork Ashland Ck.	200 m upstream of Reeder Resv.	10/11/1995
Amphizoa sp.	Caddisfly.	East Fork Ashland Creek	200 m upstream of Reeder Resv.	10/11/1995
Arctopsyche californica	Caddisfly. Found throughout the Sierra Nevada Mountains and Coastal Ranges of northern California. The Rogue River and Siskiyou National Forests appear to be the northern extent of the species' range.	Neil Creek	¼ mile upstream of Hwy. 66	11/21/2000
Caudatella cascadia	Mayfly. Relatively rare and restricted to higher elevation streams.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Caudatella sp.	Mayfly in the family Ephemerellidae. The larval type present at the site is undescribed. More mature larvae and adults are needed to evaluate the taxonomic status.	East Fork Ashland Ck.	200 m upstream of Reeder Reservoir	10/11/1995
Chryptochia sp.	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Chyranda centralis	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Eocosmoecus frontalis	Caddisfly. *Eocosmoecus frontalis* is an uncommon limnephilid (tube case-making) caddisfly found in higher elevation, small, cold streams in the PNW. Larvae prefer relatively undisturbed streams, and appear to be most common in small, cold, sub-alpine streams where the riparian vegetation is a mix of sub-alpine meadow and forest. Larvae are unusual in that they will climb out of the water and up onto streamside herbaceous plants to feed. *E. frontalis* is rare and may eventually be classified as "sensitive."	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Frisonia sp.	Stonefly	East Fork Ashland Ck.	200 m upstream of Reeder Resv.	10/11/1995
Frisonia picticeps	Stonefly	Neil Creek	¼ mile upstream of Hwy. 66	11/08/1999 11/21/2000

Taxa	Description	Stream	Sample Location	Date
Gammaridae Stygobromus?	This is a small, apparently blind, amphipod that may be associated with hyporheic habitats. It is rarely encountered. These specimens will be evaluated by Dr. John Holsinger (Old Dominion University, Norfolk, VA).	East Fork Ashland Ck.	200 m upstream of Reeder Resv.	10/11/1995
Homophylax sp.	Caddisfly. *Homophylax sp.* is rare and may eventually be classified as "sensitive" taxa.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Neothremma sp.	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/13/2000
Palaegapetus sp.	Caddisfly. Associated with moss and liverworts. Relatively rare and appears to be very sensitive to human disturbance. May eventually be classified as "sensitive" taxa.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Parapsyche almota	Caddisfly.	Neil Creek	¼ mile upstream of Hwy. 66	10/08/1993
Rhyacophila grandis	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Rhyacophila iranda	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Rhyacophila vagrita	Caddisfly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Rickera sorpta	Stonefly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Salmoperla sp.	Stonefly. Rare. This record is only the second known collecting locale for Oregon. SW Oregon is the northern limit of its range. Has a good chance of being listed as "sensitive" in the future. It is also found in northern California.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999 11/13/2000
Sierraperla sp	Rare, peltoperlid stonefly, known from California. It has been encountered in SW Oregon several times in the past two years. It appears to be strictly associated with small streams in old growth forests.	East Fork Ashland Ck.	200 m upstream of Reeder Resv.	10/11/1995
Soliperla sp.	Stonefly.	East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Stilocladius sp.	Midge (Chironomidae).	Neil Creek	¼ mile upstream of Hwy. 66	11/08/1999
		East Fork Ashland Ck.	Section 17, near ski area	11/02/1999
Thaumaleiidae	Diptera.	Neil Creek	¼ mile upstream of Hwy. 66	10/08/1993

stretch of the imagination to realize that dwindling salmonid populations would be a problem for mussels, too.

Recently, scientists have been exploring another very important ecological role of anadromous fish: providing nutrients for the entire stream ecosystem. Salmon, steelhead, and lamprey transform the bounty of the ocean into millions of pounds of fish flesh, growing much larger (and faster) than they would if they stayed "at home" in streams. When they migrate back to streams to spawn and die, all those fish carcasses provide nutrients to the stream ecosystems, reversing the natural tendency for water and nutrients to flow seaward (Quinn 2005).

How important is this? It is much like compost in a vegetable garden: more compost means bigger squash and more tomatoes. Scientific research has shown that dead anadromous fish, in streams with healthy returning populations, increase growth rates for wildlife[4], increase riparian bird populations, increase aquatic insect density, provide about 20% of the nitrogen used by riparian conifers, and provide food for juvenile salmon (Quinn 2005; Bilby et al. 1996). Bilby et al. (1996) found that juvenile salmonids ate not only insects that had fed on salmon carcasses, but the carcasses themselves. In the Ashland Assessment area, chinook, coho, steelhead, and Pacific lamprey migrate and spawn from fall (chinook) through late spring (lamprey). Each species provides food and nutrition for the newly-hatched babies of the species that preceded it: coho feed chinook; steelhead feed coho, lamprey feed steelhead.

Most readers will be familiar with the "food web". The food web is the network of relationships between predators and prey, plants and animals—in other words, who eats what, or whom. In the Ashland assessment area, the suite of fish species present fills a variety of niches, or slots, in the food web. Sculpin lay in wait for small fish and eat aquatic insects off of rocks on the bottom of the stream. Trout and young salmon prefer to eat insects floating down the current. Suckers also scrape insects and algae off of rocks with specially-designed bulbous lips and scraping plates in their mouths. Lamprey ammocetes (juvenile lamprey) hide in the sand and filter detritus out of the water column, much like a clam or mussel. And of course, young of all of these species can be tasty snacks for predatory fish, like large trout – or invading smallmouth bass.

An important note: all fish – including young steelhead and salmon – eat salmon eggs. When salmon spawn, other fish wait downstream, much like a dog waiting patiently underneath the baby's chair. However, the eggs consumed are overflow eggs, swept or bounced out of the redd and not safely buried in the gravels. Sculpin, suckers[5], and young salmon are not killing viable eggs.

Invertebrates, of course, are an essential part of the aquatic food web. Besides preying on small fish and aquatic insects, crayfish are the garbage collectors, clearing streams of carrion (Taylor et al. 2007). Crayfish eat aquatic plants, which can be important in impounded (dammed) streams where flows do

[4] Scientists can measure the amount of marine-derived Nitrogen and Carbon because they have a different molecular signature.

[5] It is not uncommon to find dead suckers along the banks of the Rogue River near popular fishing spots as fishers exact a misguided revenge (L. Lyons, personal communication, 2002).

not flush out fine sediments and instream plant cover reduces habitat quality. Several studies have found crayfish to significantly reduce the biomass of aquatic plants (Allan 1995). Crayfish are also an important food source for many species of fish and riparian-dependant mammals like otters and raccoons. Crustaceans are known to be very sensitive to pesticides and metal contamination. Although more research is needed, crayfish may prove to be a useful "canary in the coal mine" as indicators of habitat degradation, especially in urban systems (Taylor et al. 2007).

Aquatic insects lay eggs under or on the water surface. Larval stages (think: caterpillars) spend several months to years in the stream before transforming into adults, which are often terrestrial (e.g. mayflies, damselflies, dragonflies)[6]. Like crayfish, aquatic insects are a crucial link in transforming relatively inedible plant material into more easily digestible portions. As leaves and sticks fall into the stream, they are colonized by aquatic fungi. Many aquatic insect species chew or shred this plant material, apparently in order to eat the fungi (Allan 1995). The end result is a trail of tiny bits of plant material, fungi, and organic material floating down the stream, which can be picked up by other insects collecting floating matter in silk nets or with special hairs and brushes on feeding appendages. Ultimately, this plant material is converted into insects: little protein packets supporting fish as well as birds, bats, water shrews, etc.

The reader can understand that the most socially valuable fishes in local waters, salmon and steelhead, are supported by all the other species in the ecosystem.

Native Species Information and Population Dynamics

The fishes described below are those that spend all or part of their lives in the streams within the Ashland Assessment area. Most local fish distribution work has focused on salmonids. Information on other fish species is usually a by-product of these investigations. As a result, little information on non-salmonids is available.

Maps 14 and 15 demarcate the known distribution of native fish species in the Assessment area: Map 14 shows the distribution of anadromous species, and Map 15 shows the distribution of resident species. Coho, chinook, and steelhead distributions (Map 14) and rainbow and cutthroat trout distributions (Map 15) represent the latest information from ODFW and USFS surveys, both of which are relatively recent and consistently updated. The author also reviewed other survey sources to verify and add to these data. Information for Pacific lamprey (Map 14), Klamath smallscale suckers (Map 15), and reticulate sculpin were compiled from as many sources as the author could find, excepting ODFW surveys7[1]. ODFW survey data should be reviewed before creating a definitive

[6] Aquatic insects with terrestrial adult stages usually fly upstream to mate and lay eggs, again solving the problem of gravity forever pulling stream creatures downstream.

7[1] ODFW surveyors record non-salmonid fish species, but ODFW does not map those data. Therefore, information on non-salmonids is found by viewing the original data at the ODFW office in Central Point.

fish distribution map. However, it not expected that those data will expand the range of any species except possibly the reticulate sculpin.

Maps 14 and 15 illustrate basic findings: sculpin and steelhead/rainbow trout are widespread; healthy cutthroat populations exist in wildland streams; and all other native species have truncated distributions. To look at the information in another way, Table IX-2 roughly summarizes population levels for all native fish species in the Assessment area. It is hoped that fish biologists, watershed restoration teams, and stream enthusiasts will aspire to fill the information gaps on fish distribution.

Coho salmon

Coho are also called "silver salmon" or "silvers." In the Ashland Assessment area, coho spawn in mid-winter when streams are cold and flows are high from rainfall events. Like all salmonids, a female digs a shallow nest called a "redd" in which she lays her eggs; as she does so, a male immediately fertilizes the eggs by broadcasting his sperm-filled milt into the water around the eggs. The female then buries the eggs so that they are protected from predators. Juveniles hatch in early spring, and typically migrate to sea in the spring of their second year. Although many have suspected that intermittent

Table IX-2: Rough estimations of native fish population levels within the Ashland Watershed Assessment area compared between stream types and with the greater Bear Creek watershed. These estimates are the opinion of this chapter's author and will continue to change as more information on population levels becomes available.

Species	Population Levels within the Assessment Area			Population Levels within the Bear Creek Watershed
	Bear Creek	Tributaries - Urban	Tributaries – Wildland	
Coho salmon	Very low	Very low	Not present (Granite, I-5)	Low
Chinook salmon	Very low	Not present	Not present (Granite, I-5)	Low
Steelhead	Moderate	Low to Moderate	Neil only – low (Granite)	Moderate
Pacific lamprey	Very low	No data	No data	Moderate
Rainbow trout	Low	Low to moderate	High	Moderate
Cutthroat trout	Low	Low	High	Moderate
Klamath smallscale suckers	Very low	Not present	Not present	Low
Reticulate sculpin	High	Moderately High	Low? (not enough data)	Moderate
Speckled dace	No data	Not present	Not present (not dace habitat)	Low

streams provide important spawning habitat for coho salmon, a recent paper by Wiginton et al. (2006) suggests that juvenile coho using intermittent streams in western Oregon were larger and more likely to smolt than those that remained in the mainstem all year. Coho migrate to the ocean when they reach approximately 4 – 4 ¾ inches (Vogt 2004); Bear Creek coho tend to be on the large end of that scale. Most coho spend one full year (two summers) at sea, but some males return after only one summer at sea (Quinn 2005). These early returnees are smaller than normal and are commonly called "jacks."

Coho in the Ashland Watershed Assessment area are members of the Southern Oregon/Northern California Coasts "Evolutionarily Significant Unit" (SONCC coho ESU). An ESU is a population of an animal or plant that can meet and mix for reproduction, but does not usually reproduce with other ESUs of the same species. Throughout its range, the SONCC coho ESU is struggling. SONCC coho were listed as "Threatened" under the Endangered Species Act in May 1997 (NOAA 1997)[8]. SONCC coho abundance has decreased from an estimated 150,000 – 400,000 wild fish to approximately 10,000 at the time coho were listed (NOAA 1997). Survival rates of coastal coho stocks have showed a steady decline from the mid-1970s to the mid-1990s. In the Rogue Basin, recent population estimates have ranged from a low of 300 fish in 1993 to 12,213 fish in 2001 (Jacobs et al. 2002[9]). Things might be looking up: 14,632 coho were swimming through the fish ladder at Gold Ray Dam in 2005 (ODFW undated)[10].

The population in Bear Creek is part of the "Upper Rogue" population (Williams et al. 2006), and it is particularly depressed. Despite the almost 30 miles of potential coho habitat available, Bear Creek produces few fish. From 2001 – 2004, Oregon's Department of Fish and Wildlife, the Bureau of Land Management, and the U.S. Forest Service cooperated on a smolt trapping project to capture and count young salmon as they migrated to the ocean. Using standardized mathematical techniques based on the number of fish marked (with a small fin clip) and recaptured, the biologists could estimate the number of smolts actually present in each stream system. Every spring, the number of coho smolts estimated to be leaving Bear Creek are orders of magnitude lower than Little Butte Creek, an adjacent watershed of similar size and shape (Vogt 2004) (Table 9-3). For example, in 2001, Bear Creek produced 3.7 coho per mile of coho habitat (27 miles), while Little Butte Creek produced an estimated 217 coho smolts per mile of coho habitat (46 miles) (Vogt 2001). This is especially interesting because according to the latest coho habitat modeling effort, Bear Creek has higher "intrinsic potential" for coho habitat than Little Butte Creek (Williams et al. 2006). The difference in coho production may be due to

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[8] Causes have been attributed to "…channel morphology changes, substrate changes, loss of instream roughness, loss of estuarine habitat, loss of wetlands, loss/degradation of riparian areas, declines in water quality (e.g., elevated water temperatures, reduced dissolved oxygen, altered biological communities, toxics, elevated pH, and altered stream fertility), altered streamflows, fish passage impediments, elimination of habitat…" and more, caused by "…logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals and unscreened diversions for irrigation" (NOAA 1997).

[9] On the web at: http://nrimp.dfw.state.or.us/crl/Reports/OASIS/01-02finaldraft.pdf

[10] On the web at: http://www.dfw.state.or.us/fish/fish_counts/goldray/2006/gold_ray_dam._2006.asp

urbanization of Bear Creek and its tributaries. Eighty-five percent of Jackson County lives in the Bear Creek watershed. Little Butte Creek remains agricultural and forested.

Despite the urbanization, coho are spawning and rearing within the Assessment area (Tables 9-2 and 9-4; Map 14). Aaron Maxwell, a Southern Oregon University graduate student, surveyed fish[11] in Bear Creek and its tributaries for two years. In 2006, he found seven coho fry ("baby" coho) in Ashland Creek near Ashland Creek Park, just downstream of Hersey Street (Maxwell, M.S. Thesis in preparation). Other fish biologists have spotted adult coho in Ashland Creek, in the pool just below the new Winburn Way Bridge, and in Lithia Park (C. Volpe, personal communication, 2007). In 2005 and 2006, Maxwell also captured small four coho fry near the Tolman Creek culvert under

Table IX-3: Smolt trap results from springtime sampling at the mouth of Bear Creek, Jackson County, OR (Vogt 2001; Vogt 2002; Vogt 2003; Vogt 2004). Note that the Bear Creek trap was disabled several times in 2004 by high flows and debris. Without these problems, it is possible that coho would have been captured.

Sampling Year	Estimated Number of Coho Smolts Migrating to the Sea between early March and mid-June	
	Bear Creek	Little Butte Creek
2001	100	10,000
2002	2194	35,000
2003	197	68,321
2004	0	18,383

Highway 66 (Maxwell, in preparation). In July, 1998, surveyors electroshocking short reaches of stream throughout Bear Creek found one juvenile coho near North Mountain Park (Broderick 2000). Over the years, other surveyors have found coho juveniles in Bear and Ashland Creeks, but never in large numbers (C. Volpe, personal communication, 2007). Recent and extensive Neil Creek surveys did not turn up any coho in late August 2002 (SRG 2002a). This does not mean that Neil Creek does not provide habitat for coho; rather that it did not provide late summer habitat in 2002. Fish will move around between streams to find suitable rearing habitat, as needed. Such mid-season movement does, however, pose risks to small fish: they can become trapped in unsuitable locations, are exposed to predators, and may find themselves in a poor spot in which to survive the environmental conditions of changing seasons. Map 14 illustrates the current known distribution of coho within the Ashland Watershed Assessment area.

[11] With minnow traps.

Table IX-4: Presence (or absence) of fish species at sampled sites or reaches throughout the Ashland Watershed Assessment area. Absence is only recorded for lamprey surveys in Ashland and Bear Creeks in order to highlight surveyed locations.
Note: ODFW and additional USFS fish distribution data are not included here, but should be included in any complete analysis of fish distribution. The purpose of this table was to gather information from lesser-known surveys. Survey citations can be found in the Reference Section of this document. Y = this species was captured or positively identified. N = this species was not found.

(a) Maxwell, M. S. Thesis, in preparation. Sample dates: summers 2005 and 2006. Sample method: minnow traps. (b) Broderick 2000. Sample date: summers 1997 and 1998. Sample method: electrofishing 50 m stretches of stream. (c) Bureau of Land Management 2004. Sample dates: (-1) September, 2004 and (-2) May, 2004. Sample method: lamprey electroshocker. (d) Bennett 2000. Sample date: August 2000. Sample method: snorkeling. (e) Volpe, Weir, personal communication. Sample method: visual observation. (f) Hoover 1971. Sample date: summer 1969. Survey method: unknown (probably visual observation or fly-fishing). (g) Abbas 1999. Sample date: August 1997. Sample method: snorkel pools, electroshock riffles. (h) Siskiyou Research Group 2002b. Sample date: September 2001. Sample method: snorkeling. (i) Siskiyou Research Group 2002a. Sample date: August 30 – September 4, 2002. Sample method: snorkeling. (j) Frick, Weir, Volpe, Maiyo, personal communication. Sample dates: Between 1995 and 2005. Sample method: visual observation (of spawning steelhead). (k) Ecosystems Northwest 2000. Sample date: September 1999. Sample method: snorkeling.

Sample Site and Data Source	Native Fishes							Introduced Fishes				
	Coho Salmon	**Chinook Salmon**	**Steelhead/ Rainbow Trout**	**Cutthroat Trout**	**Pacific lamprey**	**Klamath smallscale sucker**	**Reticulate Sculpin**	**Fathead Minnow**	**Redside Shiner**	**Bluegill**	**Green sunfish**	**Brown bullhead**
Bear Creek: Eagle Mill Rd. crossing (a) (b)			Y (a) Y (b)			Y (b)	Y (a) Y (b)		Y (b)	Y (a)	Y (b)	
Bear Creek and Ashland Ck. Confluence (a) (c-1)			Y (a)		Y (c-1)		Y (a)					
Bear Creek at North Mountain Park (a) (b) (c-2)	Y (b)		Y (a) Y (b)		N (c-2)	Y (a) Y (b)	Y (a) Y (b)	Y (b)	Y (b)			
Bear Creek at Willow-Wind School (a)			Y (a)									
Ashland Creek from confluence with Bear Creek to Nevada Street (c-1)					N (c-1)							
Ashland Creek from confluence with Bear Creek to Winburn Way (d)			Y (d)	Y (d)								

Sample Site and Data Source	Native Fishes							Introduced Fishes				
	Coho Salmon	Chinook Salmon	Steelhead/ Rainbow Trout	Cutthroat Trout	Pacific lamprey	Klamath smallscale sucker	Reticulate Sculpin	Fathead Minnow	Redside Shiner	Bluegill	Green sunfish	Brown bullhead
Ashland Creek @ dog park and then upstream 50 m (b)			Y (b)				Y (b)					
Ashland Creek at Vogle Park below Hersey (a)	Y (a)		Y (a)				Y (a)					
Ashland Creek from Winburn Way to Granite Street Reservoir (d) (e)	(e)		Y (d)				Y? (d)					
Ashland Creek in pool across from Parks and Rec. office in Lithia Park (a)			Y (a)				Y (a)					
Ashland Creek from Granite Street Reservoir to Reeder Reservoir (d)			Y (d) rainbow trout only	Y (d)								
Ashland Creek downstream from Reeder Reservoir near water tower (a)				Y (a)			Y (a)					
East Fork Ashland Creek from Reeder Reservoir upstream ~ 4 miles (f)			Y (f) rainbow trout only	Y(f)								
East Fork Ashland Creek from Reeder Reservoir upstream 7.3 miles (g)			Y(g) rainbow trout only	Y (g)			Y (g)					
West Fork Ashland Creek from Reeder Reservoir upstream 2 ¼ miles (f)				Y (f)								

Sample Site and Data Source	Native Fishes							Introduced Fishes				
	Coho Salmon	**Chinook Salmon**	**Steelhead/ Rainbow Trout**	**Cutthroat Trout**	**Pacific lamprey**	**Klamath smallscale sucker**	**Reticulate Sculpin**	**Fathead Minnow**	**Redside Shiner**	**Bluegill**	**Green sunfish**	**Brown bullhead**
West Fork Ashland Creek From Reeder Reservoir upstream 4.1 miles (h)				Y (h)								
Neil Creek @ Emigrant Creek confluence and then upstream 50 m (b)			Y (b)				Y (b)					
Neil Creek: Mouth to confluence with Tolman Ck. (i)			Y (i)				Y (i)					
Neil Creek: manmade channel near airport (a)							Y (a)					
Neil Creek: natural channel near airport (a)			Y (a)				Y (a)					
Neil Creek: @ bridge near airport downstream 50 m (b)			Y (b)				Y (b)					
Neil Creek: between Maywood Way and Hwy. 66 (a)			Y (a)				Y (a)					
Neil Creek: Tolman Creek to small tributary 1/3 mile upstream of Reiten Drive & Hwy. 66 (i)			Y (j)				Y (i)					
Neil Creek: From small tributary 1/3 mi. upstream of Reiten Dr. and Hwy. 66 to Hwy. 66 crossing (0.78 mi.) (i)			Y (i)				Y (i)					

Sample Site and Data Source	Native Fishes							Introduced Fishes				
	Coho Salmon	Chinook Salmon	Steelhead/ Rainbow Trout	Cutthroat Trout	Pacific lamprey	Klamath smallscale sucker	Reticulate Sculpin	Fathead Minnow	Redside Shiner	Bluegill	Green sunfish	Brown bullhead
Neil Creek: just below Hwy. 66 crossing (a)							Y (a)					Y (a)
Neil Creek: just upstream of Glenyan Campground to I-5 culvert (1.32 mi.) (i)			Y (i)	Y (i)			Y (i)					
Neil Creek: just below Reiten Road crossing (a)			Y (a)				Y (a)					
Neil Creek: just upstream of RR tracks and downstream of I-5 culvert (a)			Y (a)									
Neil Creek: I-5 to USFS boundary (a) (j) (f) (i)			Y (j) Y (f) Y (i) N (a)	Y (i) N (a)								
Neil Creek: from I-5 upstream ~5 miles (f)			Y(f)									
Neil Creek: from USFS boundary 5.8 miles (k)			Y(k)	Y(k)								
Tolman Creek: at or near mouth (location slightly different between years) (a)	Y (a)		Y (a)				Y (a)					
Tolman Creek: above Hwy. 66 at Golf Course (a)												
Wrights Creek: just below Hwy. 99 (a)			Y (a)									

Chinook salmon

Chinook salmon are commonly called “kings.” They are the largest of the west coast salmon species. In the Rogue Basin, chinook migrate upstream as the first fall rains freshen the water. If the weather does not cooperate, the Bureau of Reclamation usually releases water from reservoirs to lure the fish upstream to their spawning areas. Juvenile chinook hatch in the spring and typically migrate to sea the following spring (Meehan and Bjornn 1991). Bear Creek chinook migrate to the ocean when they reach approximately 70 - 80 mm, or 2 ¾ -3 inches (Vogt 2002; Vogt 2003). Rogue River chinook spend two to four years at sea before returning to spawn (Stewart and Jacobs 2004). After ocean harvest restrictions were placed in 1991, older (and larger) fish comprised a larger proportion of the population migrating upriver to spawn (Stewart and Jacobs 2004). This may help the population because larger fish are more fecund (have more eggs). Except for three anomalous years in the late 1980’s, chinook populations have remained low for the last 30 years (Stewart and Jacobs 2004[12]). Recent numbers of Rogue River fall chinook were up: 2004 estimates were higher than any year back to 1989 except for 2002 and 2003 (also high).

Chinook in the Rogue Basin have two spawning runs, divided primarily by when they enter the river. Fall chinook enter the Rogue River and migrate upstream in the fall. Spring chinook enter the river mouth and migrate upstream in the spring. Fall chinook are the most abundant in Rogue Basin[13]. There are very few spring chinook in the Rogue Basin. The chinook in Bear Creek are fall-run; it is not known if there are any spring chinook in Bear Creek. In 2002, Vogt estimated that Bear Creek produced 7,250 fall chinook smolts.

ODFW have recorded chinook use in Bear Creek up to the mouth of Ashland Creek (Map 14). USFS Biologist Ian Reid notes that chinook have been found near North Mountain Park (personal communication 2007); however, there is concern that chinook still have difficulty swimming over the Oak Street diversion, even though the fish ladder has been improved. Recent Bear Creek and tributary surveys have not found chinook upstream of Oak Street (Broderick 2000; SRG 2002a; Maxwell, in preparation; ODFW, unpublished data). The low-gradient (“flat”), most downstream reaches of Neil and Ashland Creeks have potential as chinook habitat[14].

Steelhead and Rainbow Trout

O. mykiss is a western North American species, but has been introduced to rivers world-wide. Steelhead are the anadromous, or ocean-migrating, form of *O. mykiss*; rainbow trout are the stream-dwelling form. In the Rogue Basin, there are two separate steelhead spawning populations, separated by the time at

[12] On the web at: http://nrimp.dfw.state.or.us/crl/Reports/OASIS/04RogueChFPredictionReport.pdf.
[13] Spring chinook tend to be more common in rivers where they have a long way to go to reach their spawning grounds. For example, chinook spawning in Idaho’s Salmon River in August, start their migration up the Columbia River in the spring (Meehan and Bjornn 1991).
[14] The “gradient” is the steepness of a stream, similar to a road’s “grade”, as in “steep grade ahead.” A stream with a “low gradient” is relatively flat and has a slower speed; a “high gradient” stream is steeper and the water has a faster speed.

which they enter the Rogue River mouth as well as spawning time and location. Winter steelhead enter the Rogue River in the winter, migrating upstream and spawning in the late winter and spring; summer steelhead enter the river and migrate upstream in the late summer (Everest 1973).

Steelhead in the Ashland Assessment area are winter steelhead (USFS 1995). Winter steelhead fry (baby fish) emerge in late spring or early summer. Steelhead juveniles typically spend 1-3 years in fresh water (Quinn 2005). Since they spend less of their lifespan in the ocean, steelhead are less vulnerable to unfavorable ocean production conditions than other salmonids (Prevost et al. 1997). In the Rogue Basin, steelhead smolt migrate out to the ocean when they reach approximately 5 ½ - 6 inches in length, between late March and late May (Vogt 2004). Interestingly, the timing of smolt outmigration varies widely between years and among Rogue Basin streams, even peaking more than once in a season (Vogt 2003, Vogt 2004). This is probably related to annual and local variation in stream temperature and water flow, two of the environmental cues that "tell" steelhead when to outmigrate (Quinn 2005). Steelhead spend anywhere from 1-3 years in the ocean, so size of returning adults varies widely (Quinn 2005). Some adults do not die, but return to the ocean and then spawn again the following year. Despite 150 years of intense human manipulation, Bear Creek still supports a surprisingly robust steelhead population. In fact, among eight Rogue Bain streams studied from 1999 – 2004[15], Bear Creek was one of the two streams that produced the greatest number of steelhead smolts migrating to sea, both in absolute numbers and in number per mile of available steelhead habitat (Table 9-5) (Vogt 1998 – 2004)[16]. For example, in 2001, Bear Creek produced 230 steelhead smolts per mile of steelhead habitat, and Little Butte Creek produced 305 (Vogt 2001). It is beyond the scope of this document to analyze the differences in steelhead production between Bear and Little Butte Creek watersheds. However, it is safe to say that steelhead enter the stream

Table IX-5: Smolt trap results from springtime sampling at the mouth of Bear Creek, Jackson County, OR (Vogt 2001; Vogt 2002; Vogt 2003; Vogt 2004). Note that the Bear Creek trap was disabled several times in 2004 by high flows and debris. Without these problems, it is highly likely that more steelhead would have been captured.

Sampling Year	Estimated Number of Steelhead Smolts Migrating to the Sea between early March and mid-June	
	Bear Creek	Little Butte Creek
2001	21,000	25,000
2002	38,442	26,180
2003	10,118	19,946
2004	2	20,521

15 Bear Creek, Little Butte Creek, Big Butte Creek, South Fork Big Butte Creek, West Fork Evans Creek, the Little Applegate River, Slate Creek, and Elk Creek (Vogt 2001).

16 The only anomaly was the spring of 2004. In April and May of 2004, high flows seriously compromised the ability of the fish trap to function, and very few fish were caught in it at all. As a result, Vogt (2004) could not estimate the number of outmigrating smolts.

Figure IX-3: Red circles show steelhead in Ashland Creek, in lower Lithia Park across from the new City offices. Photo by Richard Best, Fall 2006.

and spawn later in the winter than coho. As a result, steelhead in Bear Creek may be experiencing better habitat conditions than coho: perhaps cleaner gravels, better hiding cover, fewer toxins, etc. Tributary access improves later in the season as tributary flows increase.

Within the Assessment area tributaries, steelhead spawn in the lower sections of Ashland Creek (Fig. IX-3, Map 14). The stretch through Lithia Park offers slightly better habitat than the lower reaches (Bennett 2000), so steelhead numbers are higher. Steelhead fry ("baby" steelhead) are often caught in cups by children playing in Lithia Park[17]. Both Granite Street (Fig. IX-4) and Hosler Dams (Fig. IX-5) are impassable barriers to steelhead.

In Neil Creek, snorkelers found many steelhead fry near the mouth. Both steelhead and resident rainbow trout were observed through the valley reach and between Hwy. 66 and I-5 (SRG 2002a). Local biologists have observed steelhead spawning in Neil Creek upstream of I-5 on several occasions (E. Weir personal communication, 2007; C. Volpe personal communication, 2007). However, the culvert underneath I-5 probably stops all but the most determined fish (Fig. IX-6). Subsequent U.S. Forest Service fish surveys have found a preponderance of larger-sized *O. mykiss* above the culvert, indicating that most of the *O. mykiss* population above I-5 is resident rainbow trout, not anadromous steelhead (I. Reid, personal communication, 2007).

Elsewhere in the Assessment area, local citizens have observed steelhead spawning in Clayton, Tolman, and Wrights Creek. Juveniles have been found near the mouths of Hamilton Creek and Clay Creek (ODFW, unpublished data). These finds are not surprising. Southern Oregon steelhead

[17] Please do not take steelhead fry home. Not only do they need refrigerated water to survive, it is illegal without a state permit.

commonly use intermittent tributaries for spawning and then move downstream to adjacent larger streams as the intermittent tributary dries up (Everest 1973). Similarly, some juveniles move back into tributaries as stream flows increase with winter rains (Everest 1973).

There are also resident populations of rainbow trout in the Rogue Basin, although it is often difficult to tell if the fish are rainbow or steelhead. Fish biologists assume that trout larger than "smolt" size are resident. If a population

Figure IX-4: Granite Street Dam. Photo © Jeannine Rossa, December 2005.

