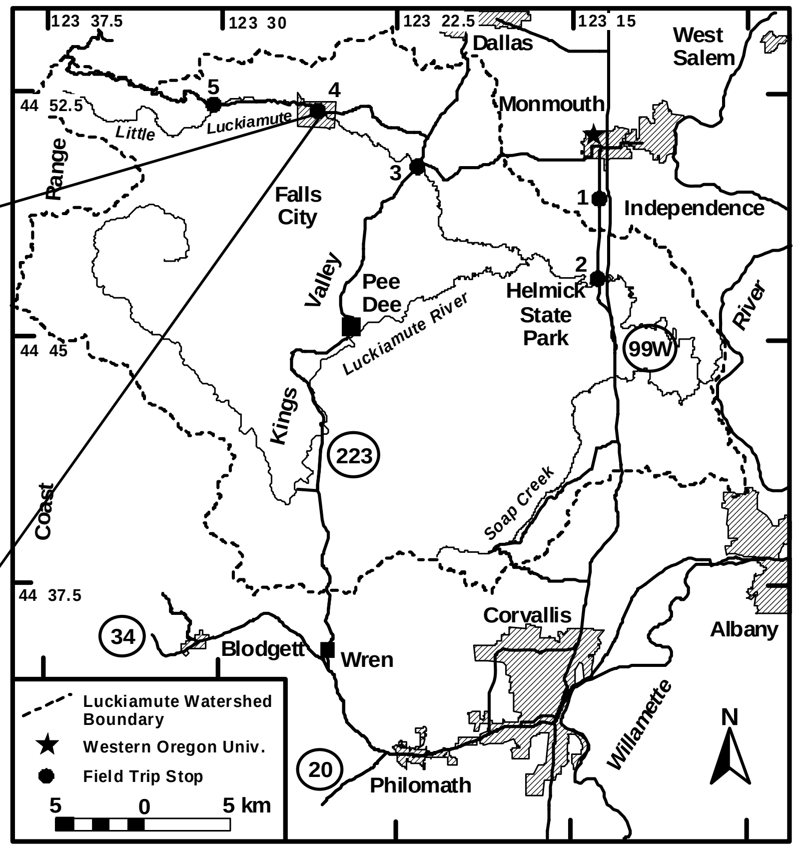
Environmental Studies in the Luckiamute Watershed, Central Coast Range, Oregon: Integrating Applied Watershed Science with Undergraduate Research and Community Outreach

Oregon Academy of Science 65th Annual Meeting

Western Oregon University February 24, 2007

Geology Section Field Trip



Trip Leaders:

Steve Taylor, Ph.D., Earth and Physical Science Department, Western Oregon University

Bryan Dutton, Ph.D., Biology Department, Western Oregon University

Katherine Noll, Earth Science Major/Biology Minor, Western Oregon University

Table of Contents

2007 OAS Geology Section Field Trip
Participant List

Saturday Feb. 24, 2007, 3:00-5:30 PM
Environmental Studies in the Luckiamute Watershed

No. in Party	Field Trip Participants / Colleagues
1	Steve Taylor, Western Oregon University (Trip Leader)
1	Bryan Dutton, Western Oregon University (Trip Leader)
1	Katie Noll, Western Oregon University (Trip Leader)
1	Jeff Templeton, Western Oregon University
1	Emily Plec, Western Oregon University
7	Toni Smith + 5-6 Geo Students and/or Faculty colleagues from Southern Oregon University
6	Bob Carson + 5 Students and/or Faculty colleagues from Whitman College
2	Beverly Vogt + Richard Bartels
2	Janet and Doug Rasmussen
2	Scott Burns + 1 student, Portland State University
1	Frank Kolwicz
8	WOU Earth Science Students (Josh Troyer, Renae Burger, Alicia Thompson, Kristin Mooney, Heather Hintz, Josh Jones, Patrick Stephenson, Ian Macnab)
1	David Anderson, Luckiamute Watershed Council / Anderson Wildlife Consulting

Total Field Trip Participants = 34

2007 OAS Field Trip E-mail Contact List

taylors@wou.edu, duttonb@wou.edu, knoll@wou.edu, plece@wou.edu, smithto@students.sou.edu, carsonrj@whitman.edu, templej@wou.edu, bevvogt@comcast.net, jkayerocks@yahoo.com, kolwicz@exchangenet.net, burnss@pdx.edu, jtroyer06@wou.edu, rburger@wou.edu, giggles_2002@comcast.net, kristinmooney@yahoo.com, jj17ice@yahoo.com, pstphen@wou.edu, imacnab06@wou.edu, BioDavidAnderson@aol.com