Figure IX-5: Hosler Dam and Reeder Reservoir. Photo © Fred Stockwell, Stockwell Photography.

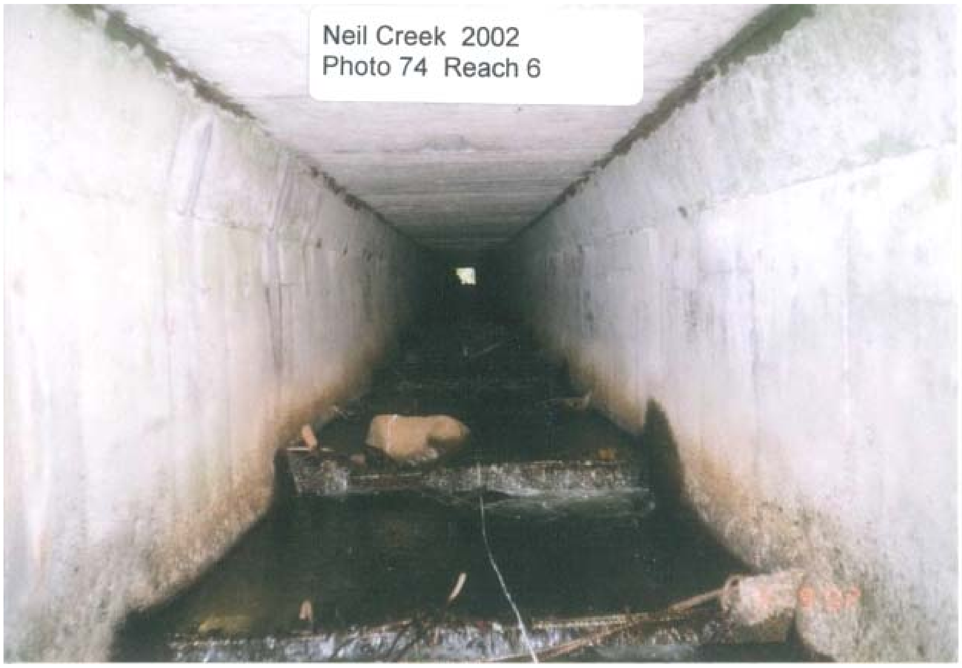

Figure IX-6: Neil Creek flowing through the cement box culvert with worn baffles under Interstate-5. The box culvert is 555-feet long. Siskiyou Research Group, September 2001 (SRG 2002a).

has a large number of larger-than-smolt-size fish, then the nearby juveniles might be considered resident (USFS 2003). The average steelhead smolt from Bear Creek is 130 – 175 mm (5 – 7 inches) (Vogt 2001; Vogt 2002; Vogt 2003). For example, Broderick (2000) found a 239 mm (9 ½ inches) *O. mykiss* in Bear Creek near Valley View Rd., which can also be assumed to be a resident rainbow trout. East Fork Ashland Creek supports a healthy population of resident rainbow trout (Abbas 1999). Forest Service fish biologists believe that these trout are descended from steelhead that migrated up both forks before Reeder and Granite Street Reservoirs were constructed (USFS 1995). Map 15 illustrates the current known distribution of rainbow trout within the Ashland Watershed Assessment area.

Cutthroat Trout

Cutthroat are spring spawners like steelhead/rainbow trout. Cutthroat trout can be anadromous, but most cutthroat populations remain in streams their entire lives. Local fish biologists do not know if Rogue Basin cutthroat are anadromous, but so far, survey data have not shed light on this question.

Throughout the west, cutthroat are usually the fish found living the farthest upstream. A plethora of studies have determined that many other salmonids species outcompete cutthroat for feeding positions and space in pools, so biologists assume that hardy cutthroat move upstream to less desirable areas. In some watersheds, cutthroat appear to migrate back and forth from larger streams or rivers to small tributaries. In these situations, competition may not be an issue.

In the Ashland Assessment area, some larger cutthroat spend at least part of the year in Bear Creek. A trapping effort by local fish biologists captured a few larger cutthroat each year at the mouth of Bear Creek (Vogt 2001; Vogt 2002; Vogt 2003; Vogt 2004). However, it is unclear whether these larger cutthroat migrate back to headwater streams to spawn, or are spawning and rearing young in Bear Creek. Researchers snorkeling on September 1, 2002, saw cutthroat in the stretch of Neil Creek below I-5, but not in the lower reaches along the valley floor (SRG 2002a). Healthy populations of cutthroat trout flourish in the West Fork of Ashland Creek above Reeder Reservoir (SRG 2002b) and in Neil Creek on U.S. Forest Service land upstream of I-5 (Ecosystems Northwest 2000). In East Fork Ashland Creek, cutthroat coexist with rainbow trout (probably remnant steelhead trapped after Reeder Reservoir construction). It appears that these two species are interbreeding (Abbas 1999). Map 15 illustrates the current known distribution of cutthroat trout within the Ashland Watershed Assessment area.

Pacific Lamprey

Pacific lampreys are anadromous fish, like salmon and steelhead. Many locals, especially native peoples, refer to lamprey as "eels;" although they are a completely different fish. Lamprey have 7 gill slits on each side, and therefore, are religiously significant to Columbia River tribes (D. Close, personal communication, 2001). Lamprey adults are also very fatty, and are still considered a delicacy by all tribes along the coast (F. Lake, personal communication, 2000). It isn't just humans that prefer lamprey – sea lions at the mouth of the Rogue River prefer lamprey over salmon (Roffe and Mate 1984).

Adult lampreys move into the river mouths in the fall and overwinter in the rivers. They do not feed at this time, but readapt to freshwater and become sexually mature (Kostow 2002). In the spring, they swim upstream to spawn in tributaries, and then die. Females construct redds by picking up stones with their mouths and forming a circle of larger stones around a patch of gravel. When all is ready, the female and her mate emit their eggs and sperm at the same time. The fertilized eggs fall down into the gravels. When the eggs hatch, the tiny larval lampreys, called ammocetes, bury into the fine sediments along the shoreline, where they live for up to 6 years, filtering detritus (bits of leaves and dead insects and moss and soil) out of the water. Eventually, the ammocetes slowly transform, growing eyes and predatory mouths, and migrate out to sea where they grow to adulthood. Stan van de Wetering, Aquatic Ecologist for the Confederated Tribes of the Siletz, has found that most "smolting" lamprey in coastal Oregon rivers migrate to sea in the fall (personal communication, 2001). However, in other basins, some ammocetes apparently migrate out in late spring, or continuously all year (Kostow 2002). In the Rogue Basin, local biologists have trapped just a few transformed lamprey moving downstream in the spring (Vogt 1999 – 2004). The vast majority of captured lamprey were un-transformed lamprey moving downstream for unknown reasons. Traps have not been operated in the fall, so we do not know if transformed lamprey migrate during those months.

Evidence of large lamprey runs described as “great wriggling masses of eels” is largely anecdotal. Local residents over the age of 60 often remember seeing “swarms” of lamprey spawning in local streams, or easily catching ammocetes to use as bait. Counts at Gold Ray Dam on the Rogue River have only been taken since 1993, but counts at other dams in the region show significant declines (Close 2001).

From 2001 – 2004, ODFW, BLM, and USFS fish biologists trapped fish moving downstream from the upper and middle reaches of Bear Creek to a stretch near the mouth of Bear Creek, or possibly into the Rogue. In 2001, they caught over 7000 ammocetes – an enormous number compared to those caught throughout the rest of the system (Table IX-5). However, traps on other regional streams, and in subsequent years on Bear Creek did not capture nearly as many lamprey as that, perhaps anomalous year. Subsequent electroshocking[18] and dipnetting surveys in Bear Creek have found very few ammocete lamprey (BLM, unpublished data; ODFW, unpublished data). Historical data from both the Rogue and Umatilla drainages have recorded similar, occasional massive outmigration (Kostow 2002). Regardless, it appears that Bear Creek has the capability to produce a large number of lamprey ammocetes, but may not do so each year. Map 14 illustrates the current known distribution of Pacific lamprey within the Ashland Watershed Assessment area.

Table IX-6: Pacific lamprey caught in smolt traps at the mouth of streams throughout the Rogue Basin, early March – mid-June, 1999 – 2004 (Vogt 1999 – 2004). **(ns = not sampled that year)**

Year Sampled	Lamprey Life Form	Trap Site							
		Bear	Big Butte	Elk	Little Applegate	Little Butte	Slate	South Fork Big Butte	West Fork Evans
1999	Adults	ns	0	ns	0	0	0	0	0
	Ammocetes	ns	131	ns	62	1631	21	0	0
2000	Adults	ns	0	ns	2	3	6	0	0
	Ammocetes	ns	161	ns	152[b]	1469	16	0	0
2001	Adults	10	ns	ns	2	4	1	0	0
	Ammocetes	6710[a]	ns	ns	136	4034	34	0	0
2002	Adults	1	ns	4	0	17	0	ns	0
	Ammocetes	470	ns	48	656	1413	7	ns	0
2003	Adults	0	ns	0	1	0	0	ns	0
	Ammocetes	6	ns	112	167	873	91	ns	0
2004	Adults	0	ns	2	0	0	1	ns	0
	Ammocetes	2	ns	101	165	917	42	ns	1

[18] A lamprey electroshocker uses an electric current to gently “tickle” the ammocetes hiding in the sand. It does not harm other fish at all (unlike other electroshockers).

a/ The ammocete count for Bear Creek in 2001 is a rough estimate. There were so many, that fish technicians had to scoop them out of the trap with shovels, estimating the number in the shovel as they tossed them back overboard.
b/ The 2000 Little Applegate River ammocete sample includes two ammocetes that were misidentified as "brook lamprey" because eyes had already developed (D. Markle, personal communication, 2000).

Klamath small-scale suckers

Klamath small-scale suckers are truly a local, native fish. They can be found throughout the Klamath and Rogue drainages, including an isolated population in the Cascade-Siskiyou National Monument west of Ashland. Unlike salmon, suckers live a long time – the oldest small-scale aged so far was 17 years old[19] (Parker and Call 2006). Little is known about the specific habits of small-scales, but like their cousins in the Columbia River and elsewhere, they are thought to be "adfluvial": rearing in streams, migrating into the more stable environment of the Klamath and Rogue rivers to spend the winter once they become adults, and then migrating back to tributary streams to spawn in the spring. Suckers are "broadcast spawners" the females deposit their eggs onto the gravels without making a nest, or redd (Moyle 2002). Most catostomid[20] larvae drift downstream upon hatching (e.g. Villa 1985; White and Harvey 2003); however research in Jenny Creek indicates that Klamath small scale sucker larvae – in Jenny Creek at least – may stay put until maturing (Parker et al. 2004; Parker and Ruhl 2005). Catostomids vary in the length of time they need to mature to adulthood (Rossa 1999). A small amount of data indicate that small-scale suckers mature at around age 4 (Parker and Call 2006; Rossa and Parker, in preparation). The small-scales in Bear Creek probably mature at around the same age.

Little data exists on smallscale sucker distribution or population trends in the Assessment area. Suckers are not considered a game fish. Therefore, suckers found during the course of "salmonid surveys" have often not been recorded. Michael Parker, a Professor of Aquatic Ecology at Southern Oregon University, remembers seining Bear Creek near Ashland as a Southern Oregon College student in the late 1970's. At that time, he says, the fisheries students captured "lots of suckers." 30 years later, electroshocking by U.S. Bureau of Reclamation captured 3 suckers near the TID siphon and 4 near North Mountain Park (Broderick 2000). Two years of minnow trapping by Maxwell (in preparation) turned up one dead adult sucker near North Mountain Park, and a handful of adults in a pool near Walker Creek (outside of the Assessment area). Although sketchy, the anecdotal evidence suggests that smallscale sucker populations in the Assessment area are dwindling.

[19] From the Klamath River, upstream of Copco Reservoir.
[20] All suckers are in the genus "*Catostomus*" – in other words, "cousins" of the small-scales.

Figure IX-7: *Cottus perplexis*, the reticulate sculpin. Photo © Jay deLong.

Reticulate Sculpin

Sculpin are little bottom-dwelling fish with enormous mouths and big fins that help stabilize them on the bottom of the stream (Fig. IX-7). They live their entire lives in streams, generally in cool, moderately-swift-flowing waters. They lay their eggs underneath boulders and large cobbles, and the males guard the nests from predators (Moyle 2002). Like suckers, there are little data on sculpin. Broderick (2000) and Siskiyou Research Group (2002) have supplied the best data. In electroshocking surveys during July and August of 1997 and 1998, sculpin comprised 92% – 97% of all captured fish in Bear Creek, lower Ashland Creek, and lower Neil Creek (Broderick 2000). At each site, Broderick sampled at least 50 m and caught between 132 – 573 fish. In Neil Creek during late summer, 2002, the Siskiyou Research Group counted only 26 sculpin, or 5% of all fish, between the mouth and Tolman Creek (SRG 2002a). However, they did find small numbers of sculpin inhabiting pools all the way up Neil Creek to the I-5 culvert. Although limited, these data suggest that sculpin populations within the Assessment area may be healthy. There are some concerned that the invasive ringed crayfish could deplete reticulate sculpin populations by preying on sculpin nests (M. Parker, personal communication, 2007). Map 15 illustrates the current known distribution of reticulate sculpin within the Ashland Watershed Assessment area.

Speckled Dace

Like Black Labradors, dace will taste test anything and everything, although they prefer to eat insects. Speckled dace are small “minnows,” so they are found in the slower-moving waters of larger streams. Without the large fins of a sculpin or swimming ability of a trout, they cannot handle the higher flows in small, steep streams. Speckled dace spawn over clean gravels and the eggs hatch quickly. Dace are usually observed in schools of 10 or more fish in or near vegetation or cover. They are curious. If you stand in the water, they will swim up and nibble on your toes. There is almost no information available on dace populations in the Assessment area. Therefore, speckled dace distribution is not delineated on Map 15.

Introduced Warmwater Fishes

Numerous private ponds throughout the Assessment area contain populations of introduced warmwater fishes like large and small mouth bass, black crappie, bluegill, catfish, brown bullhead, yellow perch, carp, goldfish, and *Gambusia*. Ponds near streams often flood and fish in them can and have escaped to Bear Creek (USFS 1995). Fish also escape from Emigrant Lake, despite the fact that Emigrant Lake's water is released through pipes at the bottom of the dam. Downstream of Talent, introduced warmwater fishes dominate the fish fauna (Dambacher 1992; Maxwell, in preparation).

Although small and large mouth bass are common downstream of Phoenix (Dambacher et al. 1992), red-sided shiners appear to be the most common non-native fish in the Ashland Assessment area (Broderick 2000; Maxwell, in preparation). Maxwell also found a brown bullhead in Neil Creek near Highway 66. This fish could be an escapee from a private pond, or from Emigrant Lake. Recorded locations of non-native fishes are highlighted with a purple "+" on Map 15.

Crayfish

Throughout most of the larger streams, the introduced ringed crayfish appear to have completely replaced the native signal crayfish (M. Parker, personal communication, 2007). Native to the Ozarks, ringed crayfish probably came in with a load of Midwestern fish brought in to stock Lost Creek Reservoir in the 1970's (M. Parker, personal communication, 2007). Some preliminary laboratory data indicate that the invasive ringed crayfish wins virtually all territory fights between the two species (M. Parker, personal communication, 2007). The reason why is not yet known; however, the ringed crayfish has bigger chelopods (front claws). Ringed crayfish can now be found in large numbers throughout the Rogue River basin, as far flung as Deer Creek in the Illinois Valley, the Applegate River, and Bear Creek. Because crayfish are often caught for fish bait, it may be just a matter of time before the invasive species invades the Klamath after falling out of someone's bait bucket.

Erim Gomez and Aaron Maxwell studied the two crayfish species as part of their Senior Thesis and M. S. Thesis, respectively, at Southern Oregon University. Gomez found that in the Ashland Assessment, invasive ringed crayfish dominate Bear Creek downstream of North Mountain Park (Gomez 2007). The stretch through North Mountain Park seems to be a "mixing zone" of both native and non-native crayfish. Neil Creek supports predominantly a native population. Ashland Creek supports only a very few crayfish, probably because the habitat is poor. Maxwell did not find crayfish during his Ashland Creek surveys, but they have been captured during occasional insect sampling (Maxwell, personal communication, 2007; BCWC, unpublished data). It is unknown whether this distribution pattern will persist, or whether the ringed crayfish will extirpate the signal crayfish from the Bear Creek system. Introduced crayfishes have completely eliminated local populations and reduced the total range of other crayfish species in the Midwest, Canada, and Europe (Taylor et al. 2007).

General Habitat Concerns

Local fish biologist, Susan Maiyo, likens chinook to couch potatoes, coho to weekend warriors, and steelhead and cutthroat to Olympic athletes (personal communication, 2000). This is because, within a given northwest watershed, chinook tend to be found in the valley bottoms, coho at intermediate elevations and distances upriver, and steelhead and cutthroat still farther upstream (Quinn 2005). Unfortunately for chinook and coho, humans also tend to concentrate in valley bottoms and foothills, especially in mountainous southern Oregon with its narrow valleys. As a result, roads, farms, cities, airports, and freeways have been constructed alongside – or on top of – streams. Such development has consequences for stream ecosystems and aquatic habitat. In this section, brief explanations of why human manipulation of stream environments can be bad for aquatic species are provided, using fish as an example. The condition of stream ecosystems in the Assessment area are also described.

Problems with *barriers:* All fish – not just anadromous species – move around in a stream. They swim upstream or downstream to avoid high flows, find cool or warmer water, reach spawning areas, or to find food, among other things. Large dams like Hosler Dam at Reeder Reservoir or the Granite Street dam completely block all species from moving up or downstream (USFS 1995). But small, homemade dams for ponds or for irrigation diversions can also block fish migration, especially on small streams. Culverts that are too small can function as a barrier, even if the water flows through: fish that are too small are not strong enough to swim through the concentrated high velocity current. Culverts often block fish because they create a tall jump that even the hardiest steelhead cannot navigate. In the Ashland Assessment area, keeping tributaries free from barriers is particularly important. Summertime flow releases from Emigrant Reservoir artificially increase Bear Creek flows when young steelhead and coho are hatching; Maxwell (personal communication, 2007) believes that tributaries like Neil Creek provide an important refuge for these young fish during the summer. The end of this chapter includes more information on barriers.

Problems with *high water temperatures*: Fish are "cold-blooded:" their internal body temperature is controlled by the external environment (as opposed to mammals, which regulate their internal temperature). "Too-high" water temperatures can stress fish. Their metabolism increases, which reduces their growth rates unless they can compensate by increasing their food intake. Such stress increases the chance they will not survive the winter, as well as increases their susceptibility to disease.

Problems with *altered streamflows* (too low or too high at the wrong time): Fish and other aquatic animals are adapted to the natural seasonal cycle of high winter flows and low summer flows. For example, young fish hatch in late spring, when flows are receding, food resources are high, and temperatures are warming up. These young fish are too small to easily navigate high flows, and need the right combination of food and temperature to grow large enough to handle the high waters and cool temperatures of winter. When flows are unnaturally high in the summer, the ability of these small fish to survive is compromised. When stream flows are too low in the summer, water temperatures rise, simply because it takes less solar energy to warm a shallow pool than a deep pool. Physically, altered streamflows can also affect habitat (see Chapter IV Hydrology). For example, higher winter flows literally roll the rocks on the bottom of the stream, which stirs up the sand and silt and entrains these fine sediments in the water column. Those fines float downstream, and the gravels and cobbles are then clean in time for fish spawning season. When winter flows are kept artificially low, this "cleaning action" does not take place (Rossa 1999).

Problems with *preventing floods* (called "regulating") and *preventing floodwaters from accessing floodplains* (called "channelizing"): Floods are a natural part of a stream ecosystem. In the same way that the ocean has low and high tides, streams have low and high flows. The problem for humans is that the flood cycle is much slower than tides, so we tend to think of floods as "abnormal" and summer "low tide" flows as "normal." Even the language we use to describe floods (e.g. "the stream jumped its banks") perpetuates this perception. In reality, the floodplain alongside streams is just as much a natural part of the stream as the summer low-flow channel. In fact, the stream's water is often trickling slowly through the rocks underneath the surface of that floodplain. This underground water environment is called the "hyporheic zone".

For the animals and insects living in and near streams, floodplains and hyporheic zones are critically important, especially in valley bottom streams[21.] Flooded floodplains provide places to hide from swift floodwaters in the main channel; floodplains provide food and habitat for wildlife as well as for fish and other stream-dwelling critters; and floodplains slow down floodwaters, preventing channel scour and encouraging the deposition of silt and other fine sediments in the floodplains, rather than in the channel.

Problems with *storm drains – and what gets washed down them*: Like most cities and towns the city of Ashland has "storm drains" that capture rainwater flowing from roads and down roadside gutters and route it straight into nearby creeks. In the Assessment Area, most storm drains and ditches run directly into stream channels. Unfortunately, this means that all the oil, creosote, dirt, tar, and other material on roads gets washed into streams. Overwatering lawns or leaking irrigation ditches can also wash herbicides and road residue straight into streams.

In the 1970's, the prevailing attitude was "dilution is the solution to pollution." In the ensuing 35 years, scientists have learned a great deal. Unfortunately, much of the material washed from streets and into streams seems

[21] Steep, mountainside streams have narrow floodplains, but the water has to go somewhere. Even small streams have floodplain areas along their banks which can be covered in fast moving water during high flows.

to be causing big problems for fish[22]. For example, weathered crude oil can cause heart defects, other malformations, genetic damage, and mortality in embryonic fish of pink salmon, herring, and zebra fish (Scholz 2004). Creosote causes egg mortality and morphological deformities in pink salmon (Vines et al. 2000). Chlorpyrifos inhibits swimming and feeding behavior in juvenile coho (Sandahl and Scholz 2004). Atrazine, North America's most widely used herbicide for corn and cotton, blunts a fish's sense of smell (Tierney et al. 2007), critical for finding mates and food, escaping predators, and, for salmon, finding one's natal stream. Coho salmon lost their ability to smell after fungicide IPBC exposures of only 10 parts per billion (Tierney et al. 2006b). Pesticides endosulfan, trifluralin, esfenvalerate and 2,4-D seriously impacted olfaction in coho salmon (Tierney 2006a). Diazinon did the same thing to chinook, causing problems with predator-avoidance and homing (Scholz et al. 2000). And dissolved copper inhibits the sense of smell in every aquatic species tested to date (Baldwin et al. 2003; Hunter and Pyle 2004; McPherson et al. 2004;). Copper dust from brake pad wear can wash into storm drains and thence into streams. Copper is also a common ingredient in many herbicides.

So what do aquatic animals need? Like all living things, they need air to breathe, food to eat, and places to raise their young. If they are long-lived, they also need refuge from extreme weather events and predators. The healthiest streams have a combination of slow- and fast-water habitats: pools where juvenile fish and other small creatures can avoid getting washed downstream, large species can hide from overhead predators (like osprey and heron), aquatic plants can take hold, gravels can collect at the downstream end, and fine sediments like sand and silt can collect at the edges (not in the spawning gravels) providing habitat areas for lamprey ammocetes and freshwater mussels; and riffles where larger rocks support aquatic insects, algae, and other food sources for fish, as well as nest areas for sculpin. “Healthy” streams have a balanced distribution of rock sizes, otherwise known as a “well-sorted substrate.” A well-sorted substrate includes everything from boulders to silt; the relative abundance of each rock size depends, in part, on the size of the stream and its underlying geology. Healthy streams also have a strong connection with their floodplains. Not only can floodwaters spread out and slow down over the floodplains, but floodplains contribute groundwater storage, fallen trees that change the channel and create pools, leaves that fall in and provide food for aquatic insects, and habitat for animals and birds that are integral members of the stream ecosystem. Streams in canyons have very narrow floodplains, but adjacent forest slopes provide fallen trees, leaves, and habitat in much the same way. Valley bottom streams usually have wide floodplains, complete with old, cutoff channels, S-shaped meanders, and seasonal wetlands.

[22] For an easy-to-read article, see http://sciencenews.org/articles/20070127/bob10.asp

Aquatic Habitat Condition in the Assessment Area

Over the aquatic habitat in the greater Bear Creek watershed, the streams in the Ashland Assessment area play a critical role in sustaining native fish, insect, and crayfish populations. RVCOG (1995) rated these streams as having the "highest fishery value" in the Bear Creek watershed. Maxwell (in preparation) believes that the streams in the Assessment area provide significant habitat for coho and steelhead in Bear Creek, as well as being the stronghold for native crayfish. The Ashland Watershed Assessment area streams plus Wagner Creek provide 72% of the steelhead summer rearing habitat in Bear Creek (USFS 1995).

Even intermittent streams like Clay and Roca Creeks play important roles. Historically, intermittent streams contributed cool water throughout the summer. Even if the streams weren't flowing, water was percolating underground and seeping out into Bear Creek. Today, some of these streams still provide important refuge habitat for young-of-the-year fish. The short, flat stretches near the mouth help ameliorate the loss of side channel habitat in Bear Creek. They may even have a little value as additional spawning area, but there is no data available to confirm that.

In the Ashland Assessment area, the best overall aquatic habitat is on U.S. Forest Service lands in East and West Forks of Ashland Creek. Unfortunately, this habitat is not available to migrating fish (or crayfish) from Bear Creek, because Granite Street (Fig. IX-4) and Hosler Dams (Fig. IX-5) block access. Neil Creek also contains good-quality aquatic habitat, but the culvert underneath I-5 appears to be a partial barrier (Fig. IX-6). Only a few steelhead are hardy enough to swim through the culvert at ideal flows.

For species that can move over land, however, the wildland riparian systems provide refuge. Adult aquatic insects, adult salamanders, birds, and wildlife species can all travel back and forth between the streams above and below Reeder Reservoir and I-5.

In the following section, aquatic habitat in each of the streams in the Assessment area is described. Ashland Creek and Neil Creek have had more detailed habitat surveys completed in the last decade; some of that information is summarized in Tables IX-8 and IX-9. Table IX-7, below, lists the stream habitat surveys available to this author and used to write this portion of the Assessment.

<u>Ashland Creek</u>

Bennett (2000) described well how important Ashland Creek is to the residents of Ashland. Not only is it a "workhorse" providing clean drinking water, hydroelectric power, irrigation, recreation, and beauty, but it connects the wildlands upstream with the city. It is a "centerpiece of the community."

Five conditions control stream habitat along Ashland Creek:

1. Urban development
2. Reeder and Granite Street Reservoirs
3. USFS roads
4. Wildland forests

5. Underlying highly-erosive, granitic geology

Aquatic habitat downstream of Lithia Park is in very poor condition (Table IX-8). Above Lithia Park but below Reeder Reservoir, stream habitat is slightly better but still very compromised. Above Reeder Reservoir, East Fork of Ashland Creek is barely impacted by human activities. West Fork of Ashland Creek is also in excellent condition. The fish, crayfish, and insect communities reflect these differences. If restored, lower Ashland Creek would be able to provide excellent habitat for juvenile coho (Williams et al. 2006).

Table IX-7: List of stream habitat surveys in the Ashland Watershed Assessment area available for this Assessment. Survey references can be found in the Reference Section of this document. All of the surveys listed except for Nawa (1997) can also be found on the Southern Oregon University's "Southern Oregon Digital Archive" at: www.hanlib.sou.edu.

Stream, survey location, type of survey, survey date	Survey reference
Bear Creek, mouth to confluence with Emigrant Creek, observational, 1986	Weber 1986
Bear Creek, mouth to confluence with Emigrant Creek, habitat types only, 1990-91	Dambacher et al. 1992
Ashland Creek, mouth to Reeder Reservoir, observational, 1969	Hoover 1971
Ashland Creek, mouth to Reeder Reservoir, observational, 2000	Bennett 2000
East Fork Ashland Creek, Reeder Reservoir for approximately 4 miles to trail crossing (Section 4), observational, 1969	Hoover 1971
East Fork Ashland Creek, Reeder Reservoir for approximately 7.3 miles to 6600' elevation (Section 17), USFS Level II, 1997	Abbas 1999
East Fork Ashland Creek, approximately 1/5 mi. upstream Reeder Reservoir and approximately ¾ mi. upstream confluence with Bull Gap, cross-section surveys, 1996	Nawa 1997
West Fork Ashland Creek, mouth for approximately 2 ¼ miles, observational, 1969	Hoover 1971
West Fork Ashland Creek, mouth for approximately 4.1 miles, USFS Level II, 2001	Siskiyou Research Group 2001
West Fork Ashland Creek, approximately ¼ mile upstream Reeder Reservoir, cross-section survey, 1996	Nawa 1997
Unnamed tributary to West Fork Ashland Creek, ¼ mile upstream from confluence with West Fork, Section 32 SE/SE, cross-section survey, 1996	Nawa 1997
Neil Creek, mouth to Quartz Creek, USFS Level II, 2002	Siskiyou Research Group 2002
Neil Creek, USFS boundary for approximately 5 miles, observational, 1969	Hoover 1971
Neil Creek, USFS boundary for approximately 5.8 miles (end of fish use), USFS Level II, 1999	Ecosystems Northwest 2000
Neil Creek, USFS land, approximately 1¼ and 2 ¼ miles upstream Quartz Creek, two cross-section surveys, 1996	Nawa 1997

Table IX-8: Summary of aquatic habitat condition in Ashland Creek, East Fork Ashland Creek, and West Fork Ashland Creek using selected in-channel aquatic habitat variables (after OWEB Form F-2b). Data compiled from the following sources: (a) Hoover 1971; (b) Bennett 2000; (c) Abbas 1999; and (d) Siskiyou Research Group 2001. Data in parentheses were not reported and are supplied, where possible, by this author based on her interpretation of the stream survey reports and her professional knowledge of the sites.

Stream and Site	**Survey Year**	**Pool-Riffle Ratio**	**Sand and Silt (% area)**		**Gravel (% area)**	**LWD**	**Potential LWD**	**Passage Issues**				**Degree channel alteration**
			Sand	**Silt**				**Culverts**	**Water Diver-sions**	**Natural falls & chutes**	**Total # Barriers**	
ASHLAND CK. (a) Mouth to Reeder Reservoir	1969	5:95	(High)	Not recorded	<10%	Very little	(Very Low)	Not recorded	Not recorded	Not recorded	2	(Severe)
ASHLAND CK. (b) Mouth to Reeder Reservoir	2000	Fewer pools than expected	High	(Little)	Not recorded	Almost none	(Very Low)	12	Several	(0)	Not recorded	Severe
EAST FORK ASHLAND CK. (a) Mouth to ~4 miles (Section 4)	1969	20:80	Not recorded	Not recorded	25%	Very little	(High)	(0)	(none)	5	Not recorded	(Limited)
EAST FORK ASHLAND CK. (c) Mouth to 7.3 miles (Section 17)	1997	~1:1	10-19%	Not recorded	D50 in Reach 3	Very little LWD; most wood small	Very High	1	(none)	26	1	Very limited other than Reeder Rsv.
WEST FORK ASHLAND CK. (a) Mouth to 2 ¼ mi.	1969	10:90	"Substrate mostly sand and boulder"	Not recorded	10%	Very little	(High)	(1)	(none)	1	Not recorded	Not recorded
WEST FORK ASHLAND CK. (d) Mouth to 4.1 mi.	2001	15:85	20-40%	Not recorded	20-25%	Very little LWD; most wood small	(High)	1	(none)	4	0	Not recorded

Urban habitat conditions downstream of Reeder Reservoir, including Lithia Park

Near the mouth, Ashland Creek wanders through some fields. In this section, the stream has room to flood and move its channel. However, just upstream is the Ashland water treatment plant which confines the channel (Figs. IX-7, IX-8) and discharges warm water into the stream. According to the Oregon

Figure IX-8: Ashland's wastewater treatment facility. Ashland Creek flows diagonally across the upper left corner of the photo, squeezed into a narrow channel. Photo © Fred Stockwell, Stockwell Photography.

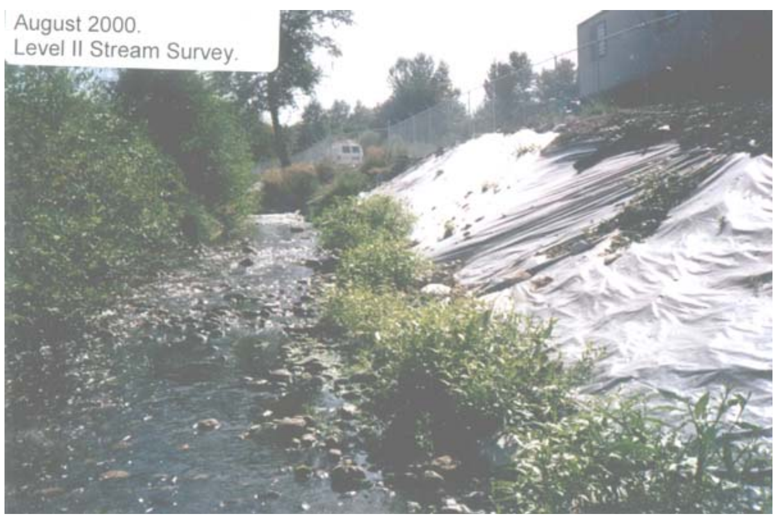

Figure IX-9: Ashland Creek, looking upstream, as it flows next to the Wastewater Treatment Facility. The plastic sheeting was due to some construction at the facility at the time the photo was taken. Siskiyou Research Group, August 1999 (SRG 2001).

Department of Environmental Quality (DEQ), stream temperatures near the effluent's outlet frequently exceed DEQ's water temperature criteria for fish[23] (DEQ 2007). See Chapter VIII, "Water Quality," for more information.

Upstream of the water treatment plant, Ashland Creek flows by the dog park and the community gardens (to be named Ashland Creek Park) with the backyards of Helman Street houses on the opposite side (Fig. IX-10). Between the Hersey Street Bridge and Lithia Park, the stream is completely confined to a narrow channel by the skate park, the recycling center, Water Street, and various buildings, one of which was constructed after the 1997 flood but others of which were built before the turn of the century (Fig. IX-11). The riparian area through this section is extremely narrow, if present at all.

Figure IX-10: Lower Ashland Creek, upstream and downstream of Hersey Street bridge. Left: Looking upstream. Note single line of trees with no understory shrubs on the left side of the stream and the blackberries on the right. Note also that the parking lot of the church is in the floodplain of the stream, and any flooding will wash parking lot oil and residue into the stream. Right: City of Ashland land near the Ashland Community Garden (aka "Vogel Park," or "Ashland Creek Park") looking downstream from Hersey Street. Note that although the stand of riparian trees grows in a strip along the stream, Ashland Creek can flood into this pasture, which could slow floodwaters and potentially reduce damage to adjacent properties. Photos © Jeannine Rossa, December 2007.

One result of this confinement is that the stream does not have a place to flow during floods. That is one reason why Ashland Creek flooded Guanajuato Way, Water Street and the adjacent buildings during December 1974 and January 1997 (See Chapter II, "History"). Another result is that this section of stream is extremely biologically compromised. Without a functioning adjacent floodplain, riparian area full of trees and shrubs, and underground hyporheic zone, this section of stream produces little food, provides little shelter, cannot attenuate flood waters, and provides only poor quality stream habitat. On top of that, water diversions, berms, and trash further degrade the stream environment (Bennett 2000).

[23] 13 degrees C (55.4 degrees F) October 15 – May 15, and 18 degrees C (64.4 degrees F) May 16 – October 14 (DEQ 2007).

Figure IX-11: Ashland Creek through the urban corridor. Left: Ashland Creek flows between buildings on its left and right and is forced through the Lithia Way culvert (background) by road fill. The Lithia Way culvert did not contain all the flood water in the 1997 flood. Right: Looking downstream from the walking bridge next to the Lithia Way culvert. The white area in the lower center of the photo shows where the stream drops over a diversion dam (and partial fish migration barrier) shunting water into the Helman ditch, in the left of the photo. There is only a single line of trees on both sides of the stream through this section. A parking lot next to Water Street is immediately adjacent to the narrow riparian area. During the floods of 1974 and 1997, this lot and Water Street itself were flooded. Photos © Jeannine Rossa, December 2007.

Aquatic macroinvertebrate survey results from lower Ashland Creek reflect the bleak aquatic habitat conditions[24]. Compare the results in Table IX-9 from the samples near the Ashland dog park with those from East Fork Ashland Creek. Almost all of the macroinvertebrates collected were collector-gatherers and collector-filterers. This means that they acquire their food from the water column, for example, by weaving small nets of silk that trap tiny particles, or by using specialized feeding appendages like the foldable fans of blackfly larvae. (Every few seconds, the blackfly brushes the fans' catch into its mouth.) A tiny percentage of the sample were shredders, which feed on fallen leaves and other organic debris, or scrapers and predators, which scrape algae off rocks and logs or feed on other insects, respectively. All of this means that there is little food available in Ashland Creek. In addition, no cold-water-preferring insects were present, and a high proportion of insects were very tolerant to high amounts of organic compounds[25] (Hilsenhoff Index). Such numbers indicate that water quality through this urban section of Ashland creek is very poor.

Between Winburn Way and Reeder Reservoir, the stream habitat is better, but still poor (Bennett 2000) (Figs. IX-12, IX-13). In order to reduce bridge hazards, the City of Ashland removed all the large, fallen trees following the 1964 and 1974 floods (USFS 1995). Sluicing Reeder Reservoir[26,27] in the

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[24] For complete taxa lists as well as additional biotic indicators, please see reports by Aquatic Biology Associates, citations are in the reference section of this document.
[25] From, for example, lawn fertilizers or septic tanks. However, Bob Wisseman notes in his 2000 report (ABA 2000), that if nutrient enrichment was excessive, he would expect that the number of insects would be greater. In other words, more nutrients would increase the collector population.
[26] And possibly Granite Street Reservoir.
[27] See Chapter VI "Sediment", this document.

Figure IX-12: Ashland Creek through Lithia Park, looking upstream. Note the large boulders creating small pockets of slow water, and the lack of deep pools. Also note the sawn end of the alder log in the lower right foreground. Photo: Siskiyou Research Group, August 1999 (SRG 2001).

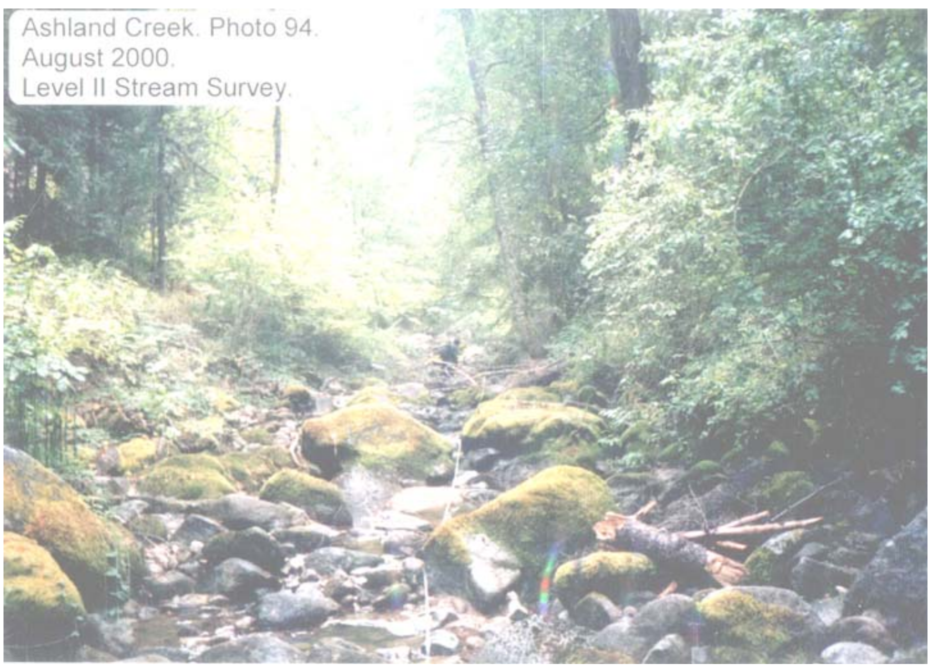

Figure IX-13: Ashland Creek between Granite Street and Hosler dams. Photo by Siskiyou Research Group, September 1999 (SRG 2001).

Figure IX-14: Fine sediment and coarse granitic sand stored in Granite Reservoir. Photo by Siskiyou Research Group, September 1999 (SRG 2001).

1970's and 80's deposited enormous amounts of fine sand, most of which is probably still stored in the channel (see Chapter VI, "Sediment Source Assessment" for more information) (Fig. IX-14). Unpaved stream-side roads, hiking and biking trails, and a quarry aggravate the situation due to the highly erosive granitic soils. Ironically, the presences of Reeder and Granite Street Reservoirs also prevents Ashland Creek from moving larger sediment downstream. In unregulated systems, streams naturally tumble rocks downstream every winter, collecting gravels and cobbles behind grade controls like logs and large boulders. All these factors have resulted in a streambed comprised primarily of sand and boulders. It is a testament to the resilience of aquatic species that steelhead continue to spawn and rear throughout this lower stretch, and coho apparently rear (at least) in the most downstream ½ mile.

Habitat conditions upstream of Reeder Reservoir

The headwaters of East and West Forks of Ashland Creek and Weasel Creek (above Forest Road #2060) have not been impacted by agriculture or urbanization. Some of the public forest lands in upper Ashland Creek have been harvested several times over the past 130 years, most recently between 1959 and 1969 (USFS 1995). During this period, some 53 miles of roads were built in the Ashland Creek watershed. In 1969 a logging and road construction moratorium was imposed in the watershed, and public access was restricted. The moratorium has enabled the maintenance of a relatively undisturbed and pristine drainage area above the city (Horton 2001).

Stream habitat conditions in unmanaged portions of East and West Fork are excellent (Table IX-8) (Abbas 1999, SRG 2002b) (Figs IX-15, 16, 17). Overall stream habitat quality is also high in managed portions of East and West

Forks Ashland Creek and their tributaries (USFS 1995). However, in both East and West Forks, stream habitat would be even better if more large wood was lodged in the stream channel, creating more and deeper pools. In both East and West Forks, the frequency of large and medium-sized fallen trees ("Large Woody Material") is very low (ABA 1994; Abbas 1999; SRG 2002b), although in West Fork, it does increase with elevation. Few large trees could be due to the time since the last fire (Fox and Bolton 2007; personal observation of this author), the frequency of major floods, the inapplicability of the size classification (developed on the coast where trees are much larger) to southern Oregon (S. Maiyo, personal communication, 2007), or some combination of all three. The amount of sand is also relatively high in East Fork Ashland Creek due to the

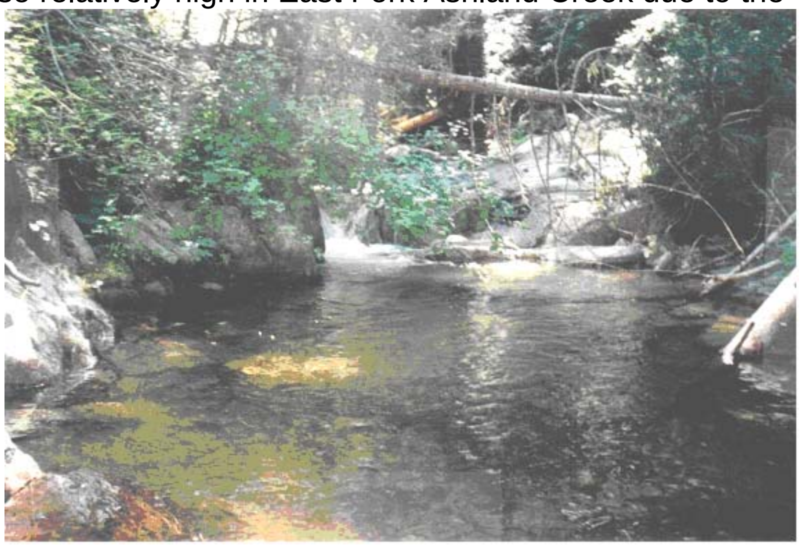

Figure IX-15: East Fork Ashland Creek, bedrock-controlled pool in Reach 1. Photo: Gar Abbas, July 1997 (Abbas 1999).

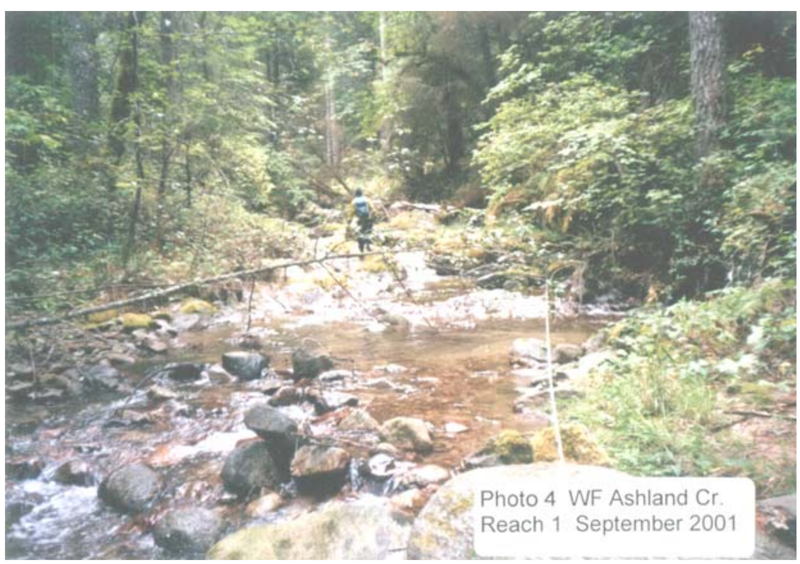

Figure IX-16: Typical lower canyon habitat in West Fork Ashland Creek. Siskiyou Research Group, September 2001 (SRG 2002b).

Figure IX-17: Debris jam in West Fork Ashland Creek. Fish were abundant both above and below this jam. Siskiyou Research Group, September 2001 (SRG 2002b).

Figure IX-18: Coarse granitic sand accumulating in pool (looking upstream). This photo was taken in West Fork, but it illustrates the phenomenon of high sand content in streams draining granite batholith geology. Photo: Siskiyou Research Group, September 2001 (SRG 2002b).

granitic soils (Fig. IX-16); however because of instream structure (fallen logs, boulders, and complex bed composition), spawning gravels, and cobbles are still abundant (Abbas 1999). Fish populations in both East and West Forks are healthy. Snorkel and electrofishing surveys found fish of many age classes far upstream in both watersheds (Abbas 1999; SRG 2002b). The presence of mineral springs in the West Fork watershed may contribute to high fish production in this stream (Nawa 1997).

Aquatic macroinvertebrate surveys confirm that East Fork Ashland Creek is a biotically productive, healthy stream (Table IX-9). A total of 21 rare or unusual species were found at two locations on 3 sampling trips (Table IX-1). Not only were these species present, but they were abundant, indicating that the stream habitat was exceptionally good (ABA 1999; ABA 2000). At all sample sites the percentage of taxa that were mayflies (E), stoneflies (P), or caddisflies (T) was very high, indicating that food was abundant, the insect food web was complex, and many microhabitats were available for specialized species. In the headwaters, 31 to 58% of the samples were composed of insects requiring cold water. Numbers were a little lower near Reeder Reservoir. Shredders composed 26 to 46% of the samples near the headwaters, indicating that the amount and diversity of riparian vegetation input is high. At all sites, the number of insects tolerating poor water quality was almost zero, or zero - quite a contrast with the macroinvertebrate community in lower Ashland Creek.

Table IX-9: Summary of benthic aquatic macroinvertebrate sampling results in streams within the Ashland Watershed Assessment area. Sampling was completed under contract for the U. S. Forest Service by Aquatic Biology Associates (Corvallis, OR), and Utah State University Bug Lab (Logan, UT) between 1993 and 2000. Erosional habitat samples were collected in mid-channel (e.g. among the larger rocks of a riffle); margin samples were collected at the edge of a stream, and detritus samples were collected on a fixed amount of leaves, sticks, and other vegetative matter in the stream channel. A short interpretation of the sampling results is provided for each sample site and year, condensed from the sampling reports with some rewording for clarity. References for the sampling reports are included in the reference section of this document.

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	**Erosional Habitat Sample**	**Margin Habitat Sample**	**Detritus Habitat Sample**	**Entire Sample**
Ashland Creek, near dog park 11/16/1999	Interpretation: There are severe habitat limitations for the aquatic invertebrate community at this site. Summer water temperatures are high, and non-supportive of salmonids. The macroinvertebrate community is severely truncated and dominated by taxa highly tolerant of warm water, fine sediments, and organic enrichment.			
Total number of invertebrates / total number of taxa	1806/14	423/16	813/16	
Number of "Sensitive" and "T&E" taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				0
% total number of invertebrates that are the top 5 most abundant taxa	97.02	95.28	97.65	
% total number invertebrates that need cold water / Number cold water taxa				0
% total number invertebrates that are EPT / Number EPT taxa	0.83/2	1.42/3	0.12/1	
% total number of invertebrates that are shredders / Number shredder taxa	0.17/1	0.47/1	0.49/2	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	3.03	11.23	2.49	

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
Number of long-lived taxa found in all 3 samples, combined				1 (exception-ally low number)
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	7.87	7.68	7.93	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	46.02/4	48.47/3	39.48/3	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	44.52/2	45.16/2	38.62/1	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	97.67/7	90.09/9	97.53/7	
Ashland Creek, near dog park 11/21/2000	Interpretation: Some metrics have improved since 1999, but overall, the changes are insignificant and do not indicate that the stream habitat has improved. There are high numbers of invertebrates tolerant to organic enrichment; however, if nutrient enrichment was excessive, invertebrate densities would be higher. Otherwise, same as Ashland Creek, 1999, above.			
Total number of invertebrates / total number of taxa	3705/23	634/24	314/19	
Number of “Sensitive” and “T&E” taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				0
% total number of invertebrates that are the top 5 most abundant taxa	93.39	87.85	3	
% total number invertebrates that need cold water / Number cold water taxa	0/0	0.16/1	0.32/1	
% total number invertebrates that are EPT / Number EPT taxa	47.23/5	54.28/6	43.31/3	
% total number of invertebrates that are shredders / Number shredder taxa	0.53/2	0/0	2.55/2	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	29.86	39.75	40.68	
Number of long-lived taxa found in all 3 samples, combined				5
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	6.28	6.01	6.10	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	2.02/2	28.12/4	8.28/2	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	1.08/1	27.76/2	7.96/1	

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	95.26/12	91.97/17	88.24/13	
East Fork Ashland Creek, 200m upstream of Reeder Resv. 10/11/95	Interpretation: The macroinvertebrate community is not truncated, even expanded. The high number of long-lived taxa indicates that flow is perennial, disturbance to substrates not high, and stream habitat complexity and retention mechanisms are high. The high number of cold-water obligates indicate that summer water temperatures are cool and fully supportive of salmonids. In addition, the taxa richness of the macroinvertebrate community is exceptionally high; rare and small stream taxa are common, not just present; microhabitat specialist richness is high; shredder community development is excellent; collector abundance is relatively low; and no taxa classed as tolerant of very low habitat integrity are present. This site demonstrates that when stream channels in a granitic watershed can naturally store and transport high amounts of coarse, granitic sand, they display and maintain very high biotic integrity**. Note: Insufficient leaf material available for detritus sample.**			
Total number of invertebrates / total number of taxa	1801/37	370/50	NA	
Number of "Sensitive" and "T&E" taxa in all 2 samples, combined (no detritus sample taken)				0
Number of rare or unusual taxa found in all 2 samples, combined (no detritus sample taken)				7 (also abundant)
% total number of invertebrates that are the top 5 most abundant taxa	46.21	60.82	NA	
% total number invertebrates that need cold water / Number cold water taxa	37.66/18	23.24/9	NA	
% total number invertebrates that are EPT / Number EPT taxa	78.03/43	86.49/37	NA	
% total number of invertebrates that are shredders / Number shredder taxa	20.68/10	4.05/8	NA	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	12.98	7.57	NA	
Number of long-lived taxa found in all 3 samples, combined			NA	10, a high number
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	2.65	1.79	NA	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	0/0	0/0	NA	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	NA	

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	38.20/24	22.70/14	NA	
East Fork Ashland Creek, in Section 17, near ski area 11/2/1999	Interpretation: Rare taxa comprised a very high proportion of the sample from this site. The number of long-lived taxa indicate that flow is perennial, substrate disturbance is not high, and habitat complexity is high. Summer water temperatures are cold, and fully supportive of salmonids. This site had very high biotic index scores (not reported in this table) for all 3 habitat types. This, combined with the high proportion of rare and small stream taxa, identify East Fork Ashland Ck. as a unique resource.			
Total number of invertebrates / total number of taxa	398/65	760/58	445/58	
Number of “Sensitive” and “T&E” taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				17
% total number of invertebrates that are the top 5 most abundant taxa	37.69	46.58	43.37	
% total number invertebrates that need cold water / Number cold water taxa	55.00/27	57.64/20	31.88/18	
% total number invertebrates that are EPT / Number EPT taxa	84.42/49	78.95/40	70.34/37	
% total number of invertebrates that are shredders / Number shredder taxa	31.64/13	27.87/9	34.59/11	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	6.47	16.59	19.55	
Number of long-lived taxa found in all 3 samples, combined				11
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	2.01	2.10	2.90	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	0/0	0/0	0.22/1	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	0/0	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	34.16/17	35.06/20	37.05/19	
East Fork Ashland Creek, in Section 17, near ski area 11/13/2000	Interpretation: Fauna dominated by higher elevation, cold water biota. This is a small subalpine stream, so this is atypical. There was little damage from the 1997 flood due to high elevation (>5000’). The stream still has large amounts of coarse sediment (e.g. cobbles, boulders) native to this watershed. Otherwise, same as East Fork Ashland Creek 1999, above.			

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
Total number of invertebrates / total number of taxa	1770/79	274/42	201/41	
Number of "Sensitive" and "T&E" taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				8
% total number of invertebrates that are the top 5 most abundant taxa	40	42.33	48.76	
% total number invertebrates that need cold water / Number cold water taxa	53.4/26	46.67/17	50.27/15	
% total number invertebrates that are EPT / Number EPT taxa	82.71/51	75.18/29	80.10/29	
% total number of invertebrates that are shredders / Number shredder taxa	33.56/14	26.26/9	46.27/8	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	10.13	19.25	14.93	
Number of long-lived taxa found in all 3 samples, combined				12
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	1.95	2.40	2.34	
% total number of invertebrates that are tolerant of <u>very low</u> habitat integrity / Number of tolerant taxa	0.85/2	0/0	0.50/1	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	0.50/1	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	27.81/23	28.44/15	23.41/16	
Neil Creek, ~ ¼ mile upstream of Hwy. 66 10/8/1993	<u>Interpretation</u>: Summer high water temperatures are borderline supportive of salmonids and cold-water insects. Overall habitat complexity and retention mechanisms are not optimal. Embedding of armor- layer rocks with coarse granitic sand is high. Scour during high water events is severe. The benthic community is moderately truncated at this site. More rare taxa would be expected in this type of stream.			
Total number of invertebrates / total number of taxa	2264/52	448/51	1486/51	
Number of "Sensitive" and "T&E" taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				2
% total number of invertebrates that are the top 5 most abundant taxa	53.17	63.17	61.52	
% total number invertebrates that need cold water / Number cold water taxa	7.24/5	2.23/3	4.18/2	

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
% total number invertebrates that are EPT / Number EPT taxa	73.67/28	75.70/26	32.03/24	
% total number of invertebrates that are shredders / Number shredder taxa	29.32/8	5.11/8	33.38/10	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	28.09	14.01	47.98	
Number of long-lived taxa found in all 3 samples combined				6 (low-moderate)
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	3.54	2.44	4.52	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of these tolerant taxa	0.18/1	0.22/1	0.67/2	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	0/0	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	35.35/22	29.27/17	43.31/21	
Neil Creek, ~ ¼ mile upstream of Hwy. 66 11/8/1999	Interpretation: Invertebrate densities in erosional and marginal habitats were very low, indicating that there had been a storm event just prior to sampling at this site (in addition to the 1997 flood). Otherwise, same as Neil Creek, 1993 (above).			
Total number of invertebrates / total number of taxa	276/43	753/32	176/35	
Number of "Sensitive" and "T&E" taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				2
% total number of invertebrates that are the top 5 most abundant taxa	44.92	84.86	69.33	
% total number invertebrates that need cold water / Number cold water taxa	23.17/12	3.85/4	3.98/3	
% total number invertebrates that are EPT / Number EPT taxa	81.88/33	96.41/23	69.32/19	
% total number of invertebrates that are shredders / Number shredder taxa	5.79/6	1.06/4	51.15/6	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	6.34	4.58	31.68	
Number of long-lived taxa found in all 3 samples combined				8
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	2.55	1.73	3.46	

Stream Name, Sample Location, Sample Date and Invertebrate Community Metrics	Erosional Habitat Sample	Margin Habitat Sample	Detritus Habitat Sample	Entire Sample
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	0.36/1	0/0	0/0	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	0/0	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	28.96/12	12.88/11	25.59/14	
Neil Creek, ~ ¼ mile upstream of Hwy. 66 11/21/2000	Interpretation: Given the relatively low elevation of this site and its proximity to urban development, the abundance of macroinvertebrates, especially EPT and cold water biota, is surprisingly high. This is probably due in large part to the buffering that a north-facing aspect provides. With the exception of 2 rare species, the fauna found at this site are all widespread and common in mid-order, Pacific northwest mountain streams. Otherwise, same as Neil Creek 1993 (above).			
Total number of invertebrates / total number of taxa	1204/66	587/36	613/45	
Number of "Sensitive" and "T&E" taxa in all 3 samples, combined				0
Number of rare or unusual taxa found in all 3 samples, combined				2
% total number of invertebrates that are the top 5 most abundant taxa	45.36	83.82	58.30	
% total number invertebrates that need cold water / Number cold water taxa	18.45/17	4.94/3	13.62/8	
% total number invertebrates that are EPT / Number EPT taxa	74.09/43	93.60/21	49.05/24	
% total number of invertebrates that are shredders / Number shredder taxa	11.48/13	1.53/5	48.75/10	
% total number of invertebrates that are multivoltine (have a 2 or more year life cycle)	15.32	7.16	35.56	
Number of long-lived taxa found in all 3 samples combined				7
Hilsenhoff Index (1 – 10; a high value means that there are high numbers of invertebrates that are very tolerant to organic enrichment)	3.40	1.75	3.70	
% total number of invertebrates that are tolerant of very low habitat integrity / Number of tolerant taxa	0/0	0/0	0/0	
% total number of invertebrates that are tolerant snails / Number of tolerant snail taxa	0/0	0/0	0/0	
% total number of invertebrates that are collector-gatherers or collector-filterers / Number of collector taxa	43.06/17	14.98/16	26.14/18	

Neil, Tolman, and Clayton Creeks

Neil Creek and its tributaries, Tolman and Clayton Creeks, drain the forested slopes of Mt. Ashland all the way from the peak to the valley floor near the Ashland airport. The wide valley bottom and mountain foothill stretches are primarily rural-residential, and privately owned. Above I-5, USFS, an industrial timber company, and private landowners with small timber holdings manage the steep canyon slopes. Stream surveys provide a detailed appraisal of Neil Creek's habitat (Ecosystems Northwest 2000; SRG 2002a). Upper Neil Creek (above I-5) is in good condition and supports a healthy cutthroat and rainbow trout population (Ecosystems Northwest 2000). Lower Neil Creek (below I-5) is in moderately poor condition, but still supports a wide variety of aquatic species including steelhead, sculpin, native crayfish and 2 rare insects (ABA 1999; SRG 2002a). Williams et al. (2006) have determined that the intrinsic potential of Neil Creek to rear juvenile coho salmon is moderate.

Factors limiting habitat quality today are essentially the same as they were 10 years ago (Prevost et al. 1997). Five things predicate Neil, Tolman, and Clayton Creeks' condition:

1. Underlying granitic geology.
2. Steep forested lands upstream of I-5.
3. Rural residential and commercial development along stream banks.
4. Water withdrawals.
5. I-5.

Neil Creek habitat conditions downstream of Interstate-5

Down stream of Hwy. 66, aquatic habitat in Neil Creek is in poor condition (SRG 2002a) (Table IX-10). Pools are shallow, featureless, and sand-dominated. Large areas of anoxic sediment are common, which implies that dirt, silt, and other fine sediments are effectively blocking water flow through sand banks (Fig. 19). A lack of large wood and boulders contributes to habitat simplification. Many riffles are not turbulent and the channel is entrenched, especially alongside the Ashland City airport where one of Neil Creek's banks is riprapped with large boulders to prevent the stream from undermining the airport pavement. The riparian area is a narrow strip of trees, and non-native Himalayan blackberries[28] dominate the understory (Fig. 19). The 1939 aerial photos (Fig. II-8) show the riparian area was already decreased down to a narrow strip in order to maximize agricultural use of adjacent fields. Today, most of these fields have been subdivided into smaller rural lots, and the concentration of houses along Neil Creek appears to have more than tripled. Surveyors found 3 irrigation water diversions, all of which appeared to be complete late summer barriers to fish movement[29]. In late August, 2002, surveyors also found high turbidity measurements in late summer – unnatural for a northwest stream system which usually experiences high turbidity levels in the winter (SRG 2002a). Late summer water temperatures were also unusually warm. Despite all this, fish are using the stream, especially juvenile steelhead in large numbers (SRG 2002a).

[28] Classified as a "noxious weed" by the State of Oregon Department of Agriculture.
[29] See barrier discussion at the end of this chapter.

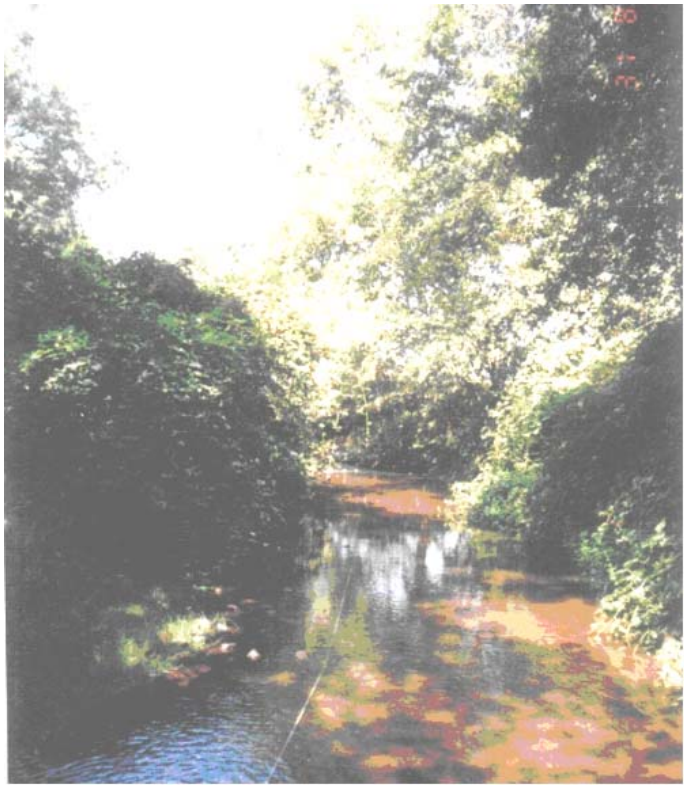

Figure IX-19: Neil Creek – a sand-filled pool. The brown color is due to excessively high turbidity levels during the stream survey. Note the blackberry-dominated riparian corridor and lack of structure or other forms of cover. Photo Siskiyou Research Group, September 1999.