ABSTRACT

ENVIRONMENTAL STUDIES IN THE LUCKIAMUTE WATERSHED, CENTRAL COAST RANGE, OREGON: INTEGRATING APPLIED WATERSHED SCIENCE WITH UNDERGRADUATE RESEARCH AND COMMUNITY OUTREACH. [1]Stephen B. Taylor, [2]Bryan E. Dutton, [1,2]Katherine Noll, and [3]Michael Cairns, [1]Earth and Physical Sciences Department, Western Oregon University, Monmouth, OR 97361, [2]Department of Biology, Western Oregon University, Monmouth, OR 97361, [3]Luckiamute Watershed Council, c/o Western Oregon University, Monmouth, OR 97361.

Mountainous watersheds are fundamental landscape elements that form an important setting for local ecological interactions, human occupation, and water resource development. They also represent the foundational components for mass sediment transfer from continental regions to ocean basins. As such, the understanding of hydrogeomorphic variables is critical for designing sustainable water resource and habitat conservation plans. From the perspective of undergraduate training in the Natural Sciences, watersheds represent the ideal natural laboratory for student application of quantitative techniques to multivariate systems with interdependent process-response mechanisms.

This field trip involves a 2.5-hour road tour of the Luckiamute River basin in the central Oregon Coast Range (Figure 1). The Luckiamute is in close proximity to the Western Oregon University (WOU) campus and is being used as a model watershed to integrate select components of applied research into a sequence of surface-process courses at WOU. Faculty and undergraduates are actively engaged with long-term studies in fluvial geomorphology, environmental geology, conservation biology, and hydrology. From a training perspective, this watershed-based curriculum: (1) incorporates research into the undergraduate science program at WOU, (2) engages students in socially-relevant watershed-based science, (3) improves quantitative skills via coursework, lab exercises and applied research, (4) develops problem-solving and scientific skills within a regional watershed setting, and (5) fosters an interconnected perspective of watershed processes across disciplines. The research model is placed in the context of community outreach via collaboration with the local watershed council.

The field trip, in conjunction with the 2007 annual meeting of the Oregon Academy of Science, provides an overview of the regional geology and geomorphology of a central Coast Range watershed. It will also present a summary of long-term research and community service initiatives in the Luckiamute basin.

2007 OAS Geology Section
Luckiamute Field Trip Road Log

0.0 mi	Lv. WOU Jackson St. Parking Lot, Monmouth Ave. south to Clay, turn left (east) on Clay, after several blocks, turn right (south) on Knox, turns into Helmick Road, continue south out of Monmouth.
1.8 mi	Veer right/straight onto Fir Crest Rd, drive up hill on gravel road, Stop 1, Fir Crest Cemetery is on right. **STOP 1 – Fir Crest Cemetery: Physiographic and Geologic Overview (Spencer-Valley Fill Domain)**. Proceed south and back onto Helmick Road.
4.9 mi	Bridge crosses Luckiamute River, turn right into Helmick State Park, just south of the bridge. **STOP 2 – Helmick State Park: Fluvial Geomorphology and Invasive Plant Research (Spencer-Valley Fill Domain)**. Leave parking lot and return north on Helmick Road, back towards Monmouth.
7.0 mi	Turn left (west) onto Elkins Road, view of Coast Range and upper Luckiamute at various points along this route. Continue west on Elkins road.
11.3 mi	Turn right (north) onto Smith Road (gravel)
14.6 mi	Smith Road ends at a stop sign, turn left (west) onto Hwy 51, "Monmouth Highway" (paved), continue on towards Coast Range.
15.6 mi	Monmouth Highway ends at Hwy 223, turn left (south) onto Kings Valley Highway (223). Continue a short distance until road crosses bridge over the Little Luckiamute River.
15.7 mi	Pull off on right shoulder, just north of bridge crossing. **STOP 3 – Bridgeport Area, Kings Valley Highway: Invasive Plant Research and Fluvial Geomorphology (Spencer-Valley Fill Domain)**. Pull back onto highway (223), continue south, watch for speeding traffic.
16.5 mi	Turn right (west) onto Gardner Road (gravel), continue towards Coast Range and Falls City.
18.3 mi	Gardner Road ends at stop sign, turn left (west) onto Bridgeport Road (paved). Note Oak Savanna habitat in the valley and views of Coast Range.
20.5 mi	Bridgeport turns into Main Street, Falls City, continue into town
20.8 mi	Turn right at stop sign and Bridge Street
20.9 mi	Take next left onto Mitchell Street.
21.1 mi	**STOP 4 – Falls at Falls City: Fluvial Geomorphology and Invasive Plant Research (Yamhill-Intrusive Domain).** Park on right side of road, shoulder is narrow but there is enough room. After stop, continue west on Mitchell, out of town.
21.3 mi	Stay toward left at fork in road.
22.7 mi	Note Gerlinger County Park on right hand side of Road. Note Coast Range topography and intensive forestry practice. There are also good cuts on oxidized colluvium on the left hand side of the road.
24.1 mi	Note Socialist Valley road on right, continue straight, listen for the banjos and the sound of coon dogs barking in the distance.
24.8 mi	Pull off on right shoulder, just before timber gate, where bride crosses the Little Luckiamute. **STOP 5 – Black Rock: Fluvial Geomorphology and Invasive Plant Research (Yamhill-Intrusive Domain)**. End of field trip.