Surveyors snorkeling this stretch of Neil Creek observed that the fish were concentrated in the places of best flow. There was also one beaver dam which created the largest and deepest pool as well as a complex aquatic-riparian environment. As of 2007, the beaver dam was no longer in existence.

In the reach above Hwy. 66 but below I-5, the stream continues through a rural residential area. Aquatic habitat is in better shape, partly due to the steeper gradient which reduces the amount of fine sediment collecting in pools. Large wood is still non-existent, but boulders and cobbles create roughness and small-scale structure (Fig. IX-20). The riparian area is still a narrow strip, so there is little input from riparian vegetation as well as little potential large wood. This is partly due to the fact that most of Neil Creek below I-5 flows through deciduous woodlands, not conifer forest. Four irrigation diversions and one culvert appeared to prevent fish passage in late summer. In late summer, 2002, stream flow was very low and water temperature warm. Surveyors noted several spots with a "slight sewer smell" (possibly leaky septics?) (SRG 2002a).

Despite the bleak picture painted by the surveys, the aquatic insect community in lower Neil Creek is not as compromised as one would imagine. Even just ¼ mile upstream of Hwy. 66, surveyors found five rare or unusual


Figure IX-20: Neil Creek upstream of Reiten Drive crossing. Photo © Jeannine Rossa, November 2007.

aquatic insects (Table IX-1). Cold water taxa were present; a large proportion of the samples were composed of mayflies (E), stoneflies (P), and caddisflies (T); and although shredder numbers were low, they were finding enough detrital material for shredding. It is obvious to surveyors, however, that the macroinvertebrate community is less than what would be expected in a cold-water stream draining a forested watershed (Table IX-10). Regardless, this relatively intact insect community may be one of the reasons why Lower Neil Creek continues to support a healthy population of steelhead despite the high fines and lack of habitat structure.

Habitat conditions upstream of Interstate-5

Upstream of I-5, the habitat changes dramatically (Fig. IX-21). The forest canopy closes over the stream, and there is no Himalayan blackberry (SRG 2002a). Upstream of TID and other irrigation diversions, there is more water and water temperatures are cooler. For several miles, Neil Creek lacks *large* woody material (USFS 1995; Ecosystems Northwest 2000), although debris jams composed of smaller pieces, bedrock controls, and boulders create habitat complexity (Fig. IX-22). Like East and West Forks, the lack of woody debris is odd, considering that stream-side logging in Neil Creek has been limited. The uppermost reaches do benefit from large wood (Fig. IX-22) and larger, deeper pools are the result. Coarse granitic sand loads are relatively high for a steep mountain stream (13% - 28%). This high amount of granite in the system is due primarily to the highly erosive nature of decomposed granitic soils throughout the Neil Creek subwatershed and a few small landslides also contribute coarse granitic sand (Ecosystems Northwest 2000). The USFS has rated a relatively high proportion of the slopes draining to upper Neil Creek as high or moderately high landslide risk (USFS 1995). Despite the sand, however, there are also

Table IX-10: Summary of aquatic habitat condition in Bear and Neil Creeks using selected in-channel aquatic habitat variables (after OWEB Form F-2b). Data were compiled from the following sources: (a) Weber 1986, (b) Dambacher et al. 1992, (c) Siskiyou Research Group 2002, (d) Hoover 1971, and (e) Ecosystems Northwest 2000. Sand and Gravel data from the Siskiyou Research Group (2002) are presented separately for pools and riffles. Data in parentheses were not reported and are supplied, where possible, by this chapter's author based on her interpretation of the stream survey reports and professional knowledge.

Stream and Site	Survey Year	Pool-Riffle Ratio	Sand (% area)	Gravel (% area)	LWD	Potential LWD	Passage Issues				Degree channel alteration
							Culverts	Water Diver-sions	Natural falls & chutes	Total # Barriers	
BEAR CK. (a) Valley View Road to confluence with Emigrant Creek	1986	1/5 of reach has "good pools and riffles"	Sand in gravel bars and filling pools; "excess"	"Excess"	(low amounts)	(Low)	0	6	0	0	(Severe)
BEAR CK. (b) Talent Lateral near Ashland to confluence with Emigrant Creek (Reach 6 of survey)	1990-1991	20:80	Not reported	(Moderate, but much of low quality)	Very low	(Low)	Not reported	Not reported	Not reported	Not reported	Severe
NEIL CK. (c) Mouth to Hwy. 66	2002	Ds:~45:55 Us: 25:75	Pools: 65-70 Riffles: 30	Pools: 15-20 Riffles: 35-40	0	Very low	2	3	0	3	Severe
NEIL CK. (c) Glenyan Campground to I-5	2002	~25:75	48:20	10:20	1 piece, total = extremely low amount	Very low	1	4	0	5	Moderately Significant
NEIL CK. (d) I-5 upstream to USFS boundary	1969	15:85	Not reported	Definite lack	Very little	Not reported	Not reported	Not reported	Not reported	0	(Some)
NEIL CK. (c) I-5 upstream to Quartz Creek	2002	15:80 (5% in culvert)	50:28	15:22	0	Low (small diameter trees)	2	0	0	1	Moderate
NEIL CK. (d) USFS boundary upstream ~ 4 ¼ mi.	1969	15:85	Not reported	Adequate Amount	Very little	Not reported	Not reported	Not reported	Not reported	0	(Very Little)
NEIL CK. (e) USFS boundary upstream ~ 5.8 mi.	2000	Ds: 20:80 Us: 10:90	13-28	20-35	1-6 pcs/mile (very low amounts)	Healthy	2	4 (2 dams, 2 screened pumps)	22	0	Very Little

Figure IX-21: Neil Creek, within 1/4 mile of Interstate 5. The character of the stream and the riparian area improves dramatically and more robust fish numbers reflect that improvement. Photo by Siskiyou Research Group, September 2001.

Figure IX-22: Neil Creek upstream of Quartz Gulch. Note smaller-diameter fallen trees. These would not be counted in a stream wood survey, but may eventually fall in and contribute to a debris jam after a large flood. Photo by Ecosystems Northwest, September 1999.

adequate amounts of clean gravel for fish spawning as well as cobble to provide aquatic insect habitat (Table IX-9; Ecosystems Northwest 2000). Upper Neil Creek supports a very healthy cutthroat trout population – or rather, populations, as some are isolated in tributaries upstream of steep waterfalls (Fig. IX-24).

Figure IX-23: Large wood creates a spectacular plunge pool, which was filled with cutthroat. Photo by Ecosystems Northwest, September 1999.

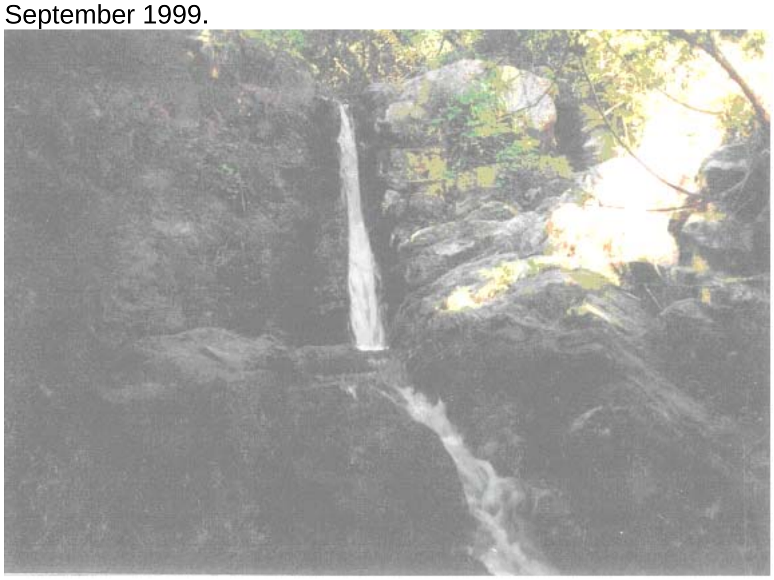

Figure IX-24: A 10' waterfall on a small tributary about 500' upstream of its confluence with Neil Creek. Fish were abundant upstream of this waterfall for another 5000'. Photo: Ecosystems Northwest, September 1999.

Tolman and Clayton Creeks

Little specific information is available on aquatic habitat condition in Tolman and Clayton Creeks, both tributaries to Neil Creek. Clayton Creek's habitat quality is poor due to channelization, bank erosion, invasive plants, lack of instream structure, and lack of suitable spawning gravel (SRG 2002a). Both drainages have some areas outside of Riparian Reserves designated as high or moderately high landslide risk (USFS 1995). In late summer, 2002, Tolman Creek increased the flow of Neil Creek by approximately 35% (SRG 2002a). Clayton Creek was not flowing at the time of survey. However, later investigations found fish holding out in isolated pools. Although specific fish distribution information was not unearthed for this Assessment, the USFS (1995) estimates that steelhead spawn in the lower mile of Tolman Creek and Clayton Creeks if adequate flows are present.

Hamilton/Clay/Roca/Paradise/Wrights Creeks

Hamilton, Clay, Roca, Paradise, and Wrights Creeks are important streams in the Ashland Watershed Assessment area. Even though they are small, they provide an important link between the wildland slopes of Mt. Ashland, the City of Ashland, and Bear Creek. They form tiny green corridors through which birds, insects and even wild animals can travel – at least part of the way[30]. Roca, Paradise, and Hamilton Creeks are all piped underground for some distance. It is quite possible that many Ashland residents are unaware that streams are flowing underneath their feet. Piped streams become sterile systems. Without sunlight, and riparian plants, the basic building blocks of the aquatic foodchain are gone. With cement walls, a piped stream has no habitat structure. This also has implications for the City, since piped streams may not be designed with enough capacity to handle floodwaters.

Hamilton, Clay, Roca, and Paradise also have a large proportion of their stream channels flowing through the urban area (e.g. Figs. IX-25, IX-26). As such, they can easily collect toxins washed into them during rainstorms, as well as fertilizers and insecticides applied in yards. As far as Bear Creek is

Figure IX-25: Hamilton Creek flowing between the parking lots of Albertson's and Rite Aid, off of Ashland Street. Stream channel is extremely simplified. Riparian vegetation is almost exclusively blackberries. Oak trees are native and were present before shopping center constructed. Photo by Jeannine Rossa, December 2007.

[30] One of the reasons why mountain lions turn up in Ashland from time to time is that migrating mammals tend to follow natural corridors like streams to get from place to place.

Figure IX-26: Roca Creek, downstream of East Main Street. Left: Roca Creek exits an underground pipe below East Main. Right: After exiting the pipe, the stream flows through a constructed wetland filled with cattails and other wetland vegetation. The wetland filters and cleans the stream water and also traps a large amount of granitic sand and fine silts; residents are concerned that the stream may damage their properties. Photos © Jeannine Rossa, December 2007.

concerned, one of the most important functions of these small streams is to provide cool water during the summer months – preferably without contamaninents included.

Hamilton and Clay Creeks also provide important fish habitat. While Hamilton and Clay Creek flow across and then down the Ashland terrace, they both flow across a very flat floodplain adjacent to Bear Creek. Even small, newly-hatched fish can easily swim up into these streams to find refuge from high water or warm temperatures in Bear Creek. Recent ODFW electroshocking surveys found juvenile fish using these small creeks (C. Volpe, personal communication 2007). The steep terrace is, of course, a natural migration barrier.

Wrights Creek is a much larger system without a natural migration barrier near the mouth. Unfortunately, the Hwy. 99 culvert is a fish passage barrier. Local residents have regularly seen steelhead below this culvert (E. Weir, personal communication, 2007). Wrights Creek flows through a steeply-sided canyon, so it is less developed than the other urban streams. However, its upper reaches have been affected by intensive timber harvesting and road construction. Stream channels have become more incised (USFS 1995).

Bear Creek

If Ashland Creek is the lifeblood of the City of Ashland, then Bear Creek is the main artery for the entire Bear Creek watershed. As a result, it has been dammed, diverted, channelized, moved, rip-rapped, and built in. It has lost riparian area, floodplain, wetlands, side channels, and spawning gravel and gained pollution and wastewater. But Bear Creek still flows and still supports fish, crayfish, amphibians, ducks, overwintering robins, and other riparian wildlife – and people.

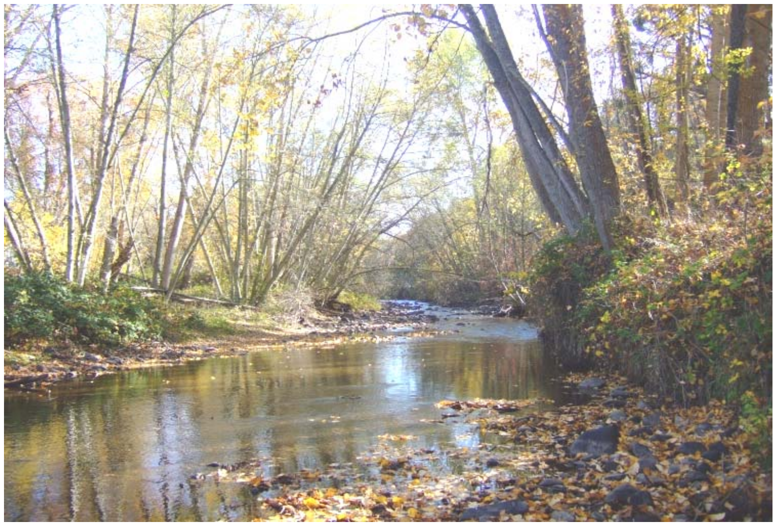

Figure IX-27: Bear Creek just upstream of its confluence with Clay Creek, October 2007. Photo © Jeannine Rossa, November 2007.

In fact, despite all the channel changes, Williams et al. (2006) found that Bear Creek has high “intrinsic potential” to support juvenile coho salmon. Ken Phippen, National Marine Fisheries Service Southwest Oregon Branch Chief, believes that Bear Creek restoration should be an “important component of coho recovery” in southern Oregon (personal communication, 2007).

As explained earlier, the upper section of Bear Creek, from Talent to Emigrant Creek, contains some of the stream’s best habitat, especially for steelhead and rainbow trout. However, habitat in Bear Creek could be vastly improved. Riffles are wide and flat, and the stream lacks high quality pools (Table IX-10). Spawning gravels are present, but are embedded with sand and fine sediments, and therefore do not provide optimal spawning beds. Sediments stored in pools are often anoxic, eliminating habitat for aquatic insects and lamprey ammocetes. The channel is very simplified, lacking the debris jams of storm-felled trees, beaver dams, side channels and gravel bars that should be present. In several places, Bear Creek is channelized with rip-rap to force it into a specific channel and discourage the stream’s natural tendency to wander back and forth. A notable location is the section between the Ashland Airport and Clay Creek (Fig. IX-27). The riparian area is dominated by invasive Himalayan blackberries, the Greenway path has been constructed along the stream, and the sewer line for the City of Ashland runs along Bear Creek, buried in the rocky soil within 100’ of the active channel.

In addition, water management of Emigrant Reservoir and Bureau of Reclamation’s Rogue River Basin system has artificially altered flows and temperatures in Bear Creek, essentially reversing the hydrograph for Emigrant Creek below Emigrant Dam (DEQ 2007; Maxwell, in preparation). Winter flows fluctuations are lower than natural (due to water storage operations), summer flows are higher than undammed flows would be, and flow fluctuations are more frequent and at different times than they would be if the stream water was not controlled for irrigation.

Figure IX-28: Left: Bear Creek looking upstream underneath the Interstate-5 bridges. A large, vegetated berm is visible behind the bridge abutment in the left of the photograph. Right: Part of the sewer pipe system for the City of Ashland. Most of the sewer pipe is underground. The Interstate-5 bridge over Bear Creek is visible in the background. Photos © Jeannine Rossa, November 2007.

Figure IX-29: Floodplain development near Bear Creek. The grey and white houses in the lower right-hand corner have been constructed on historic old side channels. The dirt and short roads in the background are a newer development off of North Mountain Avenue. The cluster of houses in the right of the photo is located on the hill, and the development is in the flat historic floodplain. Photo © Fred Stockwell, Stockwell Photography.

Figure IX-30: Floodplain development off of North Mountain Avenue. One can see the edge of Bear Creek's historic floodplain at the line of trees and bushes at the edge of the flat pasture. Beyond that line, the foothills rise in elevation. Bear Creek's active channel crosses the photo in the lower left-hand corner. Photo © Fred Stockwell, Stockwell Photography.

In the spring, water releases from the bottom of Emigrant Lake are much colder than ambient water temperatures[31]. This cold water "shock" could be detrimental to alevins still in redds or newly-hatched; however, these cool water releases may benefit some aquatic species during the summer. The Bureau of Reclamation is currently studying ways to improve water management in Bear Creek and its tributaries.

Within the Assessment area, Bear Creek's location and character has spared it some of the residential developmental pressure experienced by Ashland Creek or the other stream that flow through town. Bear Creek is big, produces spectacular floods, and flows in the valley bottom between the Ashland terrace and the foothills on the opposite bank. Consequently, residential development near the stream didn't really start until after WWII (See Chapter II "Historical Conditions"). Now, houses cozy up to the banks of the stream on East Nevada Street and Oak Street, in Nauvoo Park Estates, and most recently, within the historic and potentially still active floodplain of Bear Creek along North Mountain Avenue[32] (Figs IX-29, IX-30). The effect on Bear Creek may be to further confine a stream that already has limited ability to dissipate (and slow down) flood waters. Subsequently, high water events must concentrate their force in the channel, accelerating channel simplification and bank erosion. From

[31] See Hydromet data on U.S. Bureau of Reclamation website: www.usbr.gov/pn/hydromet/.
[32] Please refer to Jackson County's floodplain map. You can find this online at: www.co.jackson.or.us --click on "SmartMap" in the left-hand column of county services.

the perspective of perpetuating a healthy aquatic ecosystem, floodplain development also reduces our ability to restore side channel habitat.

Barriers

Besides Hosler and Granite Street dams on Ashland Creek, there are over 40 smaller human-constructed barriers on streams in the Ashland Watershed Assessment area. Barriers block fish and other aquatic animals from moving up or downstream during certain months or the entire year. Unsurprisingly, most of them are on perennial Ashland and Neil Creeks (Map 13[33]). Diversion dams of various sizes and construction materials divert water from these perennial streams into pipes and ditches for irrigation. Although some diversion dams are completely or partially dismantled during fall and winter spawning season, others remain intact all year, and can make it difficult for adults to pass to upstream areas. Figures IX-31 - IX-33 show various kinds of irrigation diversion dams found in the Assessment area. Culverts are also barriers – often more insidious because they can be very expensive to replace. It is not unusual to spend $50,000 to replace an undersized culvert with one that can pass 100-year floods on a perennial stream. Figures IX-34 - IX-36 illustrate some of the different types of culvert problems found throughout the Assessment area.

Fish biologists have had to “rethink” fish access in recent years. In decades past, fish passage (e.g. notches in diversion dams or fish ladders over other structures) was designed to pass adult salmonids over the barriers during fall spawning runs. Little thought was given to juveniles, as it was assumed that they just needed to swim downstream when smolting. However, biologists have learned that this picture was too simple. Especially in southern Oregon, adults spawn not only in tributaries, but in the larger valley-bottom streams. Juveniles often move out of the tributaries and into the valley bottom streams, but then move back into the tributaries to escape warm temperatures or predators or find more food or better habitat. Even intermittent tributaries play crucial roles for both spawning and rearing of steelhead and coho (Everest 1973 and Wiginton 2006, respectively). Therefore, barriers need to pass juvenile fish during the summer months – a much more difficult task.

In addition, society’s focus has shifted from managing game fish to restoring stream ecosystems. Not only do barriers need to pass trout and salmon, but suckers, lamprey, and salamanders. Suckers migrate great distances to spawn upstream, and cannot jump over barriers like salmonids. Adult lamprey can use their mouths like a suction device to inch-worm their way up impossibly high, sheer walls, but have difficulty swimming against strong

[33] Note that identifying and locating migration barriers is an iterative process. Map 13 identifies most of the barriers within the Ashland Watershed Assessment area, but not all. The information illustrated in this map is continuously updated. If you have information on existing barriers not represented here, please contact the Bear Creek Watershed Council at: coordinator@bearcreek-watershed.org.

Figure IX-31: Concrete irrigation diversion in Neil Creek. Photo: Siskiyou Research Group, Sept. 2001 (SRG 2002a).

Figure IX-32: Three-foot high irrigation diversion structure on Ashland Creek just upstream of Nevada Street. Photo: Siskiyou Research Group, August 2000 (SRG 2001).

Figure IX-33: Irrigation diversion structure made out of boards, rocks, and plastic in lower Neil Creek along Hwy. 66. Photo: Siskiyou Research Group, September 2001 (SRG 2002a).

Figure IX-34: Ashland Creek passing under upper Granite Street. Photo: Siskiyou Research Group, Aug. 2000 (SRG 2001).


Figure IX-35: Culverts at Ashland's drinking water treatment plant. Photo: Siskiyou Research Group, Aug. 2000 (SRG 2001).


Figure IX-36: Neil Creek culvert blocked by granitic sand and debris, far upstream in T40s-R1e-Sec. 23. Photo: Ecosystems Northwest, September 1999 (ENW 2000).

currents at the top of a dam or within a fish ladder designed for salmon. Pacific giant salamanders have difficulty negotiating culverts on small, perennial headwater streams where these salamanders are common (Sagar 2004).

The Rogue Basin Coordinating Council has a barrier list for the entire Rogue Basin compiled in the 1990's from USFS, BLM, ODFW and watershed council data. ODFW also maintains its own barrier database. Neither of these contains a complete list of all barriers in and around Ashland. The Bear Creek Watershed Council also contracted Randy Frick, a consulting fish biologist, to analyze potential fish migration barriers. The first iteration of his analysis is illustrated in Map 13. The Bear Creek Watershed Council plans to work with local citizens and agency personnel to collect additional information, at which point, Frick's analysis and map will be updated.

As part of his initial analysis, Frick (2007) prioritized eight barriers in need of fish passage improvement for either Ashland or Neil Creeks. Although the priorities may shift slightly as additional barrier information is obtained, the Assessment team has included these proposed passage restoration projects in this document's Action Plan. Frick's (2007) top twenty-five barriers recommended for fish passage improvement included the eight below, listed from downstream to upstream.

Ashland Creek:

- TID Diversion, river mile 0.3
- Smith/Myer/Roper diversion, river mile 1.2
- Van Ness Street culvert, river mile 1.5
- Helman Ditch diversion, river mile 1.7 (Figure IX-32).

Neil Creek:

- East Side Ditch diversion, approximately river mile 4.0
- Reiten Drive culvert, river mile 4.4
- I-5 box culvert with worn baffles, river mile 5.4
- Old Hwy. 99 at Tari property (at this location, it is sometimes misnamed as "Neil Creek Road") box culvert with worn baffles, river mile 5.6

Riparian Buffers

Riparian buffers are essentially "protection zones" applied to the riparian area along each side of a creek. The width of a buffer as well as the regulations controlling land management activities within a buffer vary by ownership.

Federal land management agencies apply very wide buffers called "Riparian Reserves" to streams flowing through federal lands. The intent of Riparian Reserves is to manage these special areas to benefit streams and aquatic systems. Riparian Reserve widths and allowed activities are outlined in the Northwest Forest Plan's Aquatic Conservation Strategy Standards and Guidelines. For federal lands within the Ashland Assessment Area, the National Forest has followed Northwest Forest Plan and determined Riparian Reserves widths applicable to streams in the Ashland watershed (USFS 2003, Table IX-11).

Within the City of Ashland, private and City-owned lands must comply with the City's "Physical and Environmental Constraints" Ordinance[34]. This ordinance covers development in floodplains, riparian areas, and other special non-aquatic land categories. At the time of this document's publication, the City of Ashland is updating its policy, and may create a separate Water Resources Protection Ordinace providing development guidelines along streams and wetlands. Rather than detailing riparian buffer specifications that may soon be outdated, we refer readers to the City of Ashland website: http://www.ashland.or.us/index.asp. Please also see Chapter V, Riparian and Wetlands, for more information.

Forested private lands outside of City boundaries fall under jurisdiction of the Oregon Department of Forestry and the Oregon Forest Practices Act. The Oregon Forest Practices Act requires riparian buffers of varying widths, depending on the size of stream and whether "game fish[35]" are present (Map 12).

Table IX-11: Summary of Riparian Reserve Categories, Classification Rationale, and Riparian Reserve Widths for Forest Service Managed Portions of Upper Bear Analysis Area (USFS 2003).

Water Body	Riparian Reserve Category	Rationale	Designated Reserve Width (1)	Rationale
Streams	1	Fish-bearing streams	300 feet each side of stream	300 feet slope distance from edges of stream channel is greater than the distance equal to the height of two site-potential trees (292 ft.) the outer edges of 100-year floodplain, the top of the inner gorge, and the outer edges of riparian vegetation.
Streams	2	Permanently flowing nonfish-bearing streams	150 feet each side of stream	150 feet slope distance is greater than the distance equal to the height of one site-potential tree (146 ft.), the outer edges of 100-year floodplain, the top of the inner gorge, and the outer edges of riparian vegetation.
Ponds & wetlands	3	Constructed ponds, reservoirs, & wetlands >1 acre	150 feet from edge of riparian vegetation	150 feet slope distance is greater than one site potential tree height (146 ft.), the extent of seasonally saturated soil, and the outer edges of riparian vegetation.
Lakes & ponds	4	Lakes and natural ponds	300 fee from edge of riparian vegetation t	300 feet slope distance from edges of body of water is greater than the distance equal to height of two site-potential trees (292 ft.), the extent of seasonally saturated soil, the extent of unstable and potentially unstable areas, and the extent of riparian vegetation.
Streams	5	Seasonally flowing/ intermittent streams	150 feet each side of stream	The distance equal to the height of one site-potential tree (146 ft.) is greater than 100 feet slope distance, the extent of unstable and potentially unstable areas, the outer edge of riparian vegetation, and the top of the inner gorge; 150 feet is used for this analysis.
Wetland s	5	Wetlands <1 acre	0 feet	The wetland boundary is defined, in part, as the outer edge of riparian vegetation (hydrophytic), therefore the Riparian Reserve includes the wetland only.
Unstable Areas	5	Unstable & potentially unstable areas	0 feet	The riparian reserve includes the unstable areas only since a Riparian Reserve buffer is not required outside of the unstable areas.
(1) The determination of Riparian Reserve widths for the Siskiyou Zone of the RRNF is detailed in Forest White Paper Number 36, May 3, 1994.				

[34] See: http://www.ashland.or.us/PDF/ASNMAR00.pdf.

[35] Game fish are generally those fished recreationally, for example, cutthroat trout but not sculpin. Since cutthroat are always the species found highest in the stream systems of the Ashland Assessment area, the buffer designation does extend to the end of known fish use.

Oregon Department of Forestry stream classifications have recently been revised. The old definitions of "Class 1, 2, and 3" streams are no longer applicable. There are now three stream size classifications: small, medium and large. Size is determined by drainage area, average annual flow, and channel width (OFRI 2002). There are then three stream types (below). The combination of size and use designates each stream (Table IX-12).

Type F: Fish-bearing and may also be used for domestic water;
Type D: Used for domestic water but has no fish;
Type N: All others.

Table IX-12: Riparian Management Area buffer widths for forested lands under the jurisdiction of the Oregon Department of Forestry (OFRI 2002).

Stream Size	Type F (Fish)	Type D (Domestic Water)	Type N (Neither Fish nor Water)
Large	100 feet	70 feet	70 feet
Medium	70 feet	50 feet	50 feet
Small	50 feet	20 feet	Specific protection measures, but no buffer

A stream is considered "Type D" when domestic water is removed from the stream itself, not from wells near the stream. On Type D streams, buffers are applied to the channel upstream of the water intake point. Buffers are applied for ½ the distance from the water withdrawal to the drainage crest, or 3000 feet, whichever is shorter (B. Marcu, personal communication, 2007).

Readers interested in understanding regulations for conifer or hardwood harvest, snag and downed wood retention, wildlife protection, and replanting requirements, should refer to a well-illustrated booklet published for the "lay person," "Oregon's Forest Protection Laws" (OFRI 2002) or look online at: http://egov.oregon.gov/ODF/.

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CHAPTER X: EVALUATION OF WATERSHED CONDITION (SUMMARY)

The objective of this chapter is to help you, the reader, understand how past and current land and water uses are impacting stream environments in the Ashland Assessment area. We present our key findings in a table format so that a quick read will provide you with a comprehensive "snapshot" of current stream condition. We highlight important issues, and explain why we are hopeful that restoration of streams in and around the City of Ashland is possible.

How this Assessment Corresponds to Related Documents

There have been several other aquatic ecosystem assessments of the streams within our analysis area[1]. Our assessment is more detailed than some of them and less detailed than others. This assessment closely follows the OWEB Assessment Manual.

Bear Creek Watershed Total Maximum Daily Load & Water Quality Management Plan (DEQ 2007): This recent report by DEQ focuses in great detail on specific water quality issues. Our assessment covers many aspects of habitat condition and only briefly summarizes some of the water quality information from the TMDL.

Rogue Basin Watershed Health Factors Assessment (WHFA) (Bredikin et al. 2006): The WHFA team used easily-accessible Bear Creek information based on two representative streams in the project area (Ashland and Neil Creeks) to produce a very coarse assessment of stream condition. Our assessment analyzed almost all available information for just the streams in the Ashland Assessment area (only a portion of one of the watersheds in the Rogue Basin) and contains much more site-specific and species-specific detail.

Bear Creek Watershed Tributaries Assessment (Horton 2001): The assessment team gathered for this assessment coarsely analyzed stream condition for tributaries to Bear Creek throughout the entire Bear Creek basin. Little time was available for detailed analysis. Note that much of the stream condition information included in our assessment was not yet published when this initial WA was produced.

USFS' Watershed Analysis, Watershed Assessment, and Forest Resiliency Analysis (USFS 1995, 2003, 2005): By necessity, USFS documents provide great detail on USFS lands but only broadly discuss stream management on private lands. Our assessment focuses on the urban stream systems through Ashland as well as the rural residential streams nearby. We discuss stream condition on USFS lands, but do not delve deeply into the effects of USFS activities or wildfire on streams. Readers wanting detailed analyses of USFS activities or wildfire should refer to these USFS documents.

A Quick Guide to Stream Condition in the Ashland Assessment area

High-quality aquatic habitat (and "healthy" fish community): East and West Forks Ashland Creek, Neil Creek upstream of I-5 (i.e. U. S. Forest Service land). Note: of these, only Neil Creek is accessible to anadromous fishes.