Continue back down river towards Falls City – take Falls City Road East – South onto Kings Valley Highway – East onto Monmouth Highway – Return to Monmouth and WOU.

Field Trip Introduction

- People
  - Trip Leader Introduction
  - Participant Introduction

- Organizations
  - Western Oregon University (Earth Science and Biology)
  - Luckiamute Watershed Council

- Background
  - Luckiamute Watershed – Focus of 2001 WOU Environmental Science Institute Course
    - Undergraduate Science Majors
    - Pre-service Science Education Majors
    - Practicing Science Education Professionals
  - Contextual Learning Modules
    - Geomorphology / Hydrology
    - Field Botany / Aquatic Invertebrates
    - Paleoclimatology / Earth History
    - Environmental Chemistry
  - Synergistic Research and Community Service Linkages
    - WOU Support of Luckiamute Watershed Council
    - Watershed Assessment Activities
    - Hydrogeomorphic Analysis
    - Invasive Plant Studies
  - Funding and Acknowledgments
    - National Science Foundation – OCEPT Project
    - Oregon Community Foundation
    - Western Oregon University
    - US Geological Survey / Oregon State University

- Overview of Field Trip Itinerary (refer to Fig. 1, p. 4)

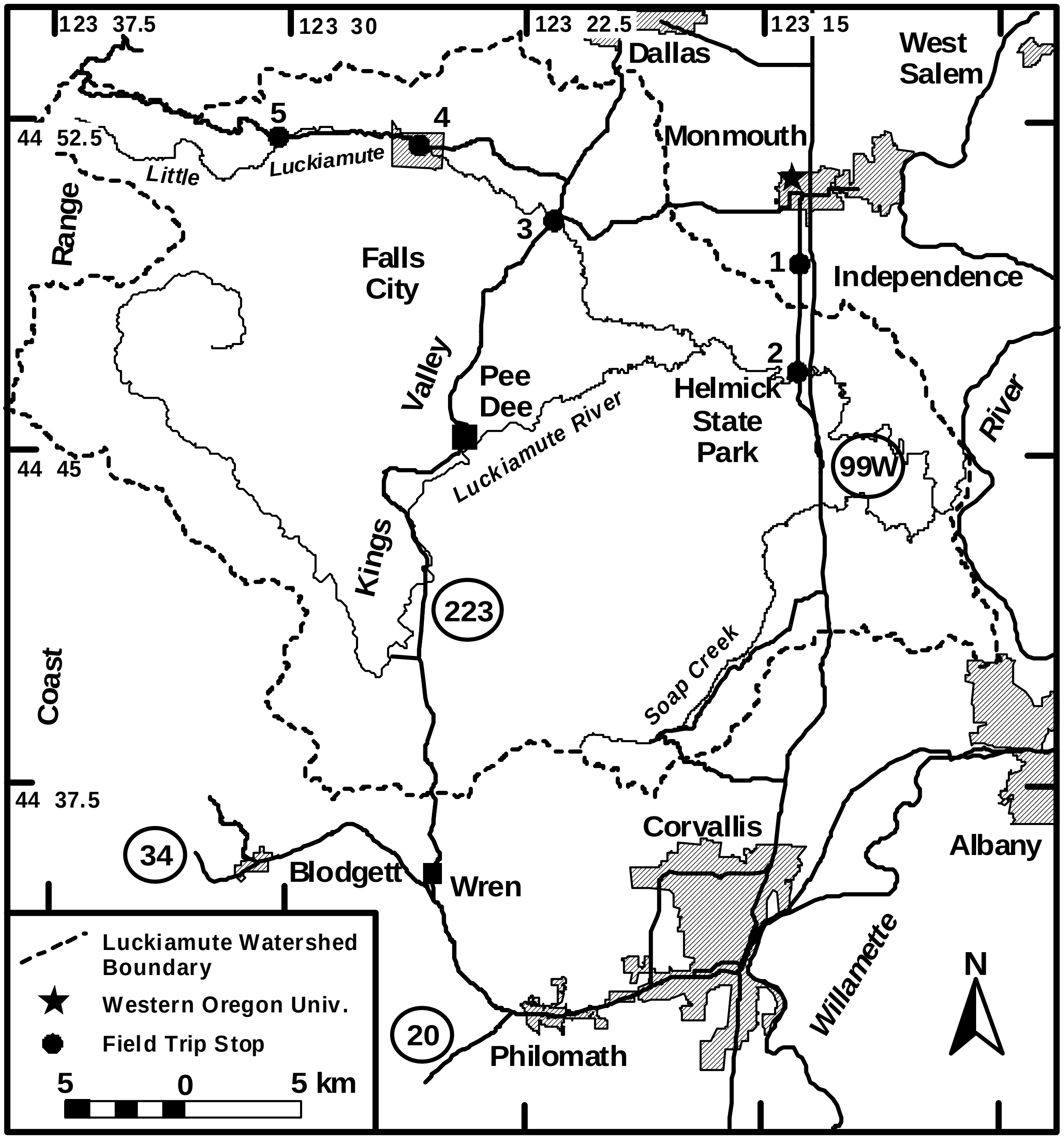


Figure 1. Location map and field trip route for the Luckiamute watershed.

History of Luckiamute Research and Service Learning at Western Oregon University

1999-Present	**WOU Geology and Biology Class Field Trips**
2001	**Environmental Science Institute Course Geomorphology, Env. Chemistry, Botany, Climatology**
2002	**Proposal Development (Watershed Learning Model)**
2003-2004	**Watershed Assessment / Luckiamute Watershed Council**
2003-Present	**Support of Luckiamute Watershed Council**
2004-Present	**Funded Research: Hydrogeomorphic Analysis (USGS-IWW)**
2004-Present	**Funded Reseach: Invasive Plant Distribution (OCF)**

Physiographic Setting of the Luckiamute Watershed

- Boundaries
  - Crest of Coast Range to West (headlands)
  - Willamette River to East

- Drainage Area = 815 km^2

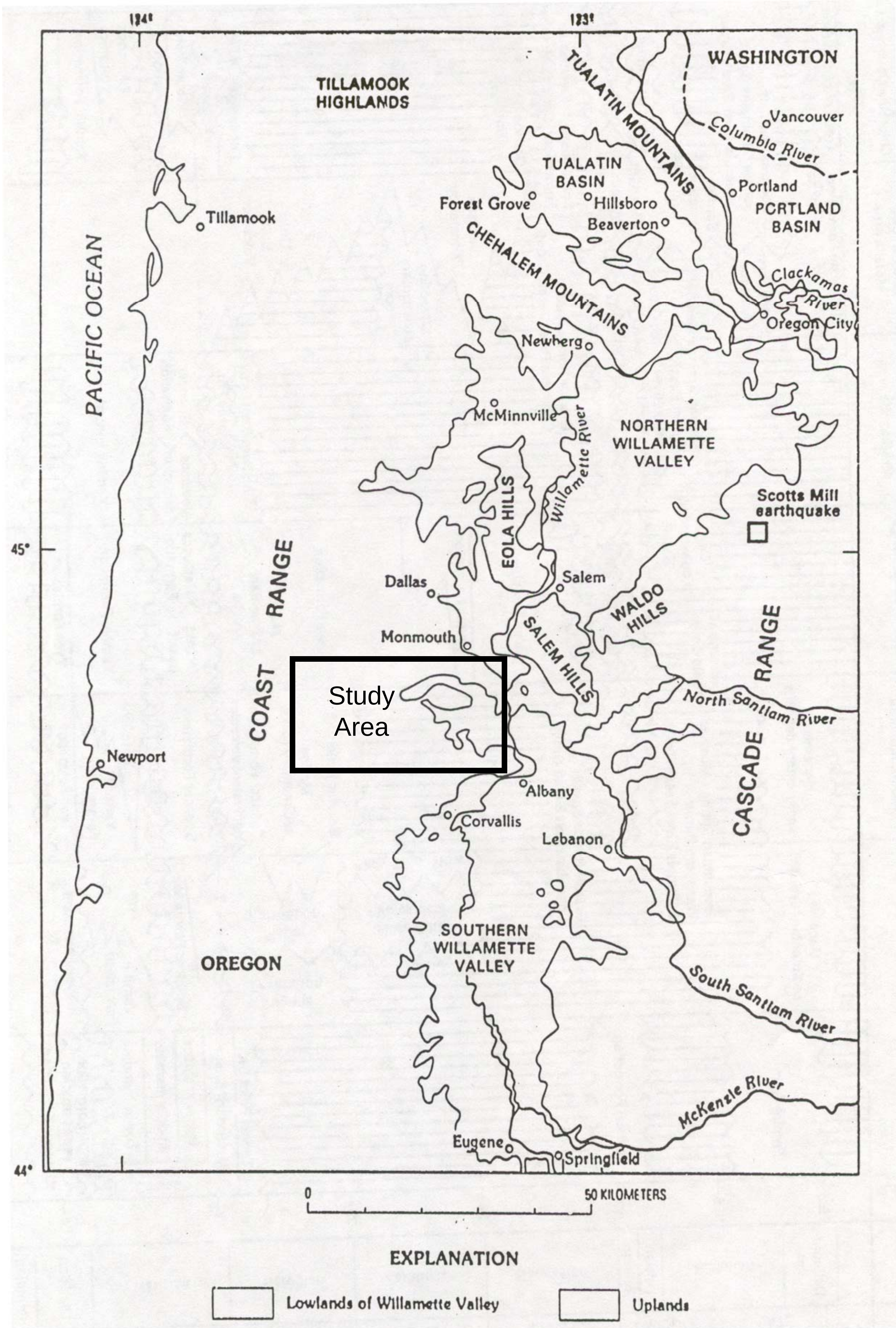
  - Largest Fifth-Field Watershed in central and northern Coast Range

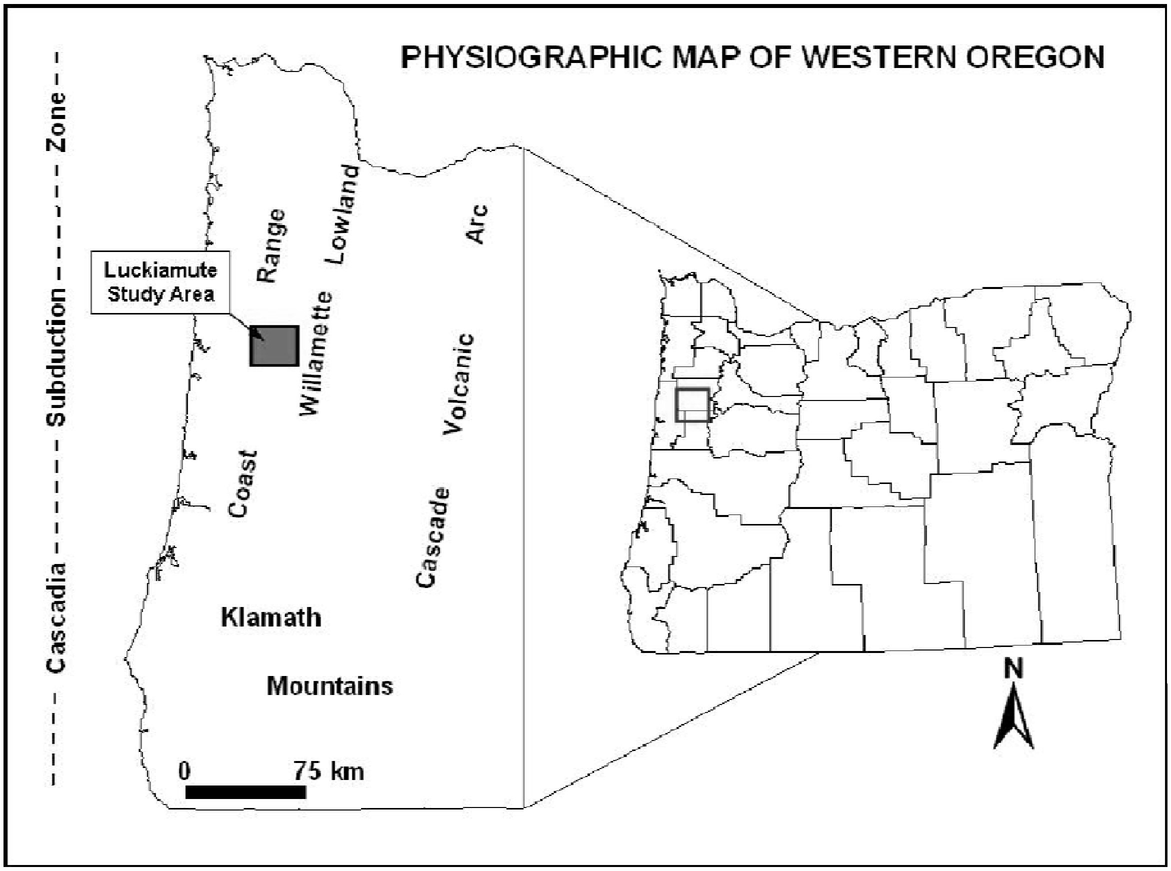
  - Primary Tributaries
    - Little Luckiamute – northern watershed
    - Luckiamute – southern watershed