Moderate-quality aquatic habitat (and moderate-size fish community): Neil Creek between Hwy. 66 and I-5, Ashland Creek between Granite Street

[1] Neil, Clayton, Tolman, Hamilton, Clay, Ashland, and Wrights Creeks, other small streams in between, and Bear Creek between Neil and Wrights Creek.

Reservoir and Hosler Dam, and fish-accessible downstream stretch of Clay Creek.

Low-quality habitat (but moderate-size fish community): Neil Creek between mouth and Hwy. 66.

Low-quality habitat (and depauperate fish community): Ashland Creek between mouth and Granite Street dam, and fish-accessible downstream stretch of Hamilton Creek.

Low-quality habitat (and naturally non-fish): Hamilton and Clay Creeks above natural barrier of Ashland terrace, Roca/Paradise Creeks and Beach Creek.

Fish-bearing streams without enough data to ascertain stream condition: Tolman, Clayton, and Wrights Creeks.

Key Findings

The key findings of the Ashland Watershed Assessment area are based on thousands of hours of work. These key findings are organized into the two tables below. Table X-1 presents key findings from Chapters II – VIII, and Table X-2 presents key findings from Chapter IX.

Table X-1: Summary of key findings organized by chapter of this document. "(+)" key findings are those that benefit aquatic ecosystems. "(–)" key findings are those that are detrimental to aquatic ecosystems. "(o)" key findings are those that are important but have neither a beneficial or detrimental effect.

Component	Key Finding (+)	Key Finding (–)	Key Finding (o)	Stream and Section
2 - History		Ashland Creek has been the site of development and water withdrawals since 1852		Ashland Creek below Granite Street dam.
2 - History		Housing and business development in active floodplain increasing		Bear Creek
2 - History		Streams channelized in 1960's for construction of I-5 and airport		Bear and Neil Creeks
2 - History		Bear Creek historically provided more spawning gravels and refuge from flows and warm temperatures		Bear Creek
2 - History	Salmon are resilient - despite harvesting zeal and habitat loss, they are still here			Bear Creek

Component	Key Finding (+)	Key Finding (–)	Key Finding (o)	Stream and Section
3 – Stream Channel Classification			Siskiyou mountains provide large amounts gravels, cobbles, sand to depositional valley-bottom streams like Neil, Bear.	All
3 – Stream Channel Classification			Stream location and gradient explains why not all streams support all species	All
3 – Stream Channel Classification		Incipient streams not protected, yet these streams control flood response of larger streams		All
4 – Hydrology and Water Use			Precipitation pattern and winter rain-on-snow events cause periodic large floods	All
4 – Hydrology and Water Use	TID system routes water through natural streams; probably extends summer flows in some streams	TID system routes water through natural streams; augmented flows often increases erosion problems		Roca/Paradise, Clay, Hamilton Wrights and Tolman Creeks
4 – Hydrology and Water Use		Lack of summer rainfall and high water demand for irrigation means streamflows can be unnaturally low		Neil, Ashland, and Bear Creeks
4 – Hydrology and Water Use		If climate change warms area, flooding could increase		All, especially Ashland and Neil Creeks
4 – Hydrology and Water Use		High % of drainage has impervious surface (in urban area), increasing flashiness of peak flows		Paradise/Roca, Hamilton, Clear, Mountain, and Beach Creeks

Component	Key Finding (+)	Key Finding (–)	Key Finding (o)	Stream and Section
4 – Hydrology and Water Use	Despite development, % impervious surface is low in some streams			Neil, Wrights, Clay, Clayton, and Tolman Creeks
5 - Riparian and Wetlands		Large wood and the potential for large wood recruitment almost non-existent		All except streams on USFS lands
5 - Riparian and Wetlands		Riparian areas reduced to very narrow strip; understory sparse or nonexistent		All except streams on USFS lands and Ashland Creek from Lithia Park entrance, upstream.
5 - Riparian and Wetlands	Shade on streams is high despite otherwise poor condition of riparian area			Ashland Creek and Neil Creek below I-5
5 - Riparian and Wetlands	Riparian condition excellent			East and West Forks Ashland Creek, Neil Ck. above I-5
5 - Riparian and Wetlands		Himalayan blackberries dominate understory		All except streams on USFS lands
5 - Riparian and Wetlands		No data		Tolman, and Clayton Creeks, urban streams, and Wrights Creek
6 - Sediment		>95% watershed analysis area composed of weak geological materials notorious for high erosion potential and landslides		All
6 - Sediment	Sediment production is also an important component of stream systems – without it, no spawning gravel	Sediment sources: human-triggered landslides, debris flows, and wildfires; roads, trails, and urban sediment	Sediment sources: “Mother Nature-triggered” landslides, debris flows, and wildfires	All

Component	Key Finding (+)	Key Finding (–)	Key Finding (o)	Stream and Section
6 - Sediment		Reeder Reservoir collects sediment after large floods; sluicing has deposited tons of fine granitic sand downstream. Dams also block natural downstream movement of spawning gravels.		Ashland Creek below Reeder Reservoir
7 – Channel Modification		Urban stream channels are highly modified: confined, and often piped		Ashland, Clay Roca/Paradise, Hamilton, and Beach Creeks
7 – Channel Modification		Streams through rural-residential areas confined by roads, berms, and other development		Bear, Tolman, Clayton, Wrights, and Neil Creeks
7 – Channel Modification	Lots of restoration opportunities on urban streams that will make a big difference			Ashland, Clay, Roca/Paradise, Hamilton, and Beach Creeks
8 - Water Quality		303(d)-listed for Temperature		Bear and Neil Creeks
8 - Water Quality		303(d)-listed for Bacteria (*E. coli*)		Ashland, Neil, and Bear Creeks
8 - Water Quality		303(d)-listed for sediment		Ashland below Reeder Res.
8 - Water Quality		Water entering and leaving Ashland wastewater treatment facility contribute to increased stream temperature		Ashland Creek near mouth
8 - Water Quality	High quality drinking water for City of Ashland			Ashland Creek
9 – Fish & Fish Habitat	Sculpin and steelhead appear to be numerous; cutthroat trout appear to be moderately successful.	Coho, sucker, fall chinook, and Pacific lamprey numbers appear low. Little data available on non-salmonids.		Bear, Clayton, Tolman, and Neil Creeks, Ashland below Granite Street dam, and the mouths of Hamilton, Clay, and others

Component	Key Finding (+)	Key Finding (–)	Key Finding (o)	Stream and Section
9 – Fish & Fish Habitat	Cutthroat and rainbow trout populations appear to be thriving	No data on sculpin or other native fishes on USFS lands.		East and West Fork Ashland Creeks; Neil Creek above Interstate-5
9 – Fish & Fish Habitat		Dams create migration barriers and water releases alter stream flows and water temperature		Bear Creek and Ashland Creek below Hosler Dam
9 – Fish & Fish Habitat		Chemicals typically found in stormwater draining directly into streams can cause serious problems for fish.		All, especially urban streams
9 – Fish & Fish Habitat	For habitat and aquatic biota information by stream, see Table 10-2, below.			

Table X-2: Summary of key findings in Chapter IX (Fish & Fish Habitat) by Stream. "(+)" key findings are those that benefit aquatic ecosystems. "(–)" key findings are those that are detrimental to aquatic ecosystems. "(o)" key findings are those that are important but have neither a beneficial or detrimental effect.

Stream	Key Finding (+)	Key Finding (–)	Key Finding (o)
Ashland Creek below Granite Street Dam	• Still has steelhead and even a few coho	• Granite Street Dam is anadromous barrier • Fish habitat extremely poor quality • Very little spawning or rearing habitat, no winter flow refuge. • Aquatic macro-invertebrate community extremely truncated (little food for fish) • Water temperatures too high near mouth • Fish barrier problems in section below No. Main • Unnaturally low summer flows. • Channel constricted through downtown; flooding not functional.	• Lithia Park section better than section between mouth and Winburn Way.

Ashland Creek between Granite Street Dam and Hosler Dam (Reeder Reservoir)	• Moderate fish population of resident cutthroat and rainbow trout	• Barriers to movement (at least partial) • Roads, trails, etc. add fine sediments. • Past reservoir sluicing left legacy of sand. • Fish habitat simplified due to removal of Large Woody Debris	
East and West Forks Ashland Creek	• Thriving fish populations • Excellent fish habitat despite lack of instream Large Wood • Macroinvertebrates extremely diverse and abundant; many rare taxa.	• Still low LWD	• Granitic watershed produces more fine sediments than is expected for non-granitic drainages.
Neil Creek from mouth to Hwy. 66	• Still many steelhead smolts • Shade	• Summer high temperature problems • Fish habitat very simplified; little spawning gravel; pool quality very low. • High amounts fine sediment embedded with silts and soil	
Neil Creek between Hwy. 66 and Interstate-5	• Moderately abundant numbers fish • Aquatic insect community still in good shape despite poor habitat conditions	• Low flow problems in summer. • Fish habitat moderately poor • Several migration barriers (at least partial barrier)	
Neil Creek above Interstate-5	• Healthy fish population, even above natural barriers • Great fish habitat		• High fines due to granitic geology means road crossings must be put in with care or become barrier
Tolman Creek	• Still has fish use • Coho found at mouth • Former barrier at 66 now fixed	• Not enough data	
Clayton Creek	• Still has fish use	• Not enough data	
Clay Creek	• Coho using downstream 1/8 mile	• Not enough data • Barrier near mouth blocks habitat • TID conduit	

Hamilton Creek	• Still has undeveloped sections • Fish use at mouth	• Not enough data • Stream piped underground in some places; surrounded by parking lots in others • TID conduit	
Wrights Creek	• Still has fish use in lower ½ mile	• Major barrier at Hwy. 99 • Not enough data otherwise	
Roca/Paradise Creeks	• Homeowner's Association working on stream restoration	• Not enough data • TID conduit	
Bear Creek	• Diverse native fish community • Opportunity for floodplain protection and side channel restoration • Riparian shade has improved • Potential to be important habitat for coho recovery	• Increasing and recent floodplain development • Emigrant flow releases affect flows and water temperatures • Access to tributaries often limited or blocked • Side channels and gravel bars severely reduced; channel simplified; no wood; few beaver. • Blackberries dominate riparian understory limiting food production • Ashland sewer line runs along stream • Oak Street possibly still not passable to all fish	

In the process of creating this document, the team found some gaps in our understanding of aquatic systems in the Assessment area. These "data gaps" are listed in Chapter XI. Much of the information needed will improve our ability to successfully accomplish the tasks outlined in the Action Plan. For example, a better understanding of how and when juvenile fish use tributaries would help the Bear Creek Watershed Council prioritize barrier removal or water temperature improvement on important tributaries. Additional data gaps have been identified that hinder the Council's ability to plan and prioritize additional projects.

From a quick review of the key findings, it is apparent that several important issues need to be addressed in order to restore or protect watershed resources:

- fish migration barriers, including Granite Street dam;
- access to good-quality tributary habitat to avoid mainstem high flows or high temperatures;
- restoration of channel complexity in fish-bearing streams;
- riparian area restoration (width, density, diversity);
- stormwater management and associated stream pollution;

- water and associated erosion management of urban streams;
- sediment management (large and small grain sizes); and
- citizen knowledge and engagement.

The Assessment team put together a list of potential projects designed to address these issues. These projects are included in Chapter XII, the "Action Plan." The Action Plan is not meant to be a complete list, but instead contains the project ideas most important and the most "doable" in the near future. As data gaps are filled, more project opportunities might present themselves; if so, the Bear Creek Watershed Council would update its Action Plan.

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CHAPTER XI: DATA GAPS

Several data gaps were noted during preparation of this watershed assessment due to access denial or limitation on field verification. Table XI-1 lists these as Field Verification Data Gaps. Confidence in the Watershed Condition Evaluation would be increased it the field verification data gaps had not developed. Perhaps review of this report will encourage landowners to allow access or volunteer to take on omitted tasks.

A second and much larger set of data gaps developed from questions that appear to need answers prior to Action Plan formulation; most require data collection and analysis. These monitoring projects, listed in Table XI-2, are considered short-term if they can be accomplished in a single season or year. Multi-year data collection and analysis may be needed to eliminate seasonal or annual variability in natural systems; these projects are considered long-term monitoring. In Table XI-2 short-term monitoring projects are listed before the long-term monitoring projects; all are grouped by watershed assessment component.

Table XI-1: Field Verification Data Gaps

03 Habitat Classification
Survey for location and extent of noxious weed species on public and private lands where landowners have an interest in coordinating control with public land managers.

Field verify current Greenway and Riparian Corridor wildfire fuel loads and fuel type to improve wildfire danger mapping.

04 Hydrology and Water Use
Field verify late summer flow in Neil Creek above I-5, below major irrigation diversions, and at mouth to protect aquatic life and water resources.

Field verify TID use of stream channels as corridors to route irrigation water from one location to another. Need information on water flow: cfs/when/where/why.

06 Sediment Sources
Locate and field verify legacy public roads, private roads and driveways, logging roads, haul roads that may erode and deliver sediment to streams.

Determine location and sediment impact of mountain bike and recreational vehicle near streams or water bodies.

09 Fish and Aquatic Wildlife

Determine fish use above recently removed/repaired passage barriers.

Gather information on fish passage (or lack thereof) across Oak Street fish ladder.

Identify where good fish habitat should be protected and where there are opportunities to create/ improve fish habitat.

List known mammal and bird species at appropriate watershed locations.

Table XI-2: Action Plan Data Gaps

03 Habitat Classification

Map extent of historic wildfires on Greenway and Riparian Corridors.

Determine how landowners can sustainably restore native plant communities.

04 Hydrology and Water Use

Inventory and monitor aquatic and riparian life in the urban streams. These activities would promote better stream management decisions as well as enrich the lives of area residents.

Gather raw precipitation data to determine rainfall intensity patterns. Identify locations in the city where storm water tends to accumulate and establish photo points or another way to monitor the highest water flow level during a storm. Associate the flow levels with the precipitation intensity data. Over time, a correlation can be developed and the adequacy of the storm drain system can be established.

Determine where increased in-stream flow may be needed to protect aquatic life and water resources.

Determine where existing consumptive water right, current water use, and Irrigation system changes may increase stream flow.

05 Riparian

Compare DEQ shade modeling with OWEB Stream Shade classification and Stream Walk canopy cover data for consensus input to riparian restoration Action Plans.

Establish permanent riparian photo-points for photo-monitoring structural and compositional vegetation change where private landowners have an interest in protecting and restoring riparian conditions.

Map and determine shade and riparian habitat for Tolman, and Clayton Creeks, urban streams, and Wrights Creek.

05 Wetlands

Establish permanent wetland photo-point for photo-monitoring structural and compositional change where private landowners have an interest in maintaining wetland conditions and functions.

06 Sediment Sources

Storm runoff has the potential to adversely affect water quality and should be monitored. The upcoming Storm Water Master plan should address this issue.

Locate and field verify legacy public roads, private roads and driveways, logging roads, haul roads that may erode and deliver sediment to streams.

Determine location and sediment impact of mountain bike and recreational vehicle use near streams or water bodies.

07 Channel Modifications

Monitor small streams flowing through the urban Ashland area that are adjusting to hydrological change imposed by urbanization. These changes are to be expected and should be monitored and managed to minimize detrimental impact such as excessive erosion and threats to property.

Locate channel modifications due to BOR and TID facilities, ODOT highway development, and CORP railroad right-of-way and determine impact on stream function and water quality.

08 Water Quality

Determine summer temperature of natural flow at mid-slope in creeks crossing Ashland terrace.

Monitor the amount of embeddedness in the East and West Fork of Ashland Creek above Reeder Reservoir as recommended in the Bear Creek TMDL and Water Quality Management plan.

Determine fecal coliform count in natural flow and commingled irrigation flow at mid-slope in creeks crossing Ashland terrace.

09 Fish and Aquatic Wildlife

Characterize aquatic macroinvertebrate community in upper Neil Creek (USFS land).

Conduct spawning surveys to determine location and duration of anadromous salmonid spawning throughout Assessment area.

Identify where good fish habitat should be protected and where there are opportunities to create/ improve fish habitat.

Assess quantity and quality of aquatic habitat (especially for fish) in Tolman, Clayton, and Wrights Creek.

Gather reach-specific distribution and abundance information (including spawning) on native fishes, especially Klamath small-scale suckers and Pacific lamprey.

Determine whether old structures in Ashland drinking water treatment plant are barriers to fish and amphibian movement.

Document and photograph all culverts, bridges, and irrigation diversions, including push-up dams, and other potential fish barriers especially to up-stream juvenile migration, and assess whether still used for intended purpose.

Determine the amount and seasonality of compounds known to be detrimental to fish health and survival strategies, e.g. copper, motor oil, herbicides, in Ashland and Bear Creeks, and small fishless streams that drain into Bear Creek.

Determine the seasonal movement of fish in and out of perennial and intermittent tributaries.

Survey for amphibian species presence on private lands and locate populations at risk from potential habitat loss or predation where landowners have an interest in protecting amphibians.

CHAPTER XII: ACTION PLAN

INTRODUCTION

We all live in a watershed and we affect it in some way every day through our personal actions. Doing the laundry, walking the dog, flushing the toilet or washing the car are some simple examples. Hopefully, by becoming more knowledgeable of our watershed, we will be able to make better personal decisions that will help keep our watershed functioning in the best possible manner. A "healthy" watershed will have well functioning aquatic habitat, good water quality, and stable stream channels with minimal flood damage.

Our collective actions also affect the watershed and they often require a collective effort to address them. This chapter addresses some specific concerns and proposed action items that were generated from residents, individuals in city government, and the assessment technical team. This document would like to encourage people to take voluntary action to improve aquatic habitats. Most of the proposed projects will require partnership and collaboration. Some projects will require licensed professionals to implement; others can be accomplished by citizen volunteers. Some of the action plans are specific to certain parties, such as individual land owners or the City. The following tables outline specific action, the parties who would be critical to project success, and where the specific project would be located. Also see Map 16 for potential action plan project locations.

While a key objective of these action items is on enhancing aquatic life and the associated habitats from the micro to the macro level (i.e. from nutrients to plants to aquatic insects to fish and birds) human residents will benefit at the same time while also meeting other goals related to water quality and hydrologic systems.

Management objectives to enrich stream habitat include:

- Encouraging channel complexity in order to improve aquatic habitat
- Improving stormwater management.
- Avoiding contamination by pollutants and excessive fine sediment, especially silt/topsoil.
- Encouraging riparian buffer enhancement.
- Providing refuge for fish and wildlife from adverse flow and temperature conditions elsewhere.
- Eliminating barriers preventing movement of fish and other aquatic species up and downstream.
- Maintaining and improving floodplain function.

POTENTIAL FUNDING SOURCES

The actions following in this chapter are diverse in the time and resources required as well as the problems they are designed to address. While the action items are a sort of "wish list", they are by no means beyond the abilities of the partners involved; however securing adequate funding may be difficult. Following are ideas for funding some of the action items, funding organizations and some of the projects that they tend to fund. The list is not complete. It is meant to give an idea of the options available. Numerous resources are available to research funding; a creative approach to funding may be helpful. Seek out local organizations such as the Bear Creek Watershed Council to assist in identifying funding sources. BCWC is in some cases available to take the lead on coordinating funding, partnering on projects as well as other aspects of project assistance and support. Other critical sources of support are "in kind" and donations from local sources.

Oregon Watershed Enhancement Board (OWEB) Funding

The Oregon Watershed Enhancement Board grant program encourages projects that foster interagency cooperation, include other sources of funding, provide for local stakeholder involvement, include youth and volunteers, and promote learning about watershed concepts.

There are four general categories of projects eligible for OWEB funding:

- On-the-ground watershed management (restoration and acquisition).
- Assessment and/or monitoring of natural resource conditions.
- Opportunities for learning about watershed concepts (education/outreach).
- Watershed council support.

Other Sources of Funding

The Farm Service Agency (FSA) Conservation Reserve Enhancement Program (CREP) is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water.

NOAA Fisheries Restoration Center is a community-based restoration program that partners with grassroots organizations to encourage hands-on citizen participation in restoration projects.

U.S. Fish and Wildlife Service natural resource assistance grants. A variety of grants are available to governmental, public and private organizations, groups and individuals.

Environmental Finance Center Network (EFCN) Directory of Watershed Resources - A searchable database of funding sources.

Environmental Protection Agency – pollution and stormwater issues

State

- **Oregon Dept. of Environmental Quality** – water quality issues
- **Oregon Watershed Enhancement Board** - habitat restoration and improvement, fish barrier removal, fish enhancement
- **Oregon Dept. of Fish & Wildlife** – irrigation fish screens, habitat improvement
- **Oregon Dept. of Transportation** – restoration as part of mitigation

Local

- **City and County Government** – in-kind contributions, funding
- **Schools and Community Groups** - in-kind contributions
- **Fishing associations** – fish and habitat enhancement

Private

- **Oregon Water Trust** – instream flow issues
- **National Fish and Wildlife Federation** – habitat improvement

Following are tables with action items grouped in general categories. Included is a brief description of the potential project, project objective, possible partners (not all inclusive), location, and a suggested priority ranking.

Note on project priority criteria: For these tables, priority was determined by "net overall benefit to the watershed." Other factors, such as ability to implement a project, cost etc. need to be part of the final prioritization and selection decision. Completion of any of these projects will be beneficial to the watershed, streams and associated aquatic life.

Table XII-1: Habitat & Floodplain Enhancement & Restoration Projects

Potential projects	Objective	Possible Partners	Location	Priority
Development & Implementation of Riparian & Wetland Ordinances	To protect & manage riparian and wetland habitats to benefit the city as a whole.	BCWC, City of Ashland	Citywide	High
Workshops – Urban Riparian Management (Annual event)[1]	To foster riparian stewardship through volunteer efforts.	BCWC, City of Ashland, OSU Extension, Jackson County, local gardening and fishing groups	Citywide	High
Create side channel habitat on Bear Cr.	Increase fish habitat in Bear Cr.	BCWC, City of Ashland, OWEB	North Mountain Park*, possibly Neil Creek (near airport)	High
Invasive plant removal	To remove invasive plants and replant with natives to improve riparian habitat.	BCWC, City of Ashland, OWEB, Bear Creek Greenway Committee, Landowners	Cooperating voluntary landowners sites Bear, Paradise, Roca, Clay, Wrights, & other Creeks.	High
Workshop - Invasive plant removal	To encourage & provide training in invasive plant identification, removal, & disposal.	BCWC, City of Ashland, OSU Extension, Jackson County, local gardening and fishing groups	Projectwide	
Riparian tree planting	To add shade to riparian areas increasing stream shading and improving habitat.	BCWC, City of Ashland, OWEB, OR DEQ	Projectwide	
Fish habitat improvement lower Clay Cr.	Remove fish barrier to increase & improve fish habitat.	Landowner, BCWC, City of Ashland, OWEB	lower Clay Cr.	

[1] Workshop complements the Riparian Ordinance.

Upper Roca Cr. stream & habitat improvement	Remove sediment, improve channel function, solve pond problem, remove invasive plants, replant w/natives.	Landowners, BCWC, City of Ashland, TID, OWEB	upper Roca Cr.	
Floodplain & channel improvement	Alter existing stream channels to improve function	Landowner, BCWC, City of Ashland, OWEB	Stream channels with historic stormwater problems –lower Clay, Hamilton	
Fish habitat improvement of tributaries	Improve fish access & habitat on tributaries near mouth	Landowner, BCWC, OWEB, fishing groups, business partners	Ashland, Clay, Hamilton, Cemetery, Neil Creeks near mouth. Also other creeks possibly.	
Stream bank improvement	Improve steam channel to reduce sediment & stormwater erosion impacts on property.	Landowner, BCWC, OWEB	See City of Ashland, Stormwater & Drainage Plan, 2000	
Riparian habitat improvement	Plant native plants on sites with turf & invasive plants or other areas lacking overstory. Widen existing riparian vegetation where possible and practical.	Landowner, BCWC, OWEB, business partners	Areas managed by Homeowner's associations, Hamilton Cr. at Albertson's Shopping Center, Hamilton Cr. at the Les Schwab Store, Ashland Creek on City land, Lithia Park, any other willing landowners, especially along Ashland Creek.	
Retain stream canopy cover	Retain large trees in existing areas	BCWC, City of Ashland, OWEB, ODEQ	Ashland, Bear, Hamilton, Neil Creeks	
Restore stream shade cover	Restore trees by planting in areas with low stream shade	BCWC, City of Ashland, OWEB, ODEQ	Ashland, Bear, Neil Creeks	
Daylight Creeks where desired & appropriate	To bring stream and riparian habitat to surface.	BCWC, City of Ashland, OWEB	Suitable sites to be determined. Data to be gathered.	

* Submitted by A. N. Maxwell, M. S. Thesis, in preparation.

Table XII-2: Stormwater Management Projects

Potential projects	Objective	Possible Partners	Location	Priority
Stormwater & sediment plan development	To manage & reduce the impacts of storm flows, pollution & sediment to local streams.	City of Ashland, OR DEQ, EPA, BCWC, others.	Citywide	High
Maintain existing stormwater management structures	Remove sediment from collection ponds on lower Roca Cr. and Neil Creek.	City of Ashland, ODOT (at Neil Cr.)	Roca Cr. below Wightman St.; constructed wetland/sediment trap at I-5.	High
Pond management workshop	Assist individuals & homeowner's associations in managing their ponds for improved hydrologic & habitat function.	BCWC, City of Ashland, OWEB, SWCD, OSU Extension	Citywide	High
Stormwater system improvement	Adjust storm drain capacity in several locations.	BCWC, City of Ashland, ODOT	Fox St., Hamilton, and Clay Cr. below Siskiyou,	High
Stormwater improvement structures	Reduce erosion, sediment, and pollution from runoff entering Billings Ranch pond.	Landowner, BCWC, City of Ashland, OWEB, OR DEQ	Billings Ranch pond area	
Replace North Main St. culvert with bridge.	Current culvert is a risk for failure in 100 year flood. Bridge with larger capacity would reduce flood risks associated with culvert blocking.	ODOT, City of Ashland, OWEB, BCWC	Ashland Creek at North Main St.	

Table XII-3: Fish Barrier Projects

Potential projects	Objective	Possible Partners	Location	Priority
Ashland Creek/TID diversion structure.	Improve fish passage.	City of Ashland, TID, EPA, BCWC, OWEB, BOR, private landowners.	Ashland Creek at stream mile 0.3	High
Neil Creek Reitan Drive box culvert	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, Jackson County.	Neil Creek at stream mile 4.4 Map 16 □1	
Neil Creek Interstate 5 box culvert (restore baffles)	Improve fish passage.	City of Ashland, EPA, ODOT, BCWC, OWEB, private landowners.	Neil Creek at stream mile 5.4 Map 16 □2	
Neil Creek Old 99/Tari's box culvert (restore baffles)	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, private landowners.	Neil Creek at stream mile 5.6 Map 16 □3	
Ashland Creek Smith/Myer/Roper diversion	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, private landowners.	Ashland Creek at stream mile 1.2	
Ashland Creek Van Ness diversion	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, private landowners.	Ashland Creek at stream mile 1.5	
Ashland Creek Helman diversion	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, private landowners.	Ashland Creek at stream mile 1.7	
Neil Creek East Side diversion ditch	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB, private landowners.	Neil Creek at stream mile 4.0	
Fish screens on TID turnouts to natural creeks.	Prevent fish entering irrigation system.	ODFW, TID, BCWC, private landowners.	Projectwide	
Evaluate possibilities of improving fish passage at Oak St. dam/fish ladder.	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB.	Ashland Creek at Oak St.	
Discuss possibilities of removing Granite St. dam on Ashland Cr.	Improve fish passage.	City of Ashland, EPA, BCWC, OWEB.	Ashland Creek at Granite St. Dam	

Table XII-4: Stream Flow Projects

Potential projects	Objective	Possible Partners	Location	Priority
Restore a minimum of 2 cfs in Neil Creek in late summer (through conservation and other changes in water usage).	Increase stream flow.	Oregon Water Trust, TID, BCWC, private landowners.	Neil Creek	High
Convert unused or underused water rights to instream use.	Increase stream flow.	Oregon Water Trust, TID, BCWC, private landowners.	Projectwide, Neil and Wrights Creek specifically	
Work with TID to redesign system to reduce erosion in urban "conduit" streams.	Reduce erosion in "conduit streams".	TID, BCWC, private landowners.	Projectwide	

Table XII-5: Sediment/Pollutants/Erosion Control Projects

Potential projects	Objective	Possible Partners	Location	Priority
Continue to develop & implement City of Ashland Stormwater and Drainage Plan.	Reduce sediment & pollutants in streams.	City of Ashland, EPA, BCWC, OWEB, citizens.	Project wide	High
Encourage & implement sediment reduction methods.	Reduce sediment & pollutants in streams.	City of Ashland, EPA, BCWC, OWEB, Jackson County, private landowners.	Project wide	High
Establish storm watch program.	Educate & involve citizens. Reduce sediment & pollutants in streams.	City of Ashland, EPA, BCWC, OWEB, Jackson County, citizens.	Project wide	High
Coordinate citizens groups to restore trail system.	Educate & involve citizens. Improve local recreation. Reduce sediment & pollutants in streams.	City of Ashland, EPA, BCWC, OWEB, Jackson County, citizens, USFS.	Project wide	High
Inventory of erosion problems		City, BCWC, Jackson County, USFS, and other groups		High

Table XII-6: Education & Outreach Projects

Potential projects	Objective	Possible Partners	Location	Priority
Fish & watershed education booth at the children's wading pool, Lithia Park, on July 4 when many people are in the creek wading and catching juvenile fish.	Watershed education. Preserve fish.	BCWC	Lithia Park	High
Fish Friendly Landscaping/Best Management Practices Workshop to control weeds and insects and improve water quality.	Reduce water usage and stream contaminants associated with landscape applications and management.	Professional & home landscapers and gardeners, OSU Master Gardeners, BCWC, City of Ashland, RVCOG.	Projectwide	High
Provide signage for named streams at street and road crossings.	Increase watershed awareness.	BCWC, City of Ashland, Jackson County.	Projectwide	High
Create a forum for people who are impacted by stream and stormwater issues. This is an opportunity to collaborate with people who face similar challenges. The Bear Creek Watershed Council has a website with forum capability. Residents see need for assistance in communication re. problems, solutions, and issues affecting specific creeks.	Provide a communication & organizing vehicle to assist creek side landowners in collaborating and solving common problems.	BCWC, citizens, City of Ashland, homeowner's associations.	Web-based	High
Workshops on eradication of invasive plants and effective techniques.	Educate landowners on management techniques.	City of Ashland, landowners, BCWC, RVCOG.	Projectwide	High
Continue group collaboration to encourage exploration of nature in our own backyard. Education materials distributed via program implementation. Continue public education using events and media to raise awareness of watershed issues such as stormwater, habitat preservation and restoration.	Watershed education.	BCWC, citizens, City of Ashland, local/regional environmental education organizations, schools, community education groups.	Projectwide	

Collaboration project to produce and distribute educational materials recommending proper use and disposal of everyday products with toxic components and reducing their presence in waterways.	Reducing contaminants in streams.	City of Ashland, local retailers, BCWC, RVCOG.	Projectwide	
Tour of sites where landowners have managed stream channel to protect property and improve habitat and/or use unique water conservation techniques.	Educate landowners on management techniques.	City of Ashland, landowners, BCWC, RVCOG.	Projectwide	
Create and distribute regional guide to assist in choosing and maintaining native and naturalistic plants for riparian areas.	Improve riparian areas.	Professional & home landscapers and gardeners, OSU Master Gardeners, BCWC, City of Ashland, RVCOG.	Projectwide	
Tour of properties utilizing unique water conservation techniques such as, low flow irrigation, xeriscaping, and water catchment systems.	Conservation education	Property owners, BCWC, City of Ashland, RVCOG.	Projectwide	
Provide signage cautioning people to leave fish in Ashland Creek.	Increase watershed awareness.	BCWC, City of Ashland.	Projectwide	
Partner with Bear Creek Greenway to sign/educate about hydrologic systems, invasive weeds, and floodplain features along path.	Increase watershed awareness.	BCWC, City of Ashland, Bear Creek Greenway Committee	Projectwide	

ACTION PLAN TOPICS

HABITAT & FLOODPLAIN ENHANCEMENT & RESTORATION

Concerns:

1. Desire to implement City Riparian Ordinance.
2. Invasive plants.
3. Protect and manage streams systems to function to their full potential as hydrologic and ecologic resources.
4. Interest in improving and protecting aquatic and riparian habitat, especially for fish and wildlife.
5. Maintain high water quality. Fertilizer, chemicals and paints products, road runoff contamination.
6. Interest in bringing piped streams to surface.

Recommendations:

1. Assist the City of Ashland in developing and implementing an appropriate ordinance. Complement this effort with an annual "Riparian Management" workshop. Put in place an enforceable and meaningful wetland and riparian ordinance including sufficient setbacks and providing for maintenance of a functioning riparian area to improve the hydrologic function of the many stream miles within the city limits. Just like the city has addressed fire, the same can be done for hydrologic issues, flooding, sediment, and debris flows. Neglected hydrologic issues can result in catastrophic events. A goal should be to reduce and buffer these effects on human life, property, and the city infrastructure. Addressing these risks will reduce costs associated with repairs, maintenance, and damage. Some residents may need to more clearly understand the goals of an ordinance promoting and preserving stream function and its benefit to residents and property. Topics to address in the ordinance should be: reducing the removal of riparian vegetation and habitat and reducing development in functioning hydrologic areas such as floodplains. Surface water, groundwater, and sediment need to have a way to move down slope while minimally impacting property owners. Creating and encouraging floodplains and wetlands will allow them to function as hydrologic buffers. Continue to accurately document historic areas of flooding for City of Ashland and encourage city to eliminate floodplain development. There are historic areas of flooding where the city and county are permitting development.

2. Encourage riparian buffer development and enhancement especially alternatives to blackberries - see new guide *Riparian Tree Planting in SW Oregon* extension.oregonstate.edu/catalog/pdf/em/em8893-e.pdf Promoting native plants and habitat friendly design and maintenance will decrease owner expense from damage and maintenance in the long run.

Many creatures will try to adapt to the urban environment, some successfully. Residents should watch for wildlife and look for opportunities to assist.

3. Treat small streams like Paradise and Roca as functional stream habitats, even though much of their flow in the summer may be irrigation water. These waterbodies function as streams to the city residents, create a natural environment, and should not be treated as ditches.

4. Bear Creek Watershed Council to work with TID and the City of Ashland to better understand TID water management in and around Ashland. Provide non-proprietary flow information to interested residents (e.g. interactive website). Explore opportunities to improve water management in the city to benefit streams while continuing to meet irrigation needs.

5. Carefully consider the floodplain map in use and do not allow development in areas with historic flood risk; reduce risk where possible.

6. Explore possibility of "daylighting" piped streams through the City of Ashland (e.g. Paradise Creek near Walker School). Objectives for bringing streams back to surface need to be determined as well as benefits and problems.

7. Explore developing a thermal credit program with the City of Ashland and Oregon Dept. of Environmental Quality. Currently, the city water treatment plant is in compliance with all DEQ water quality standards except temperature. There exists the possibility of having the city reduce its thermal impact on Bear Creek by increasing shade in riparian areas and increasing stream setbacks to allow a healthy tree canopy. Various possible solutions exist to work towards meeting the Oregon DEQ Total Maximum Daily Load standards using the Bear Creek Water Quality Management Plan.

8. Encourage partnerships between city and landowners to solve floodplain issues. Examples could include land swaps trading city owned land out of floodplains with high risk floodplain property owned by private parties, reductions in sewer or utility fees for implementation of stormwater management techniques. Win/win solutions can allow landowners to do the right thing and still make viable economic decisions.

9. Work with the Ashland Planning Commission to assure "watershed friendly" land use decisions.

<u>Site specific recommendations:</u>

1. Improve coho refuge habitat in lower Clay Creek near Bear Creek confluence. Improvements include: remove fish barrier - double culvert (PVC pipes) under access road for City of Ashland sewer line; ensuring access to sewer; removing blackberries; and planting native vegetation. (Property owner requested project and City of Ashland has project marked

for review.) This site is a fish barrier and its removal would allow small juvenile fish access to intermittent streams and off stream habitat. Current site has erosion problem: culverts not appropriate solution for crossing creek; access road threatened with damage or loss – alternative access must be designed. See Figure XII-2 and XII-3, Map 16, Action Plan Sites, Δ 1.

2. Residents of the Upper Roca Cr. area between Prospect & Emma St have concerns regarding their shared creek habitat including sediment accumulation, undercutting of the stream bank, blackberries and other invasive plants. Sediment is collecting in a constructed pool/pond in the stream channel resulting in flooding due to lack of sufficient floodplain. There is a need to allow sediment to travel through or be removed from site. The site is not accessible to heavy equipment. Perhaps a solution can be worked out with homeowners, TID, and city to partner to remove sediment since channel provides critical functions for the three parties. Solution may require removing pond and restoring more natural channel in Roca Creek. Would require working with TID to define and meet specific flow objectives. These property owners are in need of planning and technical assistance with habitat restoration. The homeowner's association responsible for the site is motivated and organized to address concerns and looking for financial and technical assistance. See Figure XII-1, Map 16, Action Plan Sites, Δ 2.

3. Remove undersized culvert on Clay Creek in Clay Creek Park. Culvert plugs and overflows access road to adjacent property. See Figure XII-4,

Figure XII-1: Upper Roca Creek constructed pond site needing sediment removal, weed eradication (Yellow Flag).

Photo XII-2: Clay Creek near Bear Creek at potential project site. See Map 16, Action Plan Sites, ∆ 1.

Photo XII-3: Clay Creek at potential project site, view from access road over PVC pipes in photo XII-2. Note same pipe gate and post in both photos.

Figure XII-4: Clay Creek at Clay Creek Park. Culvert under path blocked.

4. In general – look for sites for development of floodplain, channel complexity, and side channel habitat areas. Analyze hydrologic and hydraulic aspects of stormwater i.e. what does the water do on and to the land and through the pipes used to move it. Develop tools relating bankfull channel width to basin area to make rough determinations of the areas which should be dedicated to flood event impacts. Potential sites include Neil, Clay, Hamilton, and Cemetery Creeks all downstream of Siskiyou Blvd. with historic flood and stormwater problems. See Map 16, Action Plan Sites, ∆ 3A, 3B, 3C, 3D.

5. Where feasible, improve habitat especially at the mouth of Wrights, Ashland, Clay, and Neil Creeks which generally have cool water and better fish habitat. Fish in Bear Creek can then seek out and utilize calmer flows and cooler temps of tributaries. See Map 16, Action Plan Sites, ∆ 4A, 4B, 4C, 4D.

6. Work with property owners interested in blackberry and other invasive plant eradication. Several individuals on Wrights, Bear, Paradise, Roca, Beach, and Clay have stepped forward. The goal is to begin riparian restoration in several neighborhoods.

7. Work with residents to resolve site-specific bank erosion problems, e.g. a location on lower Roca. Some of these erosion issues may be the result of urban stream manipulation or water management and may require cooperation from many partners to resolve. See Map 16, Action Plan Site, ∆ 5.

8. Improve riparian and floodplain habitat in channelized areas near commercial development. For example,– Hamilton Cr. at Albertson's Shopping Center on Ashland St. and Hamilton Cr. at the Les Schwab Store on Ashland St. Consider redesigning to give the stream more room in stepped design, similar to Guanajuato Way, with additional riparian plantings. See Map 16, Action Plan Sites, ∆ 6A, 6B.

9. Explore potential to improve riparian and floodplain habitat in channelized areas near wastewater treatment plant and Ashland City airport.

10. Restore channel complexity and create side channel habitat where possible to increase fish habitat and floodwater dissipation areas on city owned property and encourage development of side channel habitat on private land by assisting with incentives and technical support when possible. Possible locations for side channel habitat are Bear Creek at North Mountain Park (Aaron Maxwell, personal communication, see Map 16, Action Plan Sites, ∆ 7) and Ashland Creek at the proposed Ashland Creek Park. Also - analyze remaining floodplain along Bear Creek and along tributaries for possible side channel habitat areas/complexity. The ultimate goal would be to restore some of the original channel complexity.

11. Evaluate Bear Creek bridges at Oak Street and North Mountain Avenue to determine if the bridges are restricting streamflow, as well of the feasibility and appropriateness of any improvements.

12. Discuss, with appropriate parties, the feasibility of retaining Large Woody Debris in Ashland and Bear Creeks, and if not, possible solutions such as securing wood which can move in high water.

13. Retain shade on sections of creek which still have large trees and sufficient canopy.
    a. Ashland Creek from Reeder Reservoir to mouth
    b. Bear Creek with Conservation Easement
    c. Hamilton Creek with Conservation Easement
    d. Neil Creek from Interstate-5 to Dead Indian Memorial Road

14. Restore historic shade on streams with very little canopy by planting trees.
    a. Ashland Creek at Calle Guanajuato
    b. Bear Creek from Interstate 5 to Oak Street
    c. Neil Creek from Airport to East Main Street

WATER QUALITY AND QUANTITY

Stormwater management

Concerns:

- Stormwater system maintenance, debris plugs and undersize culverts in city and county road systems.

- Flood risk and debris flow hazards. Concern city is not using an accurate floodplain map.

- Increase pervious surfaces and reduce impervious surfaces in developed areas to reduce runoff and increase absorption and groundwater recharge.

Recommend:

Assist the City of Ashland in its development and implementation of a stormwater, drainage, and sediment plan to address current and potential hydrologic and hydraulic stormwater related problems and integrate it into city planning and ongoing management and maintenance activities. Previous plans have been completed, but it appears that little has been implemented. Implementation needs to be given a higher priority.

Analysis tools needed -

- Obtain raw precipitation data to determine neighborhood or subwatershed rainfall intensity patterns.
- Identify locations in the city where stormwater related problems occur as cited in 2000 Stormwater and Drainage Master Plan and in other locations.
- Establish photo points or some other way to monitor the highest water level of the storm.
- Associate the flow levels with the precipitation intensity data.

Over time, a correlation can be developed and the adequacy of the storm drain system can be established. This action item is an opportunity to involve citizens in data collection and monitoring.

Site specific issues and concerns:

1. Fox St. near 908 Fox small storm drain box is insufficient to handle storms. Two 8" pipes enter box, but only one 6" pipe leaves. See Map 16, Action Plan Sites, ○1.

2. Around Fox St. and Wrights Creek Drive intersection, channel is entrenched though creek stayed within channel during ’97 flood. See Map 16, Action Plan Sites, ○1.

3. Hamilton/Clay Cr. below Siskiyou. As evidenced in storms of ’74 & ’97, current culverts are undersized. This area appears to be in need of on-site detention ponds. Improvement and increase in habitat and development of a floodplain will allow controlled and confined space for floodwaters to expand as necessary. The flashiness of the creek needs to be addressed to reduce associated problems such as high flows which scour to cobble, and then quickly drop resulting in large amounts of fine sediments left in bed. Improving sediment transport, keeping the right size material moving through stream system would benefit stream system and reduce damage. See Map 16, Action Plan Sites, ○2A, ○2B.

4. Storm water runoff site on Billings Ranch drains area above North Main St. around hospital etc. Storm water enters Billings’ property near new subdivision creating erosion problems. Excessive storm drain flows above Billings’ pond are increasing sediment, weeds, and erosion. See Map 16, Action Plan Sites, ○3.

5. It is critical that City public works and other responsible entities record the history of the projects and perform required maintenance to make the systems functional. For example: Roca Cr. wetland below Wightman needs sediment removed regularly to function properly. It is necessary for the City of Ashland staff to work with the county to share information on common stormwater problems e.g. County culvert on W. Fork Hamilton Cr. (under Tolman Cr. Rd. approx 1200 block) needs regular maintenance to prevent plugs during storm events. The City of Ashland has a complex network of gutters, ditches and culverts that drain small catchments throughout the city. These artificial features require regular inspection and maintenance.

6. Improve private pond management by hosting informational and technical assistance workshop. Several ponds are managed by homeowner’s associations. The privately owned pond areas need to be managed for flow and sediment to maintain their functionality and role in the hydrologic system. Ponds can provide habitat as well as storage for stormwater if they are regulated and maintained. Homeowner’s associations can play an important role in the management of their properties which are often unbuildable areas along riparian and wetland habitats.

7. On Ashland Creek, north of Plaza, replace North Main St. culvert with bridge that can pass a 100 year flood or at least as much as the Winburn Way bridge can pass. Historically, this section of Ashland Creek has been prone to high degree of property damage in past floods. Current culvert is a risk for failure in 100 year flood. Bridge with larger capacity would reduce flood risks associated with culvert blocking. This is an Oregon Dept. of Transportation responsibility. See Map 16, Action Plan Sites, ○4.

Stream flow

Concerns:

1. Low late season flow in Neil Creek, Wrights Creek.

2. Address impact of development on natural stream flow, hydrologic systems.

3. Address lack of irrigation water.

4. Convert unused irrigation rights to instream flow for fish use.

Recommend:

1. Restore a minimum of 2 cfs in Neil Creek in late summer. Would require partnership with voluntary irrigators re. their rights and usage.

2. Enlist Oregon Water Trust (OWT) to educate and work with landowners to convert any unused irrigation rights to instream/fish use. Perhaps a group of landowners who use the TID water have more than enough. Find ways homeowners can reduce water use in their yard (drip, etc.) and work with OWT. Perhaps unused water right could rotate among landowners or a portion of an individuals' rights could be collectively leased to stay instream. Are there individuals or entities who have unused water rights which could remain instream? What other ways can water be kept instream?

3. Work with TID to redesign irrigation system to reduce erosion problems in urban "conduit" streams. This might include piping systems or other expensive infrastructure but would eliminate the use of some creeks as ditches and reduce/eliminate summer flow.

Sediment/Pollutants/ Erosion Control Issues

Concerns:

1. Reduce ability of herbicides/pesticides to enter stream system.

2. Address bacteria inputs from flood irrigation runoff and other sources. Investigate possible mitigation by altering manure management and irrigation systems.

3. Consider detention ponds and bio-swales for stormwater mitigation.

4. Reduce runoff from parking lots, roads, and highways into stream system.

5. Address stream bank instability, downcutting.

6. Address erosion on unpaved roads.

7. Technical and financial assistance for property owners re: erosion control techniques.

Recommendations:

1. Encourage sediment reduction methods such as the reduction of impermeable surfaces, incorporating bioswales and other structures to catch stormwater, sediment, and filter pollutants, installation of rainwater catchment systems. Provide incentives such as credits, variances or other methods or direct regulation through city planning ordinances. These actions should identified in the Stormwater Plan.

2. Engage the public to help public works find trouble spots before the storm. Establish rural and urban storm watch volunteers to patrol roads and identify culvert and ditch problems. Community groups and volunteers can assist agencies with their road drainage maintenance programs. Motivate citizens to assist land managers to benefit the watershed.

3. Help coordinate the Mountain Bike Association, scouts, and schools to work with USFS to restore, renovate, and revegate heavily-used and fragile roads and trails eroding granitic sand into streams. The assessment area has a system of mountain roads and the ditches associated with these roads are particularly critical. The steeper slopes give the surface water high energy and erosion potential and the steeper slopes are more susceptible to slope failure. There is a need to identify and inventory wet trail crossings locations & construct small trail bridges / walkways at stream crossings and wet areas.

4. Continue to develop and implement City of Ashland Stormwater and Drainage Plan. Storm drains are a source of sediment and pollution which gets into creeks. Work with City to explore whether the “worst” drains flow into the treatment plant? Or, can small “treatment areas”, bioswales, or retention ponds be built at the outflow of these drains? Can city offer reduction in utility or other fees in exchange for implementation of stormwater management techniques on private property? Continue with stormwater education efforts through schools and parks department.

5. Suggest city and private groups and individuals lobby Congress to increase the USFS road maintenance budget – especially for areas flowing into city water sources. A strong argument can be made that if these roads are to be kept, then they need to be maintained.

Site specific recommendations:

1. Resolve debris flow @ Neil Creek box culvert by road outslope & relief culvert. Put outslope on Old Highway 99, provide relief culvert for high flows.

2. Rebuild failing road prism in Sec. 31, 38-1East (above Butler Ford). See Figure XII-5.

3. Reduce sediment eroded from confined livestock operations and TID lateral. Look for funding from National Resource Conservation Service (NRCS), and Jackson County Soil and Water Conservation Service (SWCS). Tolman Cr. has some specific sites with an opportunity for riparian fencing and off site watering. Sediment eroded from confined livestock operations needs technical advice and help.

4. Continue to sample Ashland Creek for fecal coliform to find if water is safe for contact in Lithia Park. Currently, Rogue Valley Council of Governments performs stream water bacteria sampling. Problem areas can be determined by increased sampling along stream sections.

5. Test Neil Creek for fecal coliform to find if water is safe above Hwy. 66.

6. Research whether ODOT use of magnesium chloride de-icer on I-5 adversely affect fish in Neil Creek.

7. Monitor and reduce sediment from quarries above Lithia Park in Ashland Creek watershed and Tolman and Hamilton Creek watersheds.

8. The watershed would benefit from an inventory of erosion problems to prioritize and assess sites where road damage and erosion is occurring. Project partners could include the City, BCWC, Jackson County, USFS, and other groups. Special attention needs to be paid to Ashland's many unpaved roads and alleys. Volunteer storm monitors/road walkers could be involved in finding trouble spots.

Figure XII-5: Failing road prism in Sec. 31, 38-1East (above Butler Ford).

Temperature

Objective:

Reduce stream temperatures during summer.

Recommendations:

1. Reduce temperature of water entering Ashland Creek from Ashland Wastewater Treatment Plant.

2. Increase riparian tree planting.

FISH BARRIERS

There are over 40 barriers to fish movement in the Ashland Watershed Assessment area. The barriers detailed below and on Table XII-3 are some which perhaps deserve higher priority because the potential for success being greater and/or the benefit greater. See Chapter IX and Map 13 for further information on Fish Barriers.

Objective:

To allow native fish of all age classes to access stream habitat in both perennial and intermittent streams.

Recommendations:

1. Work with TID and ODFW to install fish screens on TID turnouts to natural creeks.

2. Eliminate push-up/board and plastic irrigation dams in Neil Creek below 66 and other locations as feasible.

3. Work with TID and other partners to remove fish barriers on Ashland Creek:
   a. @ TID diversion structure
   b. @ Smith/Myer/Roper diversion
   c. @ Van Ness diversion
   d. @ Helman pushup diversion

4. Work with various partners to remove fish barriers on Neil Creek. Also work with ODOT to improve fish passage through I-5 culvert.
   a. @ Reiten Drive box culvert (Map 16 □1)
   b. @ Interstate 5 box culvert: restore baffles (Map 16 □2)
   c. @ Tari's box culvert: restore baffles (Map 16 □3)
   d. @ East Side Diversion ditch

5. Begin conversation with City of Ashland about removing fish barrier at Granite Street dam on Ashland Creek to open up potential habitat up to Hosler Dam.

6. Get technical assistance to redesign Oak Street dam and fish ladder on Bear Creek to improve fish passage.

Figure XII-6: Fish barrier on Ashland Creek at Smith/Meyer/Roper diversion, August 2007.

EDUCATION AND OUTREACH

Objective:

Public education on landscape, watershed management, and wildlife issues to remind people of their stewardship responsibilities and opportunities.

The education recommendations are an opportunity for partnering with the Ashland Parks and Recreation Dept. and local schools and organizations. Some of these recommendations have been in use, particularly by the North Mountain Park Nature Center, but more funding and support could bring more information to those who can use it. Homeowners associations could be targeted. General information is readily available; the need is to get it to sites in the assessment area where people could improve their stream systems.

Many landowners have concern over invasive plants, but they need information, tools, and strategies for identifying and eradicating them and a maintenance plan for the long term management to control invasive plants and improve hydrologic systems.

Recommend:

1. Bear Creek Watershed Council sponsor a fish education booth at the Children's wading pool, Lithia Park, on July 4 when many people are in the creek wading and catching juvenile steelhead and possibly coho.

2. Fish Friendly Landscaping/Best Management Practices Workshop to control weeds and insects and improve water quality. Invite professional and home landscapers and gardeners, partner with OSU Master Gardeners and others. Goal to increase use of natives plants, reduce use of water, and chemicals.

3. Provide signage for named streams at street and road crossings.

4. Create a forum for people who are impacted by stream and stormwater issues with a communication/organizing vehicle to assist creek side landowners in collaborating and solving shared problems. Communication vehicle to include news about what's going on in one's local creek; practical information and sharing of experience. Residents would like notification of upstream development plans. This is an opportunity to collaborate with people who face similar challenges. Bear Creek Watershed Council forum software is available to be used by interested individuals and groups. The Bear Creek Watershed Council has a website with forum capability to allow a thread for each creek, maps, and information for landowners to exchange ideas online. Residents see need for assistance in communication re. issues, problems, and solutions affecting creeks in Ashland. Collaboration between the city, private individuals, and homeowner's associations, and BCWC could facilitate improvements.

5. Host workshop on safe eradication of invasive plants and effective techniques.

6. Continued group collaboration to encourage exploration of wetland wonders & nature in our own backyard. Partners could produce guide of local sites. Continue public education using program delivery, events, and media to raise awareness of watershed issues such as stormwater, habitat preservation and restoration.

7. Initiate group collaboration project to produce and distribute educational materials recommending proper use and disposal of everyday products with toxic components (e.g. paint, household herbicides, and batteries) and reducing their presence in waterways. Distribute at retail outlets, paint stores: wherever products are sold. Work with City Stormwater/Non-point Source management program.

8. Arrange and publicize tours of sites where landowners have managed a stream channel to protect property and improve habitat.

9. Create and distribute website or booklet information on choosing and maintaining native and naturalistic plants for riparian areas. Create guide with local examples and photos of a healthy riparian area – including different design options but focusing on habitat and hydrologic improvement. Include information specific to the region. RVCOG has several regional oriented brochures which could work.

10. Tour of properties utilizing unique water conservation techniques such as, irrigation techniques and water catchment systems.

11. Provide signage cautioning people to leave fish in Ashland Creek.

12. Partner with Bear Creek Greenway Committee to sign/educate about hydrologic systems, invasive weeds, and floodplain features along Greenway path.

MONITORING

Monitoring is an important component for all on–the-ground projects. On-the-ground projects should be monitored for completion and meeting project goals and objectives. Data collection is also needed to fill data gaps (see Chapter XI).

Objective:

To obtain useful data to improve our understanding of watershed function and condition. Provisions should be made for appropriate analysis, storage, and retrieval of the data, perhaps using Rogue MAP.

Recommendations:

1. Fill in data gaps as related to potential project sites regarding fish and wildlife presence, riparian condition including vegetation and shade, water quality. Use trained volunteers in a Streamwalk, Roadwalk, Stormwatch program.

2. Obtain raw precipitation data to determine rainfall intensity patterns.

3. Identify locations in the city where stormwater related problems occur using 2000 Stormwater and Drainage Plan or other resources.

4. Establish photo points or some other way to monitor the highest water level of the storm, riparian vegetation, stream channel changes, and bank erosion.

5. Establish rural and urban storm watch volunteers to patrol roads and identify culvert and ditch problems.

6. Perform an inventory of erosion problems to prioritize and assess sites where road damage and erosion is occurring.

7. Water quality testing for project monitoring and to increase public awareness. Partner with community and recreation groups and schools, citizens, volunteers, homeowners assoc. Monitor stormwater runoff including water quality, turbidity, bacteria, toxins and contaminants. Make a list of water quality monitoring opportunities especially for students as

well as monitoring strategies and resources. Will require a trained individual to maintain data quality.

8. Record channel condition photo points. Annually photograph same point on same date. Look at specific sites where channel modification may be happening. Develop and establish list of potential sites, perhaps a couple on every stream and set up a monitoring plan to establish who will be responsible for doing monitoring. Good opportunity for volunteers.

9. Where stream temperature is an issue, consider a targeted Stream Temperature Characterization Study (similar to Umpqua). Perhaps attempt to delist some stream sections. Project oriented monitoring. Look to EPA, OWEB for funding.

10. Monitor how TID return flows affect the stream system. How much warm water, contaminants, sediment from TID ditch ends up in streams? Is it a problem that partners are willing to address?

FROM WATER QUALITY SECTION OF ACTION PLAN:

11. Continue to sample Ashland Creek for fecal coliform to find if water is safe for contact in Lithia Park. Currently, Rogue Valley Council of Governments performs stream water bacteria sampling. Problem areas can be determined by increased sampling along stream sections.

12. Test Neil Creek for fecal coliform to find if water is safe above Hwy. 66.

13. Monitor and reduce sediment from quarries above Lithia Park in Ashland Creek watershed and Tolman and Hamilton Creek watersheds.

14. The watershed would benefit from an inventory of erosion problems to prioritize and assess sites where road damage and erosion is occurring. Project partners could include the City, BCWC, Jackson County, USFS, and other groups. Special attention needs to be paid to Ashland's many unpaved roads and alleys. Volunteer storm monitors/road walkers could be involved in finding trouble spots.

LIST OF MAPS

All maps found at end of document.

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

BCWC - Bear Creek Watershed Council
BLM – Bureau of Land Management
BTU– British Thermal Unit
cfs– cubic feet per second
DEQ– Department of Environmental Quality
FPA– Forest Practices Act
LCDC – Land Conservation and Development Department
NMFS– National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
OAR– Oregon Administrative Rule
ODF– Oregon Department of Forestry
ODFW – Oregon Department of Fish and Wildlife
ODOT – Oregon Department of Transportation
OWEB – Oregon Watershed Enhancement Board
TMDL– Total Maximum Daily Load
RVCOG – Rogue Valley Council of Governments
SONCC ESU - Southern Oregon/Northern California Coasts “Evolutionarily Significant Unit”
SOU – Southern Oregon University
USFS– United States Forest Service
USGS– United States Geologic Service
WSC– Watershed Council

ACKNOWLEDGMENTS

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Roger Christianson, Professor of Biology, Department of Biology, Southern Oregon University – photographs.

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Steve Koskella, K&C Environmental

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Jeff LaLande, Archaeologist, Rogue River National Forest – historical data.

Susan Maiyo, Fisheries Biologist, Rogue River National Forest – technical information, survey data, references, data analysis.

Bob Marcu, Forest Practices Forester, Oregon Department of Forestry – Technical information.

Malena Marvin, formerly Southern Oregon University, now Outreach and Development Director, Klamath Riverkeeper – historical information.

Aaron Maxwell, M. S. Student, Department of Biology, Southern Oregon University – technical information, survey data, project ideas.

Bill Meyers, Rogue Basin Coordinator, Oregon Department of Environmental Quality, technical information and water quality data.

Glenn Northcross, Local historian – photographs.

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Rich Piaskowski, Fisheries Biologist, GeoEngineers – technical information, survey data.

Ian Reid, Fisheries Biologist, Ashland Ranger District – technical information, data analysis.

Stewart Reid, Fisheries Ecologist, Western Fishes – technical information; project ideas

Kim Schonek, Monitoring Coordinator, Oregon Water Trust. – flow measurement in Neil Creek.

Terry Skibby, Local historian – photographs.

Jennifer Smith, Fisheries Biologist, Bureau of Land Management – technical information, data analysis.

Fred Stockwell, Stockwell Photography (www.stockwellphotos.com) – photographs.

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Jerry Vogt, Fisheries biologist, Oregon Department of Transportation – fish passage information

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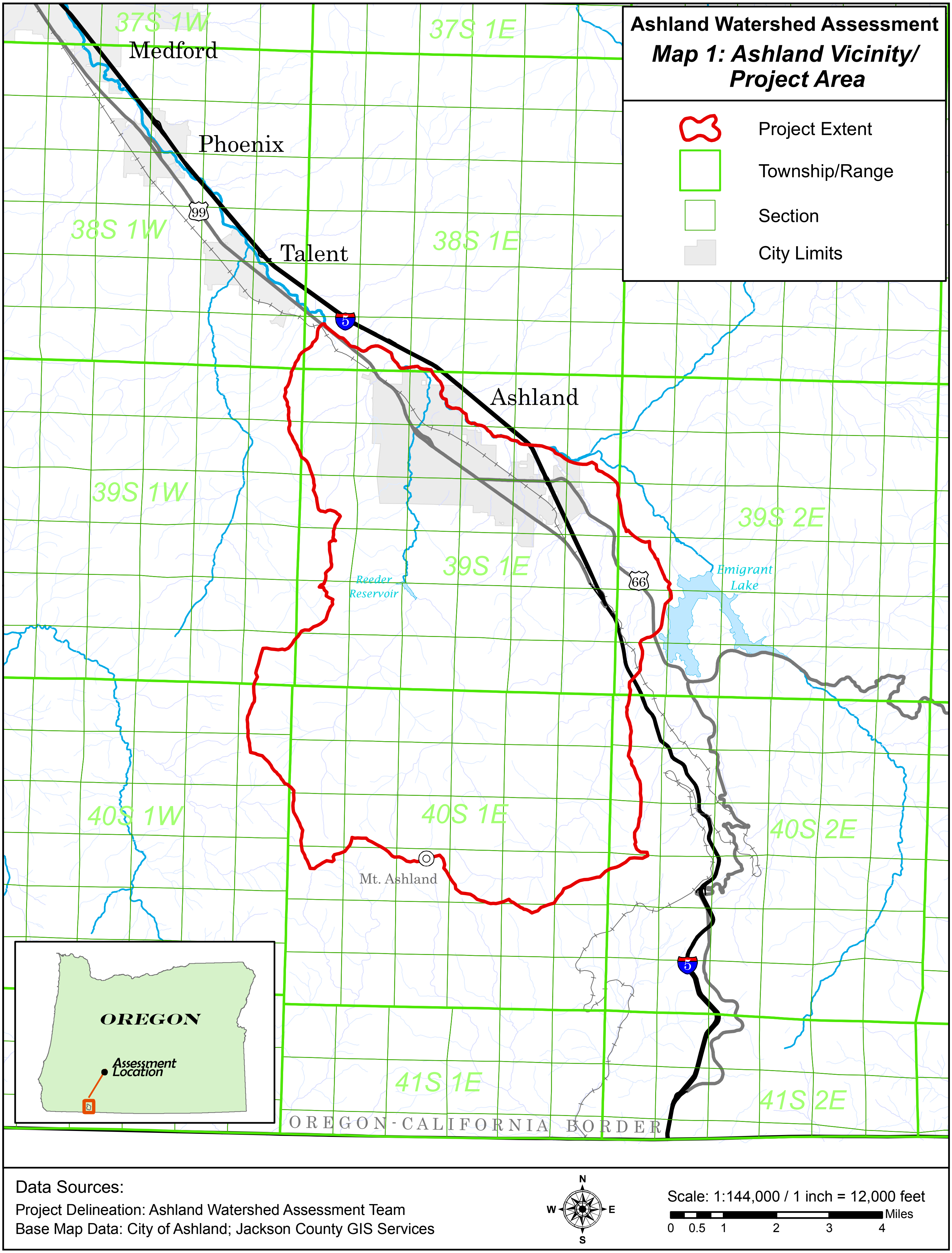
And finally, the Bear Creek Watershed Council Executive Committee, who had faith in the Project Team to succeed.