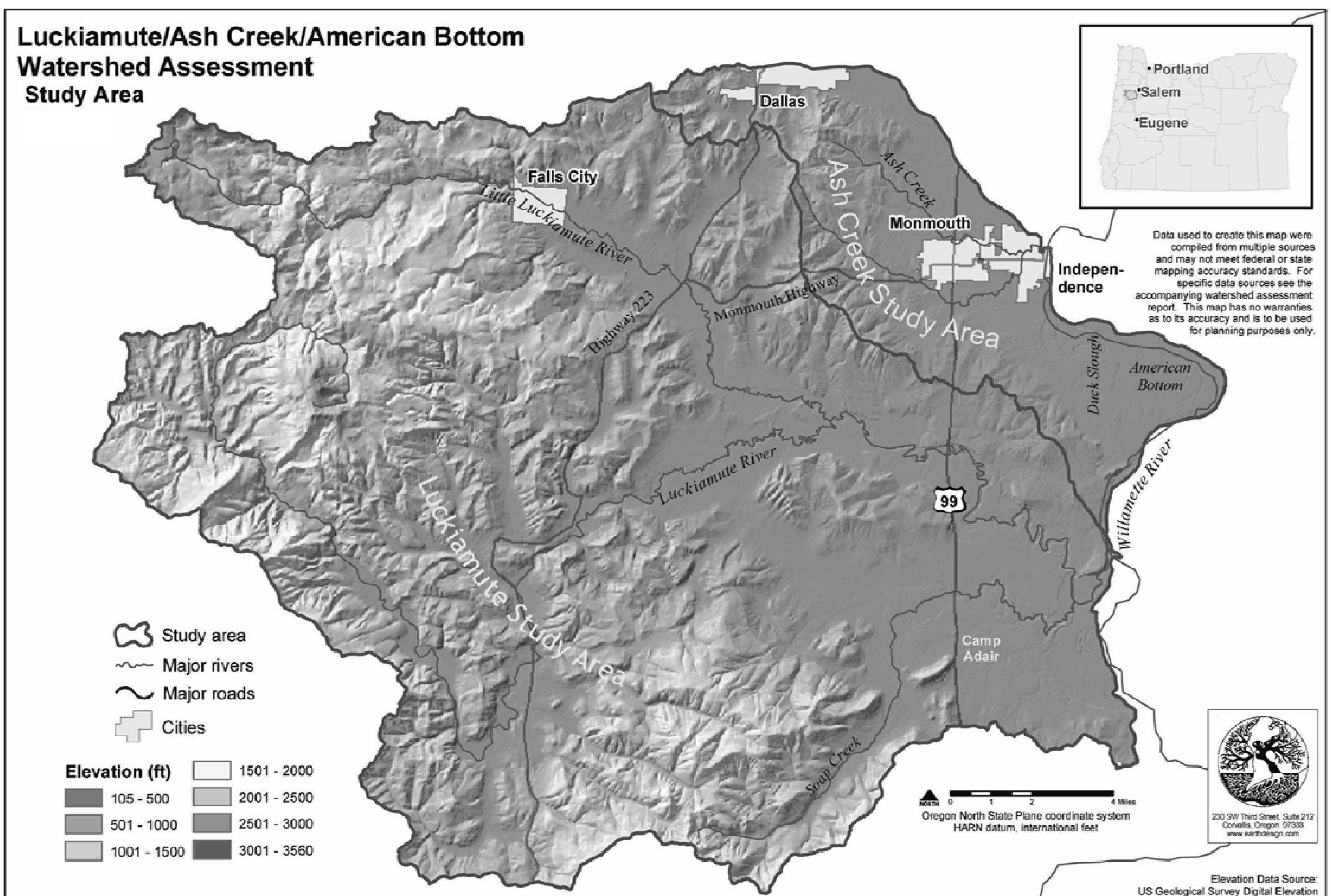
  - Secondary Tributaries
    - Soap Creek, Maxfield Creek, Woods Creek, Teal Ck

- Elevation Range:
  - Min: 46 m (150 ft) at Willamette
  - Max: 1016 m (3333 ft) at Fanno Peak
  - Avg. Basin Elevation: 277 m (910 ft)

- Basin Morphometry
  - Average Stream Gradient: 3 m /km
  - Total Stream Length: 90.7 km


124°
123°
WASHINGTON
TILLAMOOK HIGHLANDS
TUALATIN MOUNTAINS
Vancouver
Columbia River
TUALATIN BASIN
Portland
Forest Grove
Hillsboro
PORTLAND BASIN
Tillamook
Beaverton
CHEHALEM MOUNTAINS
Clackamas River
Oregon City
PACIFIC OCEAN
Newberg
McMinnville
Willamette River
NORTHERN WILLAMETTE VALLEY
Scotts Mill earthquake
EOLA HILLS
45°
Salem
Dallas
WALDO HILLS
COAST RANGE
SALEM HILLS
Monmouth
Study Area
North Santiam River
CASCADE RANGE
Newport
Albany
Corvallis
Lebanon
SOUTHERN WILLAMETTE VALLEY
OREGON
South Santiam River
McKenzie River
Eugene
Springfield
44°
0
50 KILOMETERS
EXPLANATION
Lowlands of Willamette Valley
Uplands