Ashland Watershed Assessment
Map 1: Ashland Vicinity/ Project Area
Project Extent
Township/Range
Section
City Limits
Medford
Phoenix
Talent
Ashland
37S 1W
37S 1E
38S 1W
38S 1E
39S 1W
39S 1E
39S 2E
40S 1W
40S 1E
40S 2E
41S 1E
41S 2E
99
5
66
Reeder Reservoir
Emigrant Lake
Mt. Ashland
OREGON-CALIFORNIA BORDER
OREGON
Assessment Location
Data Sources:
Project Delineation: Ashland Watershed Assessment Team
Base Map Data: City of Ashland; Jackson County GIS Services
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Scale: 1:144,000 / 1 inch = 12,000 feet
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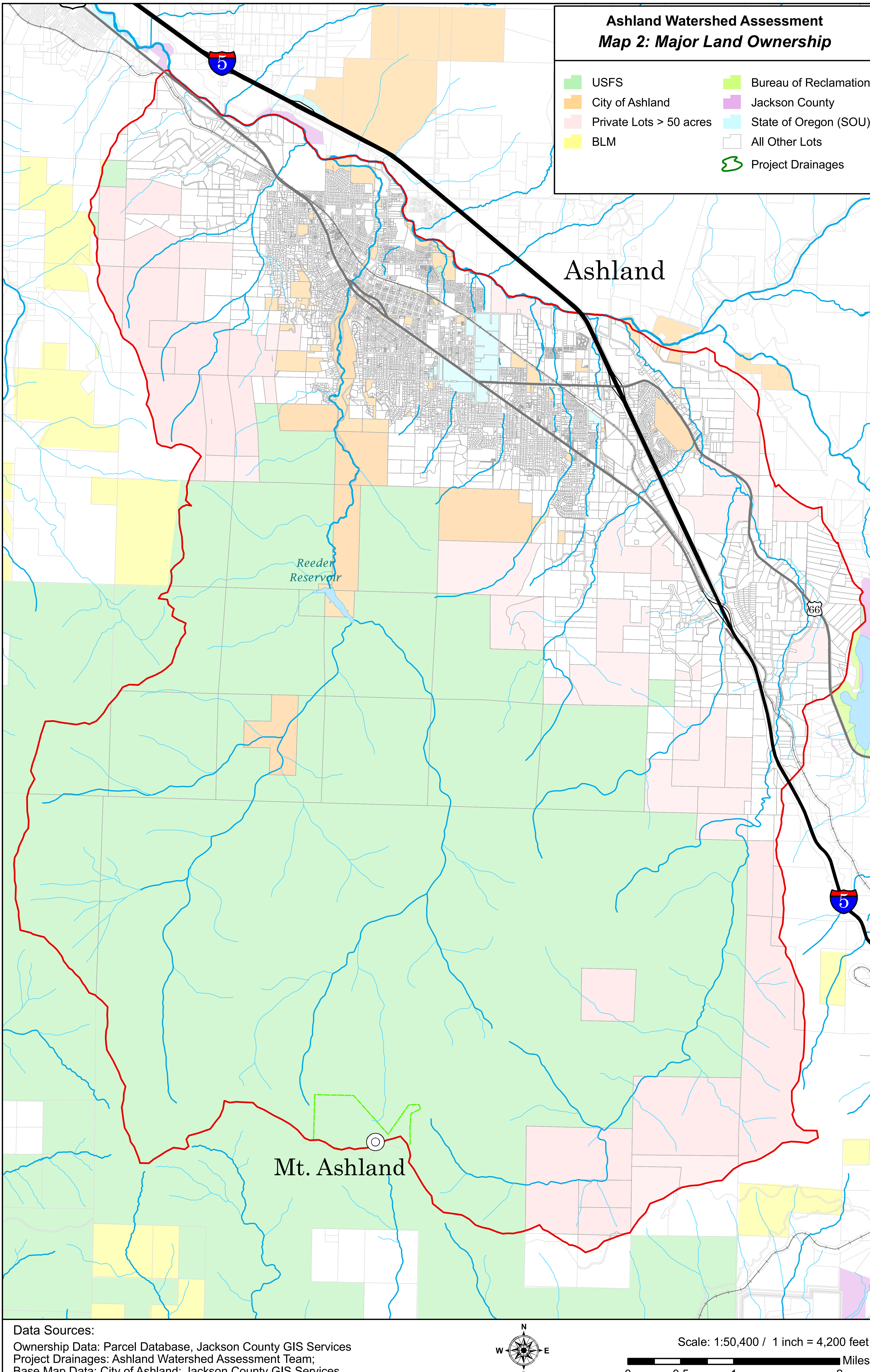
Miles



Ashland Watershed Assessment
Map 2: Major Land Ownership
USFS
City of Ashland
Private Lots > 50 acres
BLM
Bureau of Reclamation
Jackson County
State of Oregon (SOU)
All Other Lots
Project Drainages
Ashland
Reeder Reservoir
Mt. Ashland
5
66
Data Sources:
Ownership Data: Parcel Database, Jackson County GIS Services
Project Drainages: Ashland Watershed Assessment Team;
Base Map Data: City of Ashland; Jackson County GIS Services
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Scale: 1:50,400 / 1 inch = 4,200 feet
Miles
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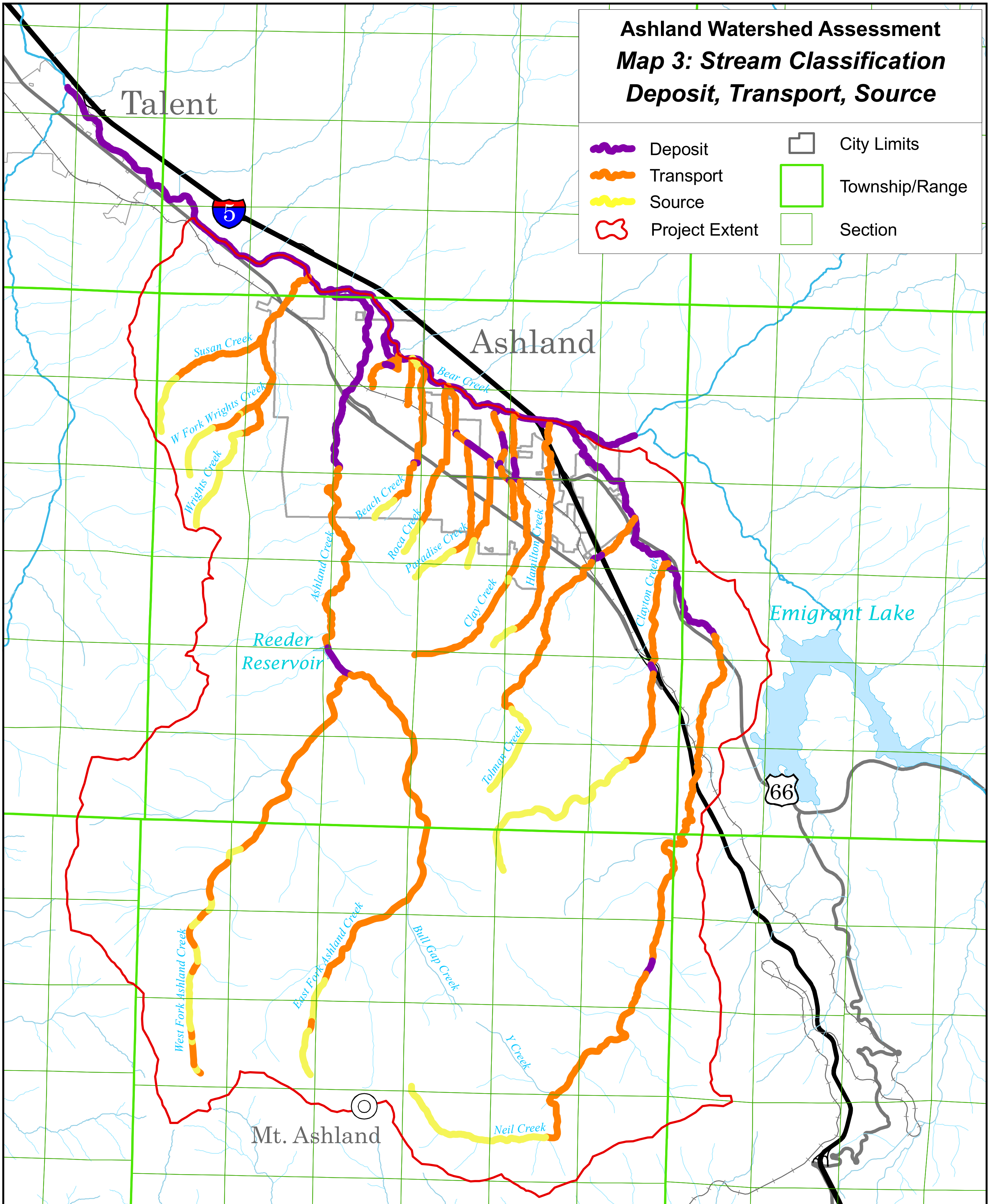


Data Sources:

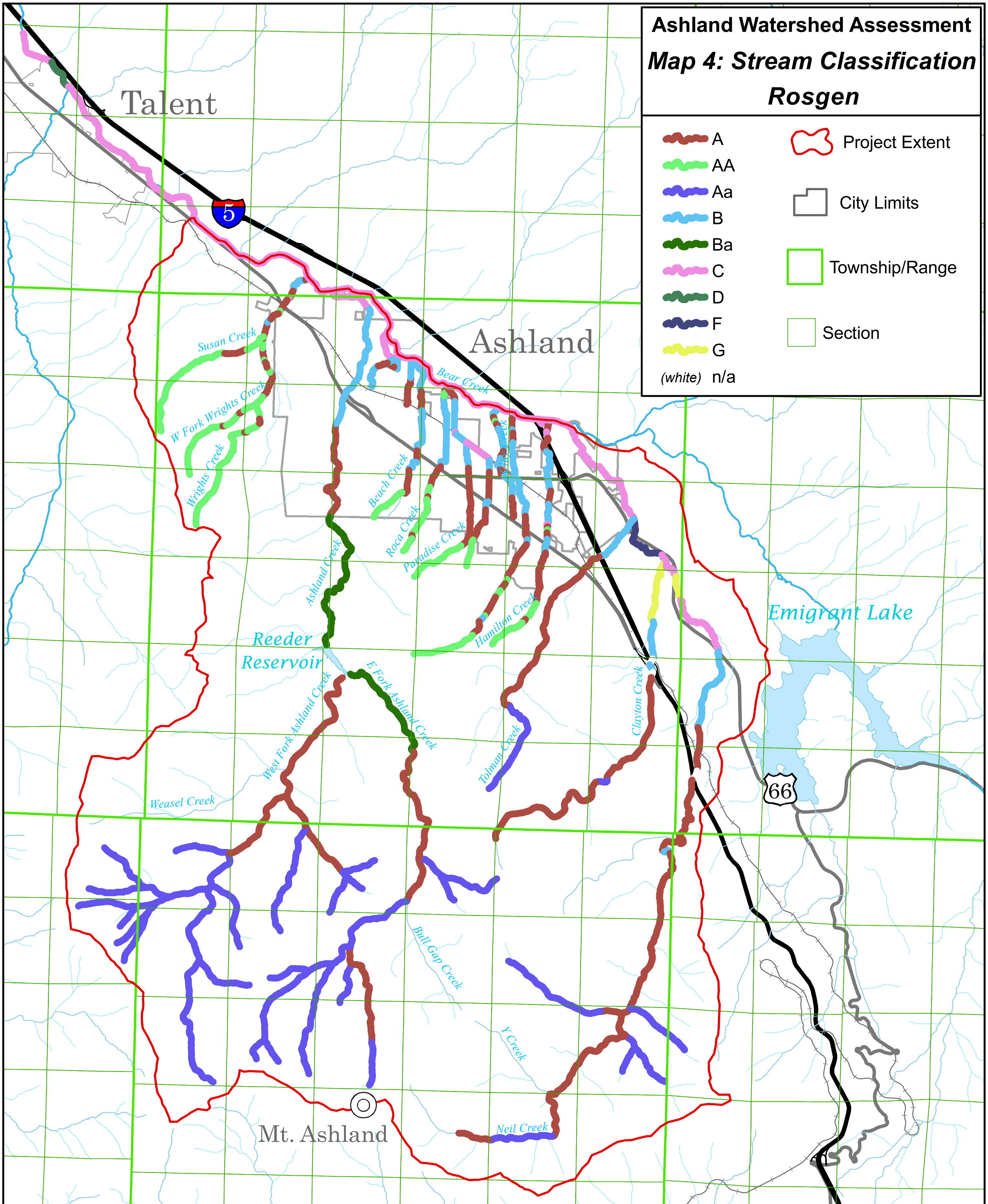
Deposit, Transport, Source Classification: Kent Smith, Ashland Watershed Assessment Team; Project Delineation: Ashland Watershed Assessment Team; Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1:90,000 / 1 inch = 7,500 feet

0 0.5 1 2 3 Miles

Ashland Watershed Assessment

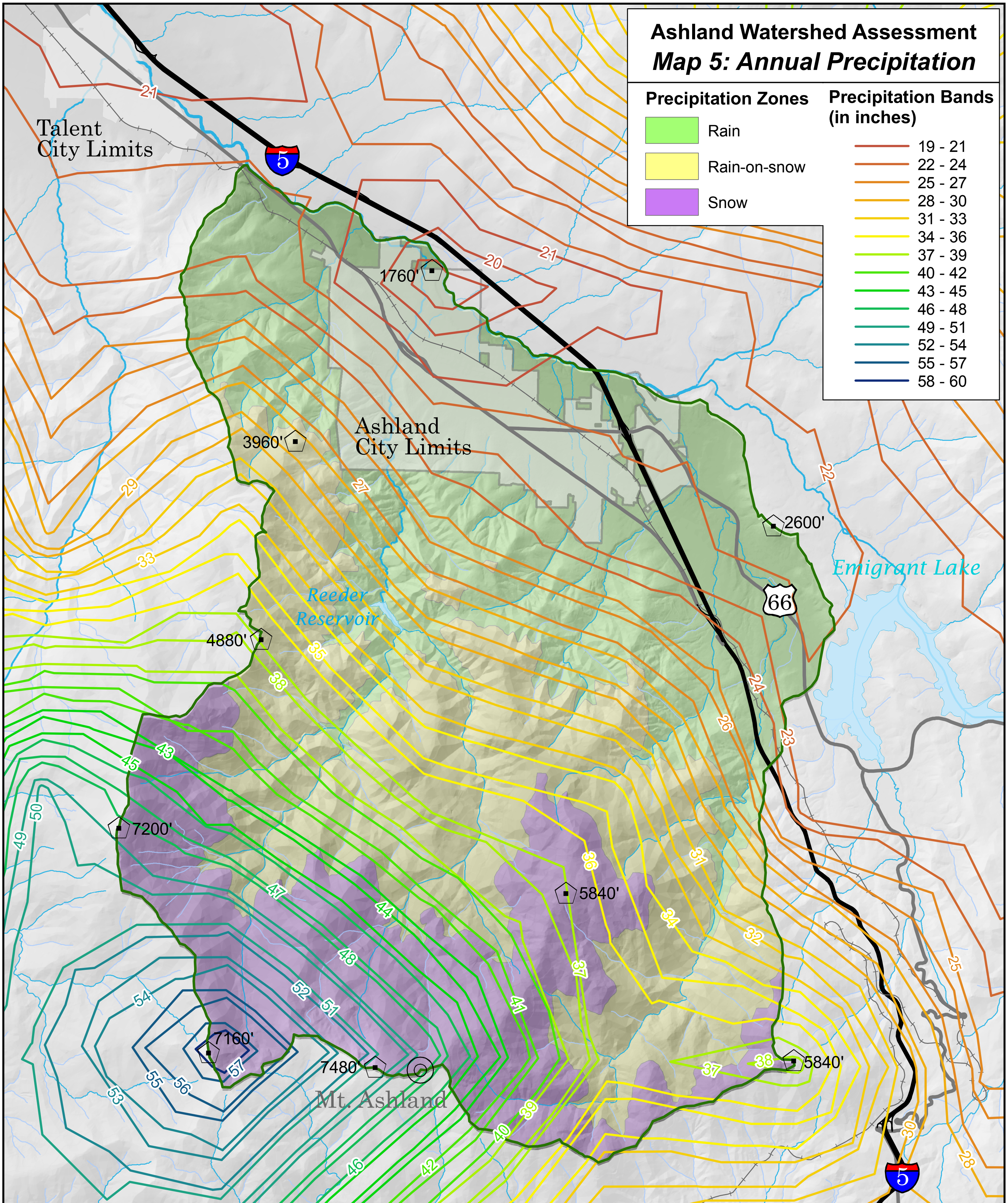
Map 4: Stream Classification Rosgen



Data Sources:
Rosgen Classification: TMDL Assessment Report- Bear Creek, OR. ODEQ, May 9, 2000. Insight Consultants, May 15, 2007;
Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1: 90,000 / 1 inch = 7,500 feet

0 0.5 1 2 3 Miles



Data Sources:

Precipitation Isolines: Natural Resources Conservation Service (NRCS)
Project Delineation: Ashland Watershed Assessment Team
Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1:90,000 / 1 inch = 7500 feet

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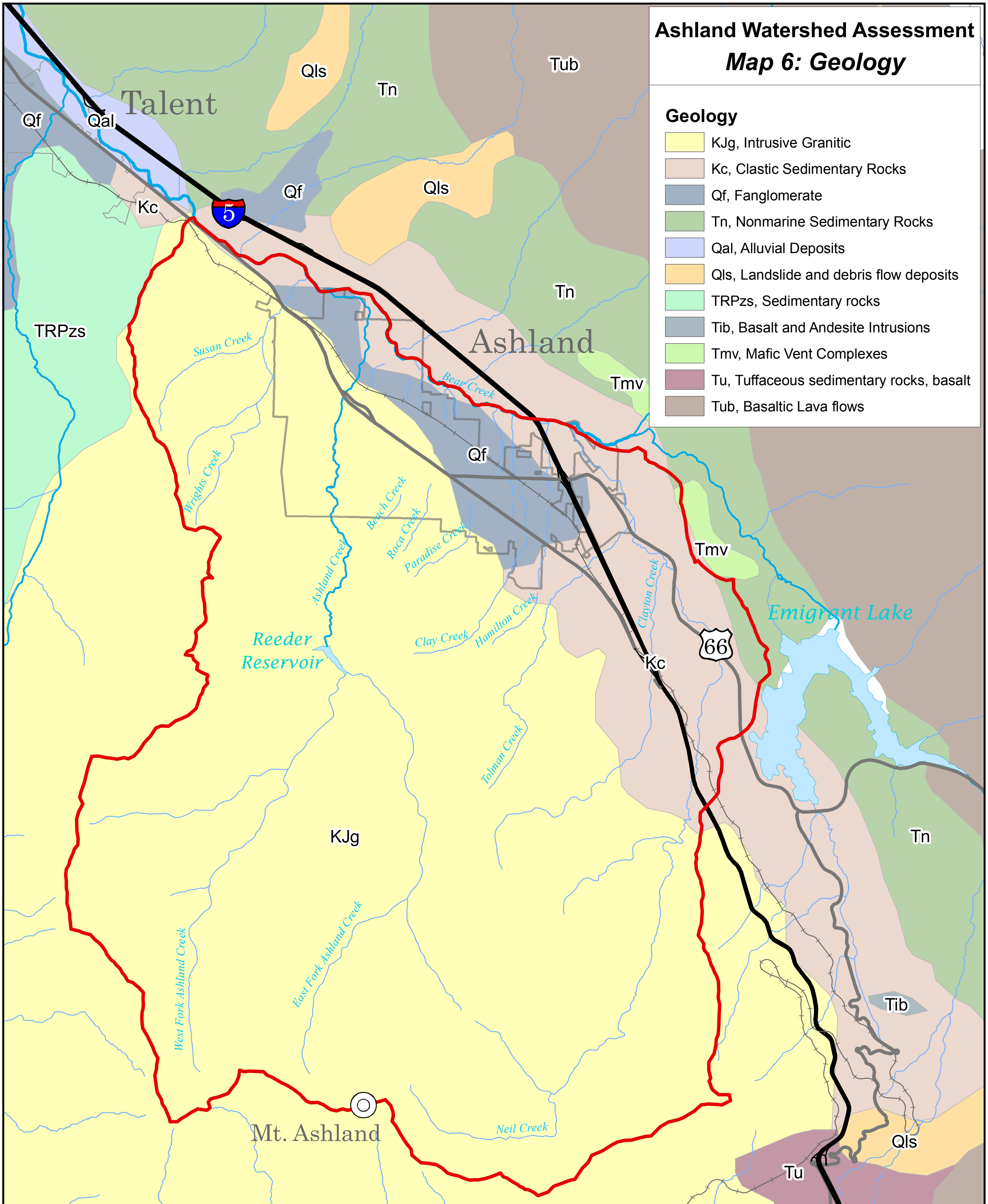
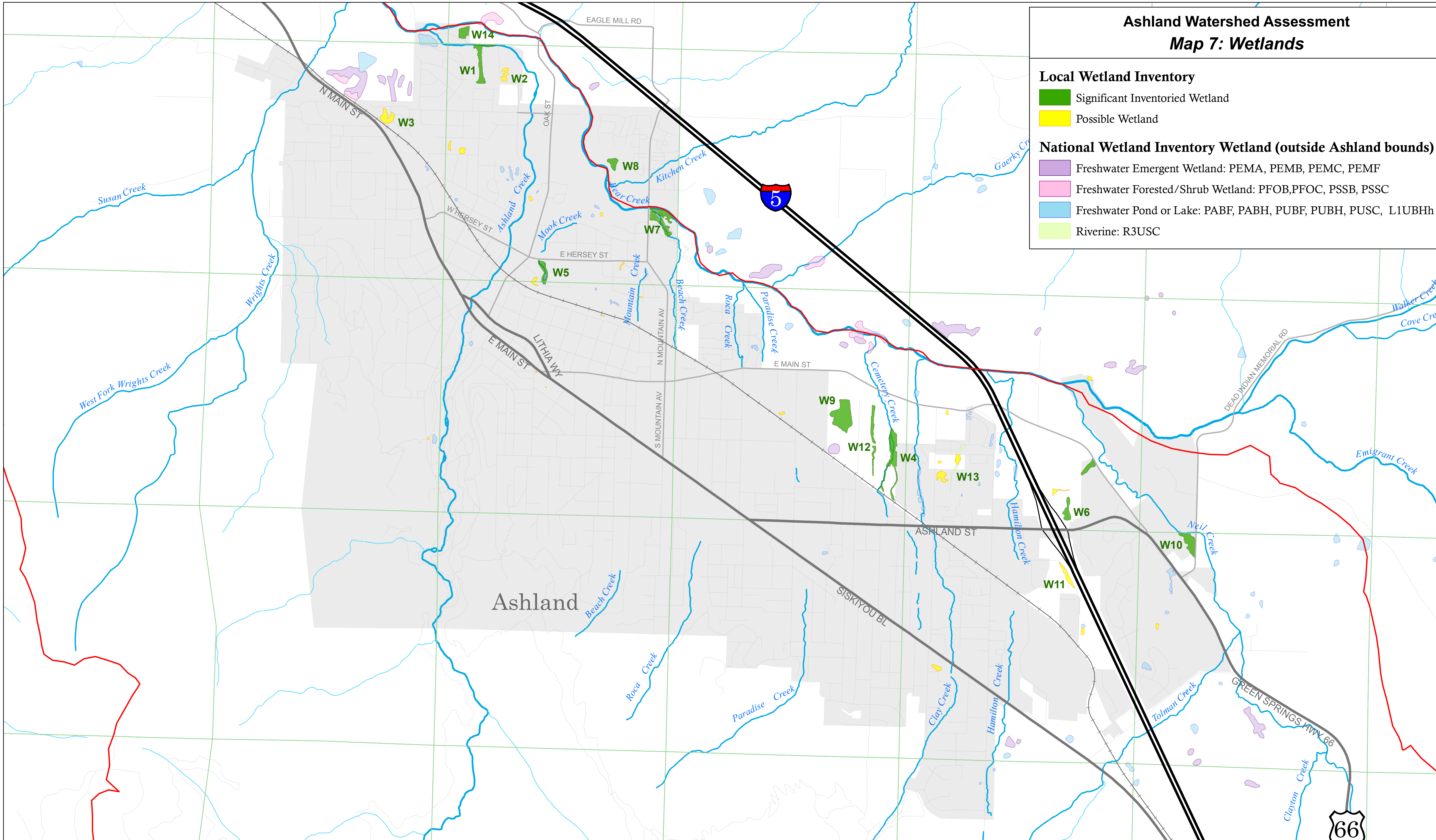


Data Sources:

Geology: USGS; Project Delineation: Ashland Watershed Assessment Team;
Base Map Data: City of Ashland, Jackson County GIS Services



N
W
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S

Scale: 1:24,000 / 1 inch = 2,000 feet

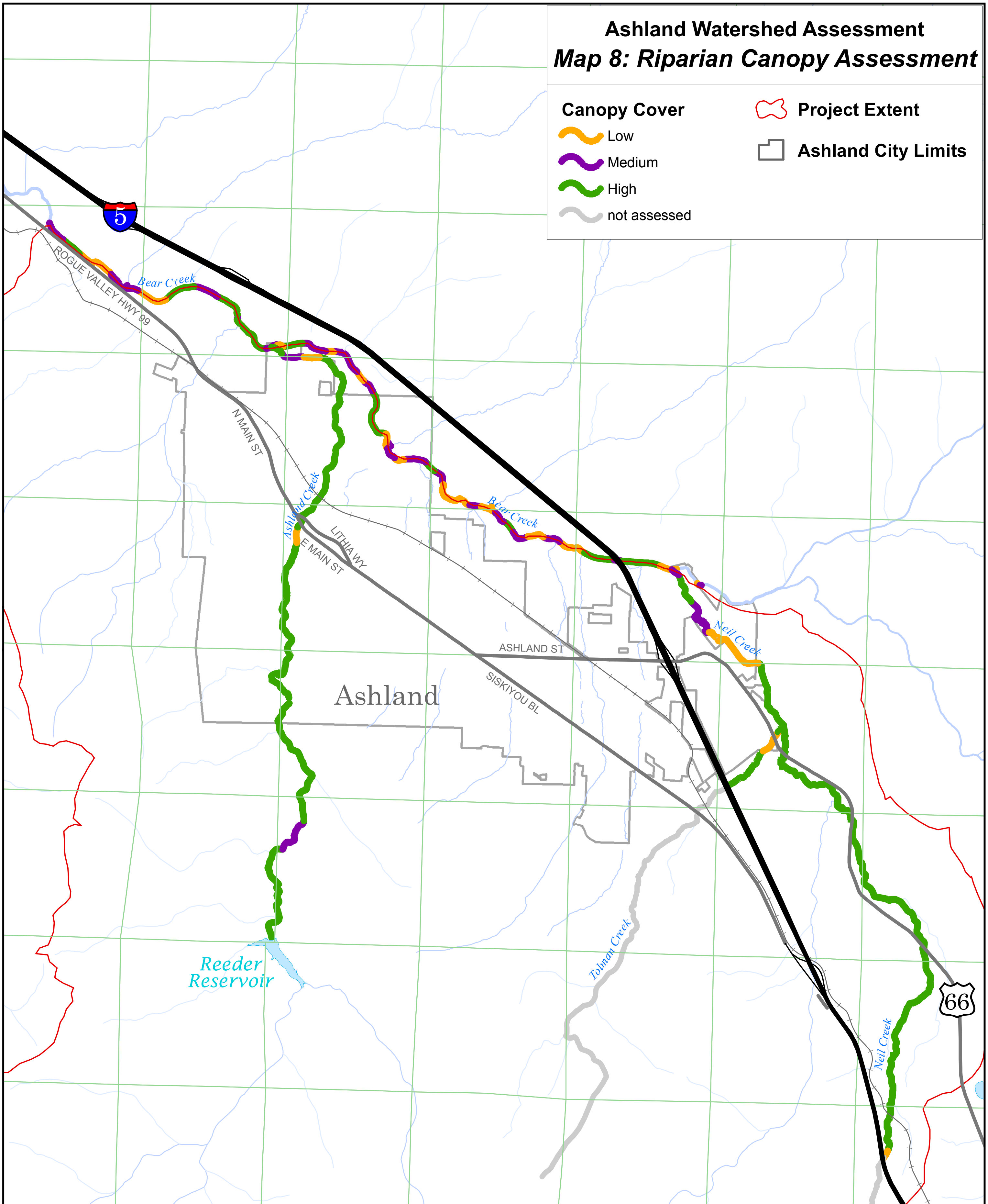
0 0.5 1 Miles

Data Sources:

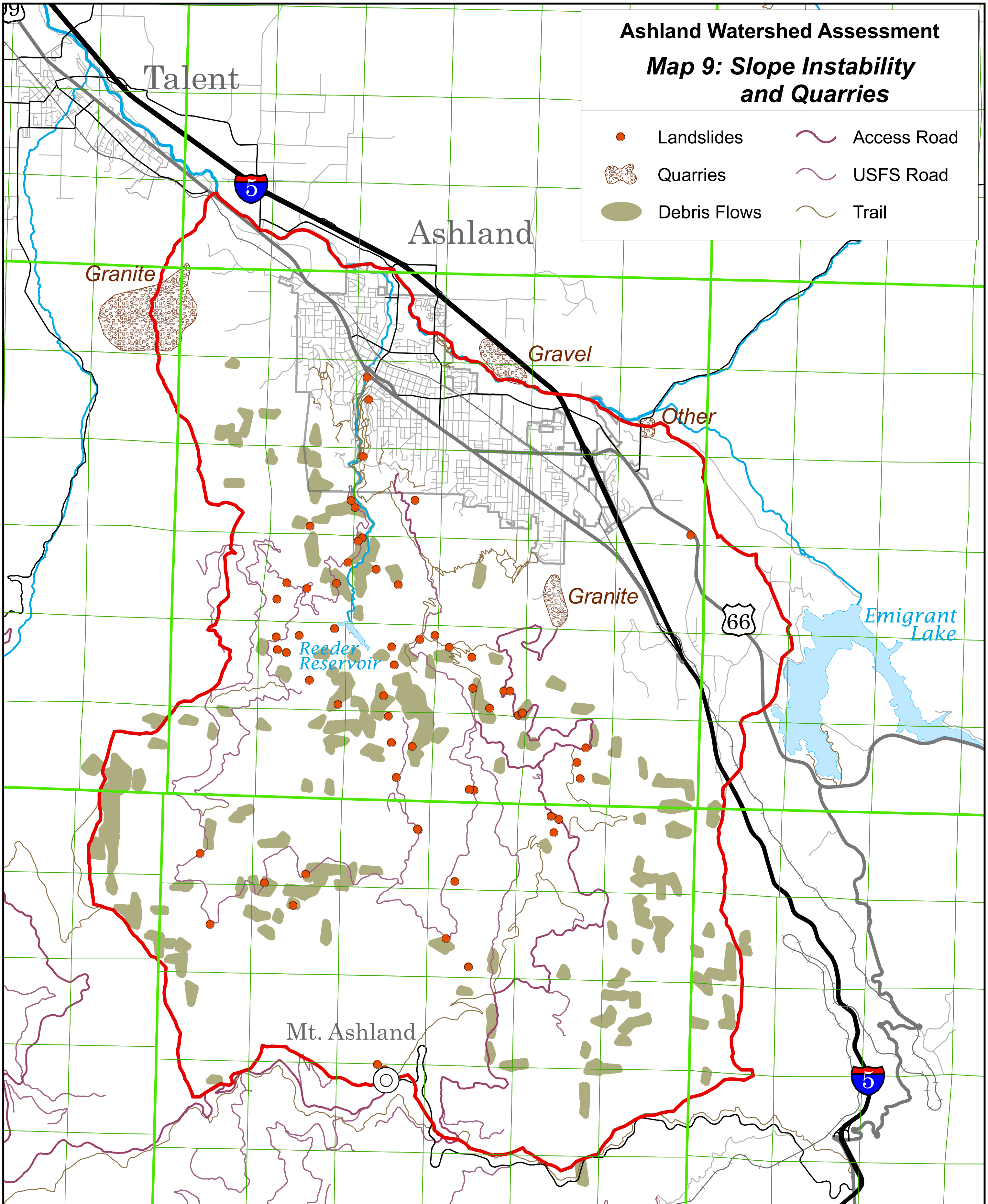
Ashland Area wetlands: SWCA conducted a wetlands analysis for the City of Ashland, completed 5/2007.

Outside of Ashland area: National Wetlands Inventory: http://wetlandsfws.er.usgs.gov/imf/sites/NWI_CONUS/CONUS_metadata/wetland_polys.htm downloaded from NWI May 30, 2007

Base data: Jackson County GIS Services; City of Ashland GIS



Data Sources:
Canopy Assessment: SRG, Terri Ayers, June 2005;
Project Delineation: Ashland Watershed Assessment Team;
Base Map Data: City of Ashland, Jackson County GIS Services



Data Sources:
Quarries and Landslides: Jackson County;
Debris Flows: Oregon Department of Forestry;
Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1: 90,000 / 1 inch = 7,500 feet

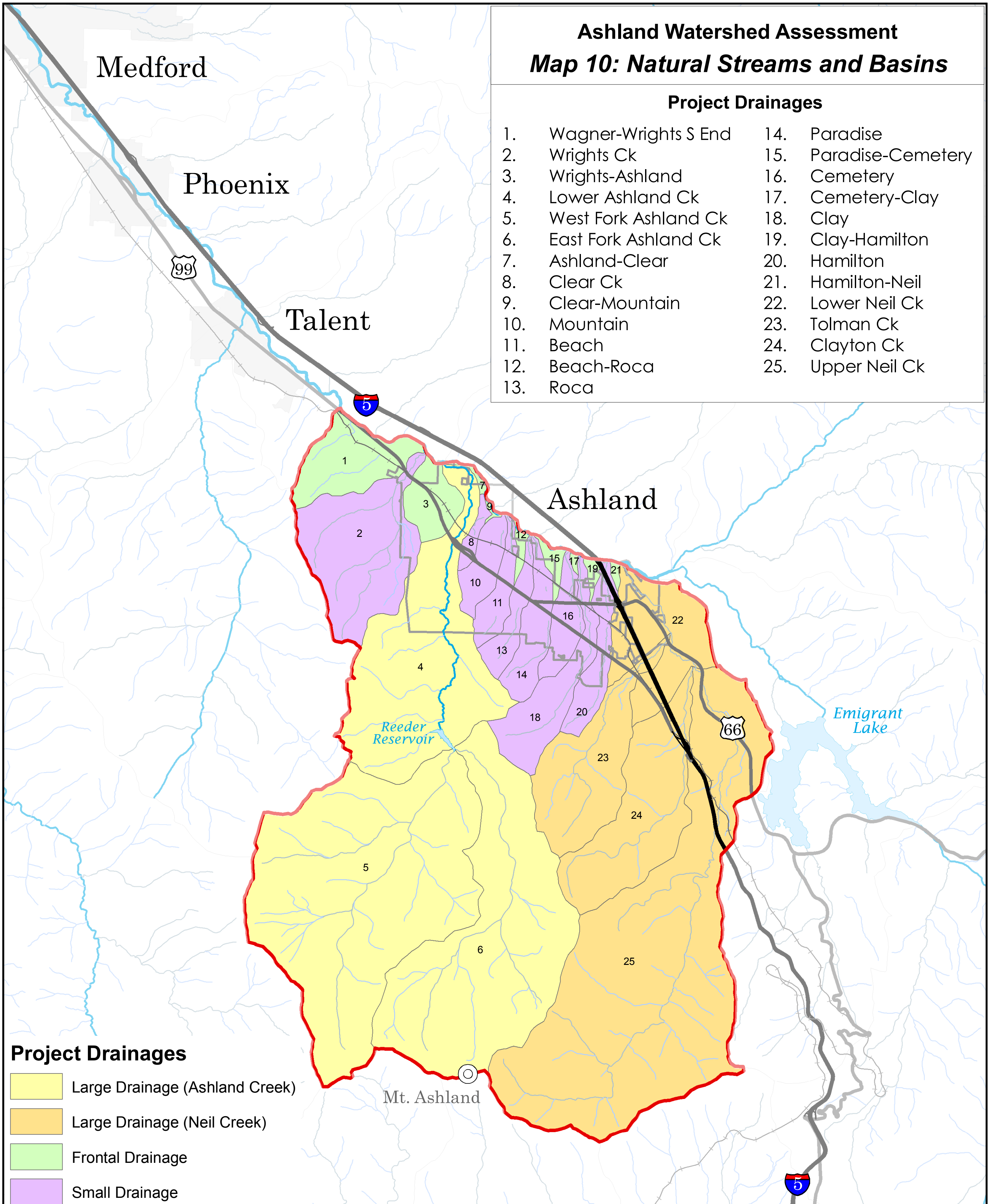
0 0.5 1 2 3 Miles

Ashland Watershed Assessment

Map 10: Natural Streams and Basins

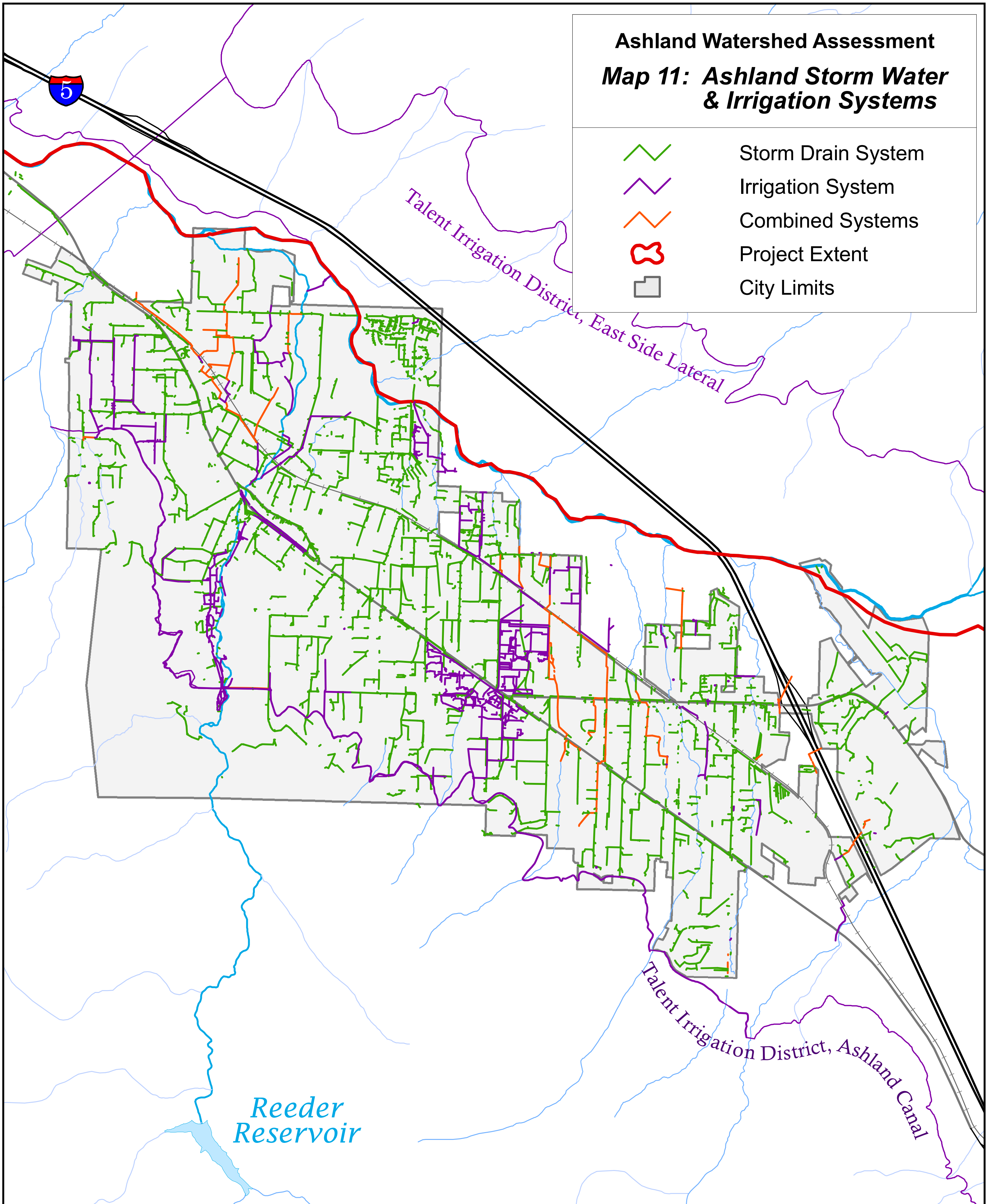
Project Drainages

1. Wagner-Wrights S End
2. Wrights Ck
3. Wrights-Ashland
4. Lower Ashland Ck
5. West Fork Ashland Ck
6. East Fork Ashland Ck
7. Ashland-Clear
8. Clear Ck
9. Clear-Mountain
10. Mountain
11. Beach
12. Beach-Roca
13. Roca
14. Paradise
15. Paradise-Cemetery
16. Cemetery
17. Cemetery-Clay
18. Clay
19. Clay-Hamilton
20. Hamilton
21. Hamilton-Neil
22. Lower Neil Ck
23. Tolman Ck
24. Clayton Ck
25. Upper Neil Ck



Data Sources:

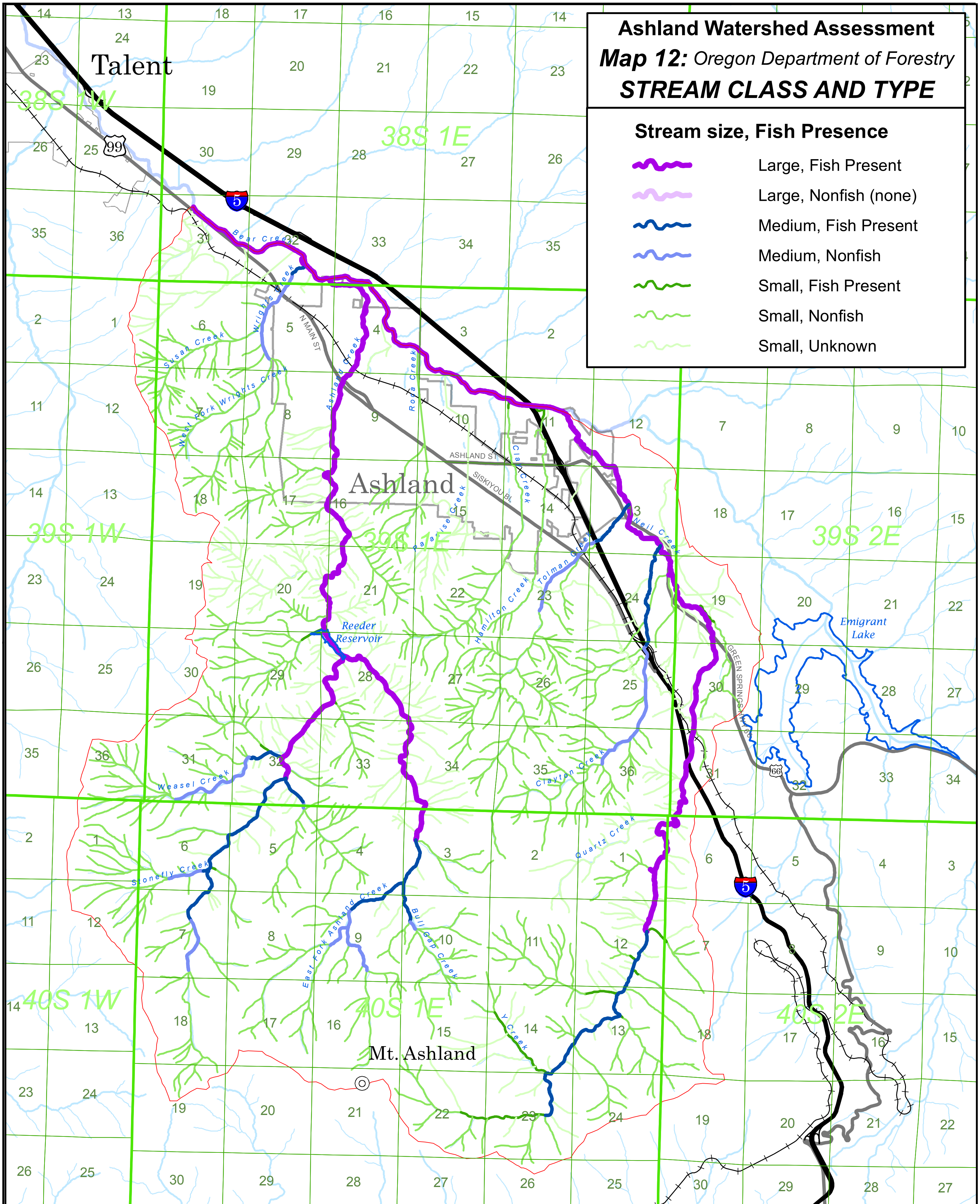
Project Drainage Delineations: Ashland Watershed AssessmentTeam;
Base Map Data: City of Ashland; Jackson County GIS Services



Data Sources:
Storm Drain and Irrigation System: City of Ashland Public Works Dept;
Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1:36,000 / 1 inch = 3000 feet

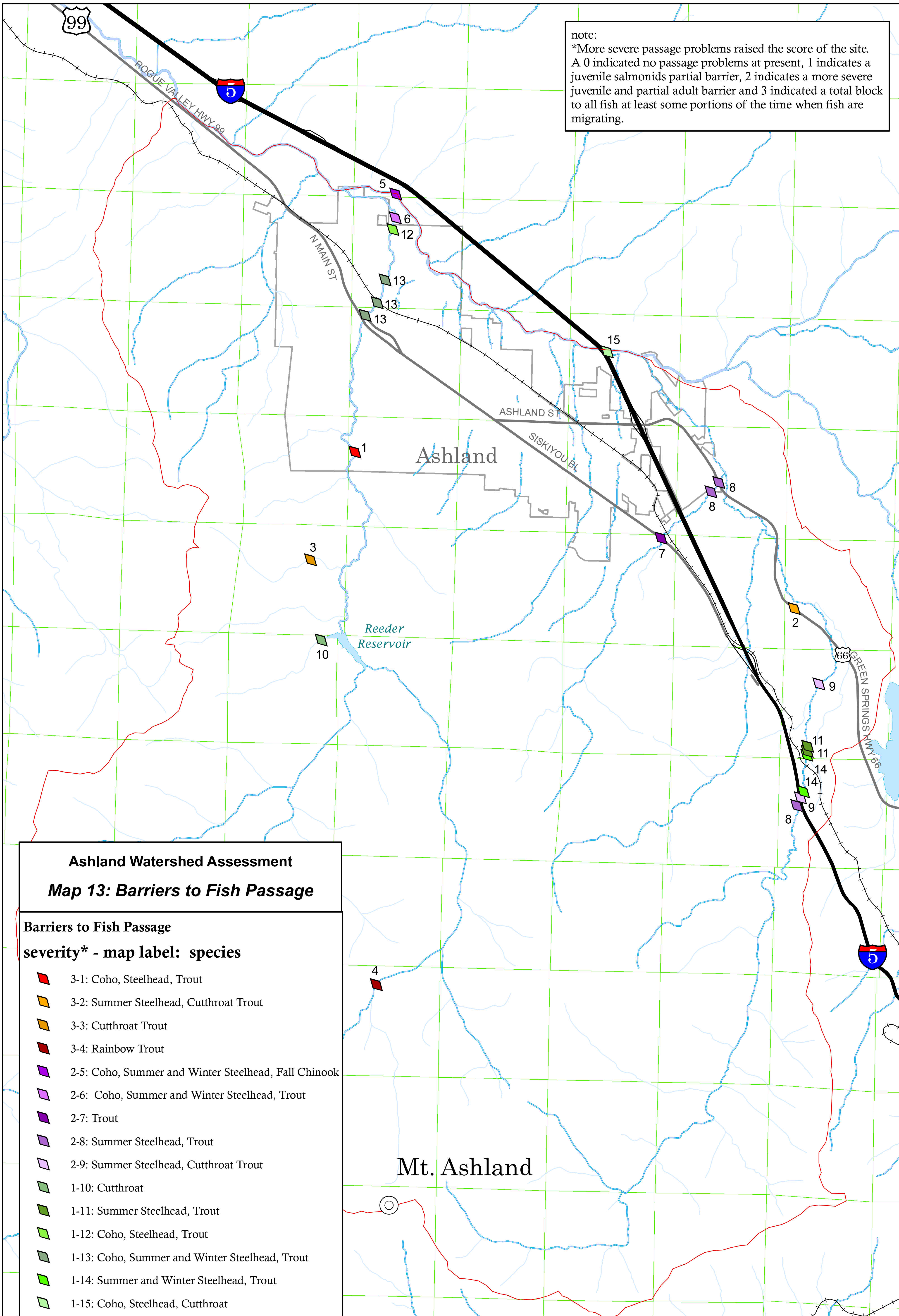
0 0.5 1 Miles



Data Sources:
ODF Stream Class and Type: Oregon Department of Forestry website:
http://www.odf.state.or.us/gis/fishpres/fishpres_i.asp
Base Map Data: City of Ashland; Jackson County GIS Services

Scale: 1:90,000 / 1 inch = 7,500 feet

0 0.5 1 2 3 Miles

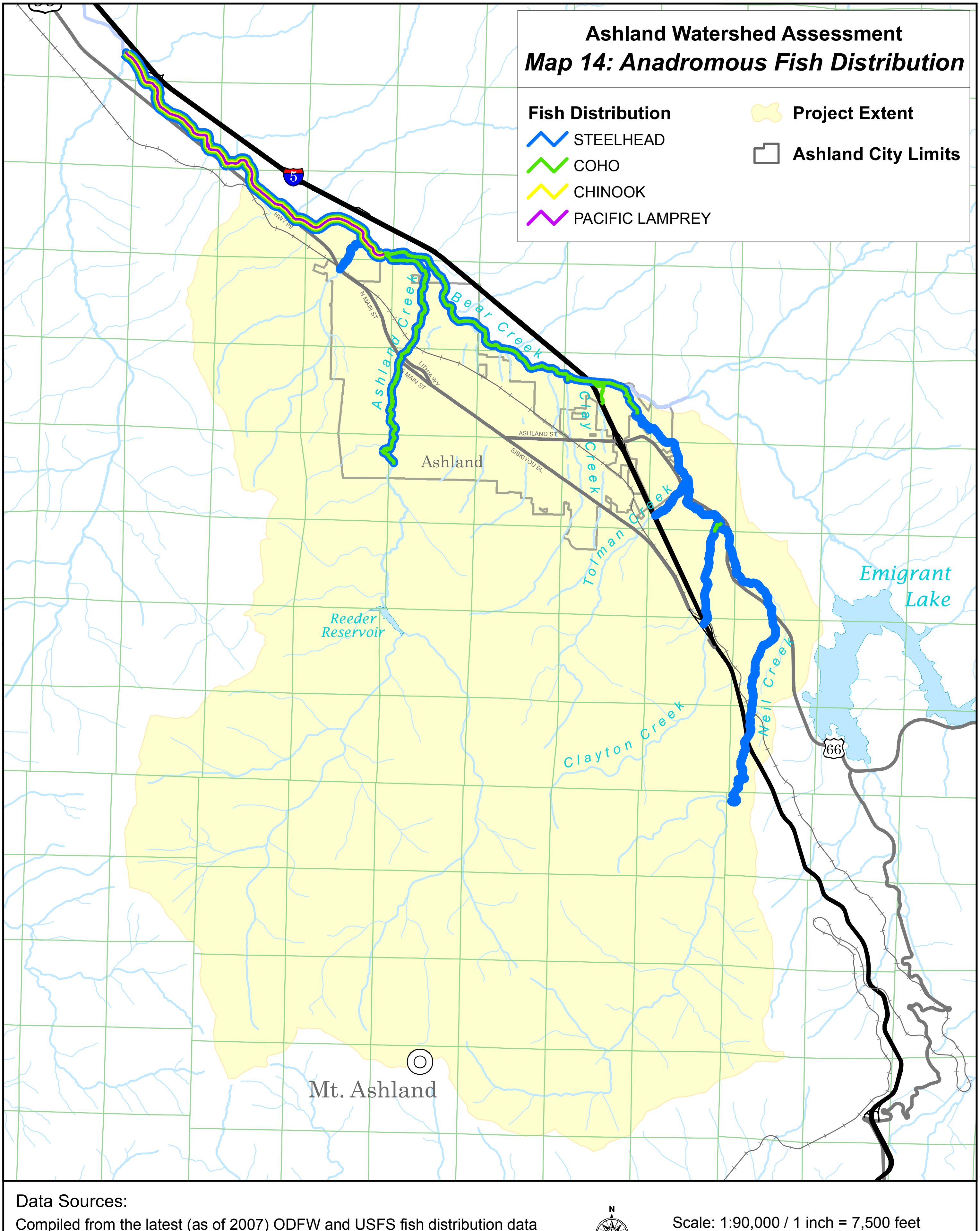


Data Sources:
Barriers to Fish Passage: Compiled from ODFW, USFS, and City of Ashland sources by Randy Frick and Richard Best
Project Drainages: Bear Creek Watershed Council Team
Base Map Data: City of Ashland; Jackson County GIS Services

N W E S

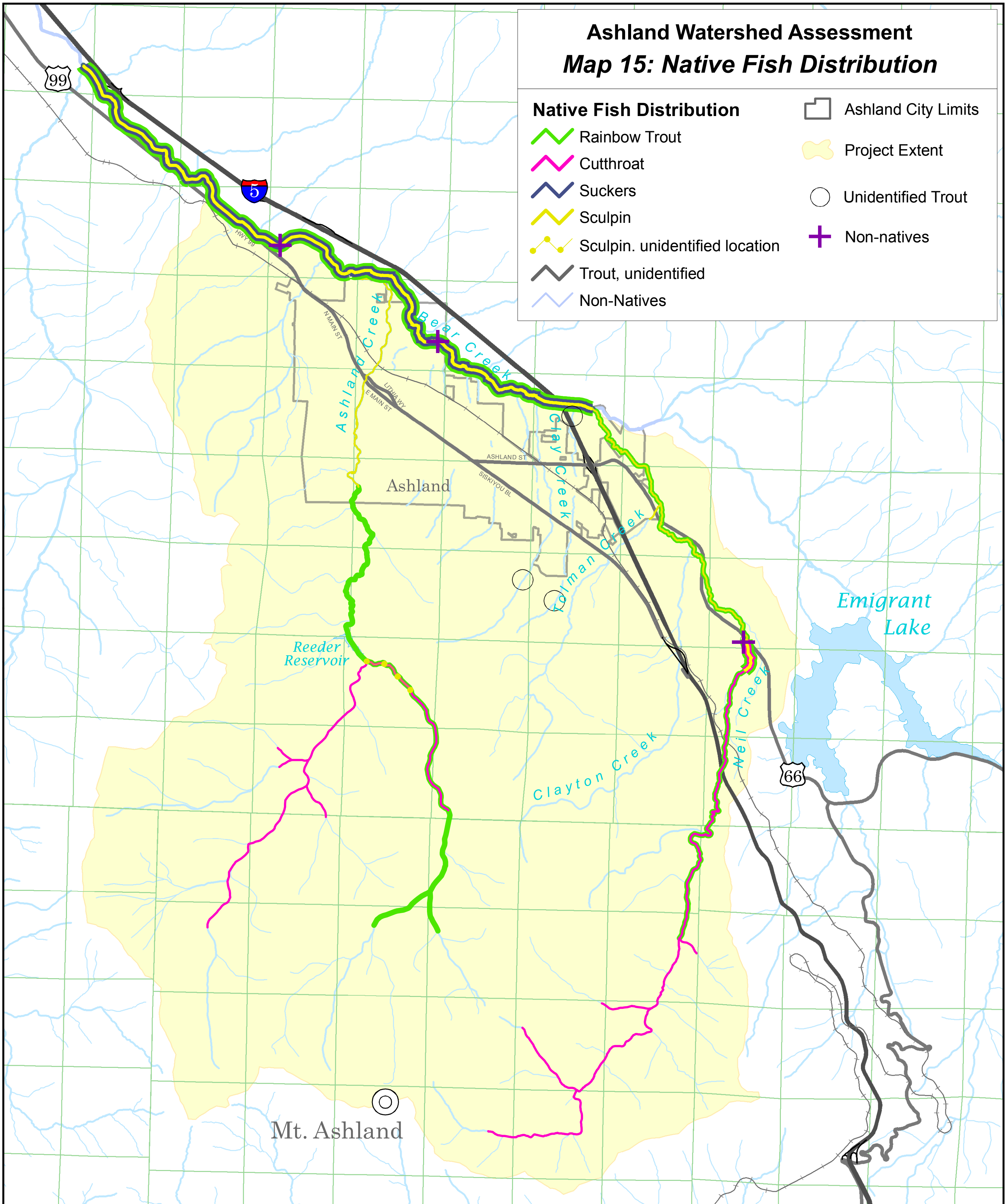
Scale: 1:50,400 / 1 inch = 4,200 feet

0 0.5 1 2 Miles



Data Sources:

Compiled from the latest (as of 2007) ODFW and USFS fish distribution data by Randy Frick, with amendments by Jeannine Rossa based on personal communication with local biologists (Volpe 2007; Weir 2007) and recent surveys (BLM, unpublished data; Maxwell, in preparation).



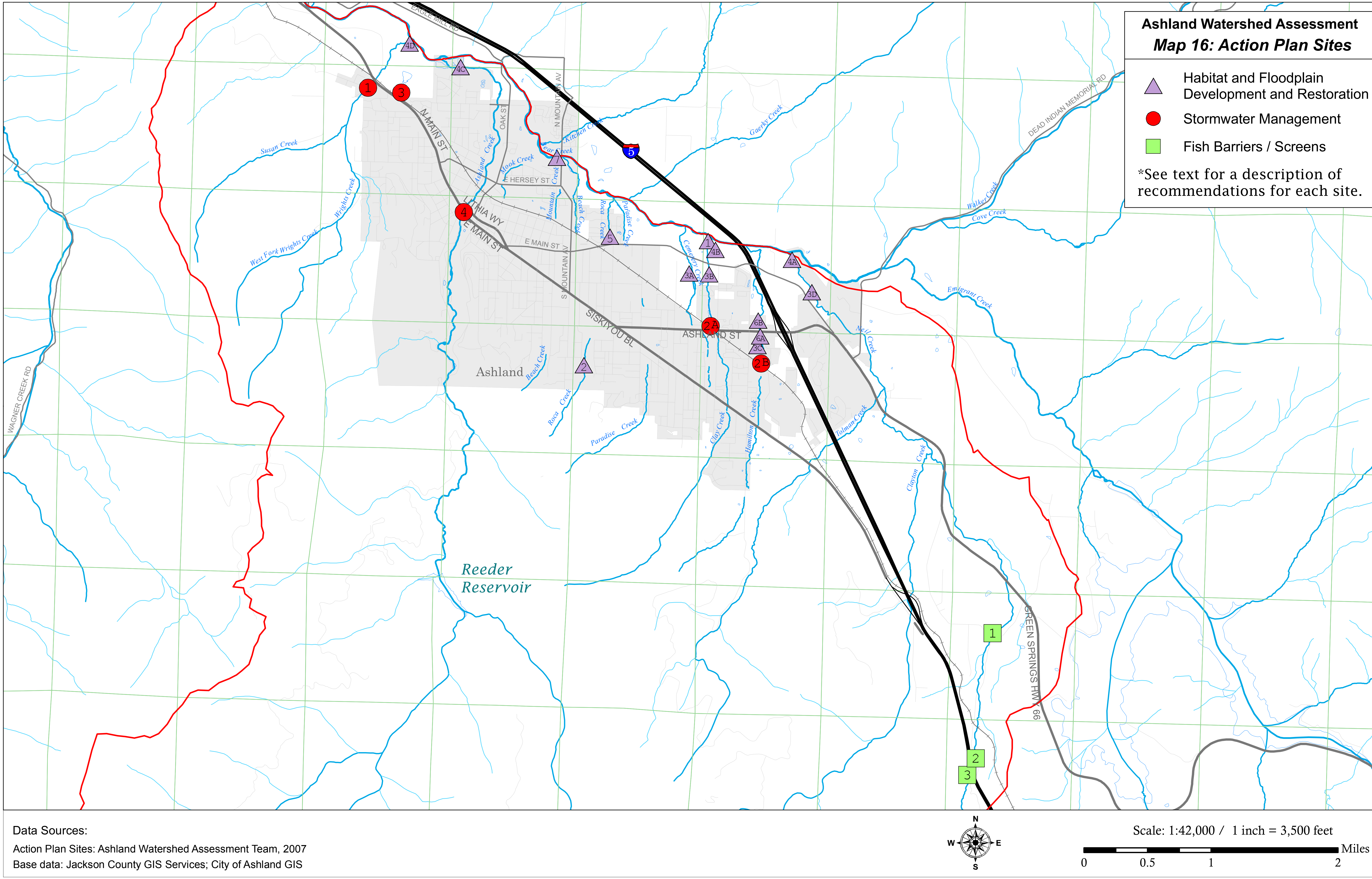
Data Sources:

Compiled by Jeannine Rossa from USFS surveys (Abbas 1999), USFS-contracted surveys (Bennett 2000; Ecosystems Northwest 2001, SRG 2002a, and SRG 2002b), BLM surveys (unpublished data), BOR surveys (Broderick 2000), and recent research (Maxwell, in preparation).

N W E S

Scale: 1:90,000 / 1 inch = 7,500 feet

0 0.5 1 2 3 Miles



Data Sources:

Action Plan Sites: Ashland Watershed Assessment Team, 2007

Base data: Jackson County GIS Services; City of Ashland GIS