From Luckiamute Watershed Council

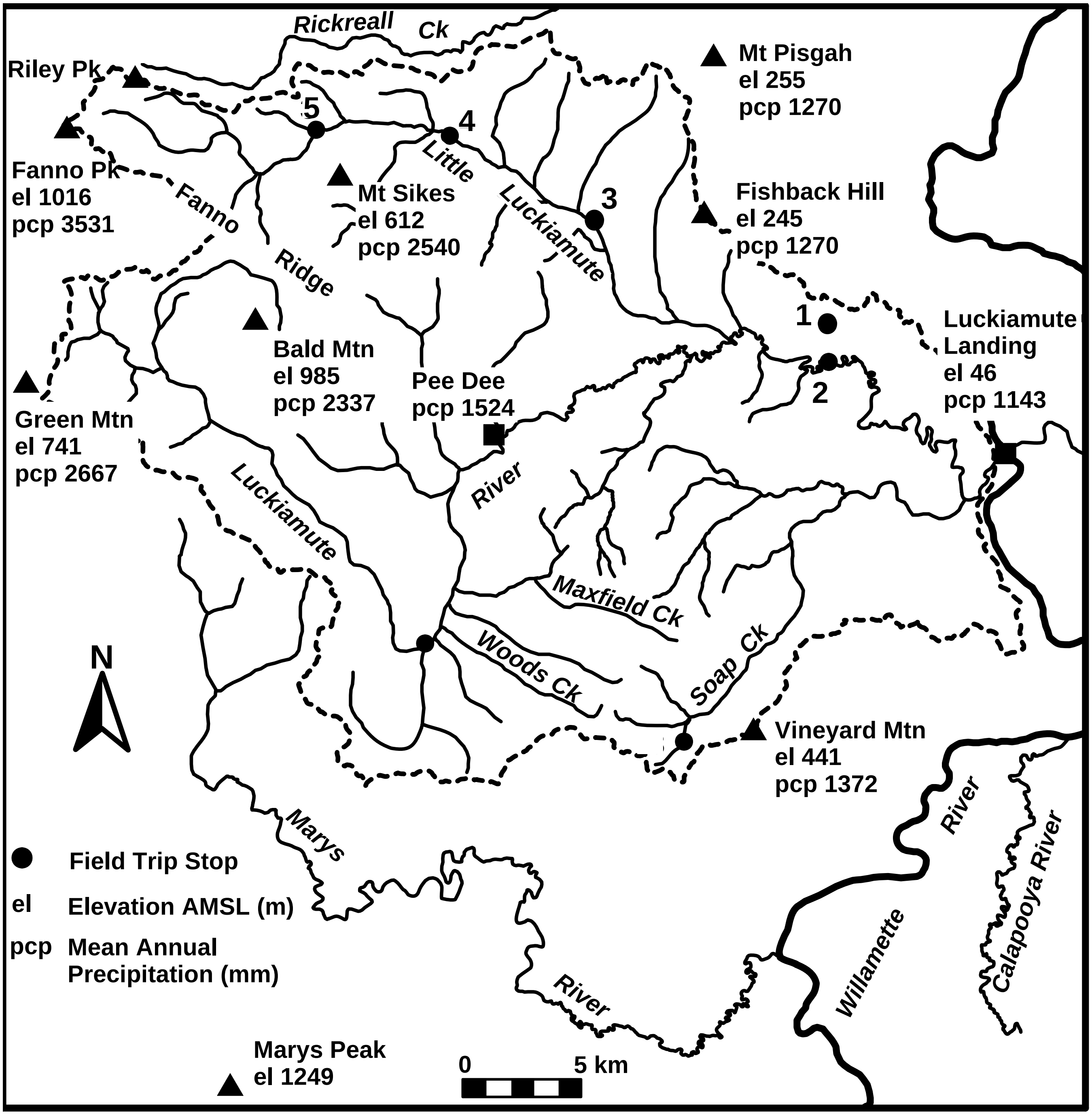
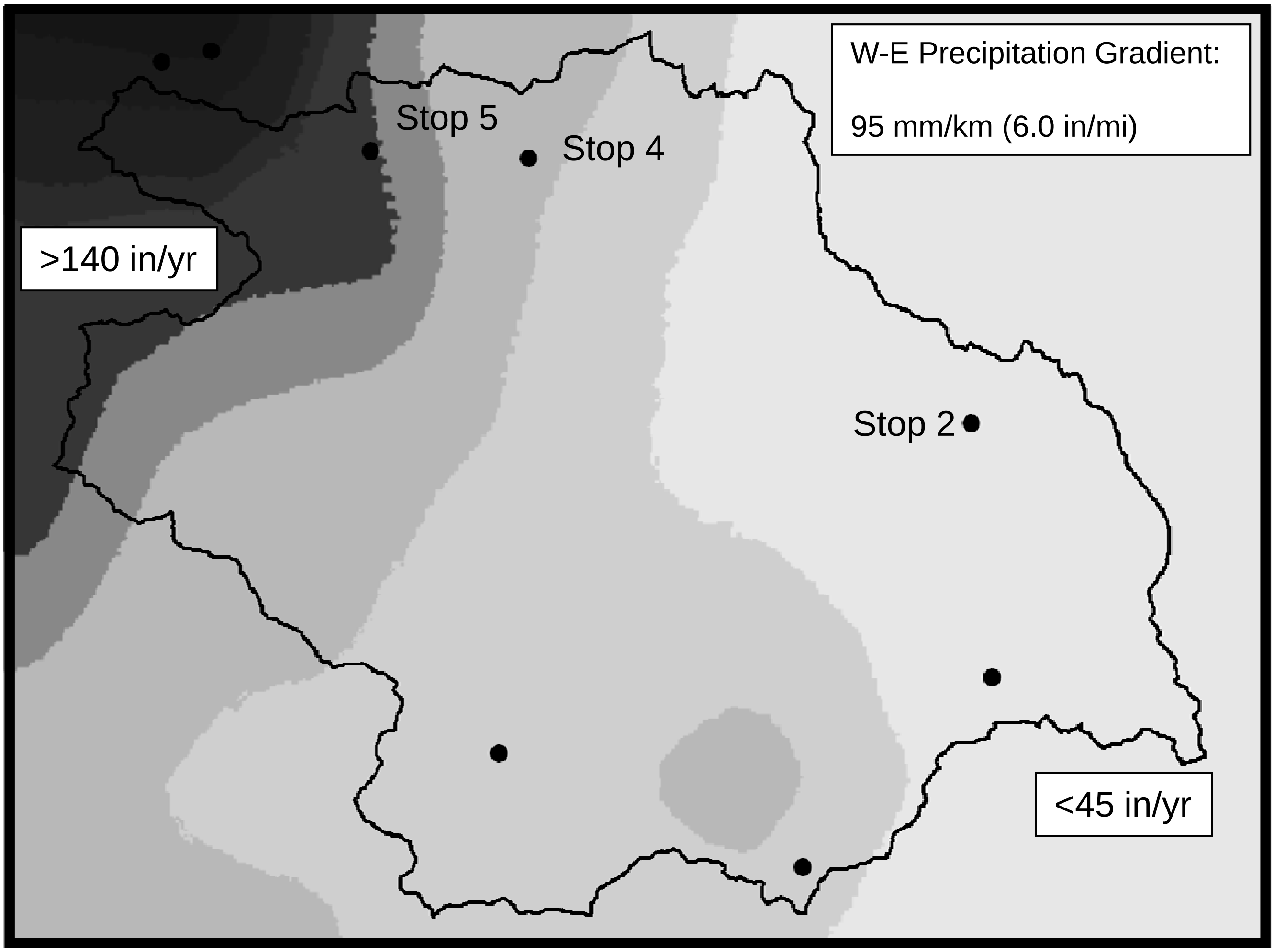
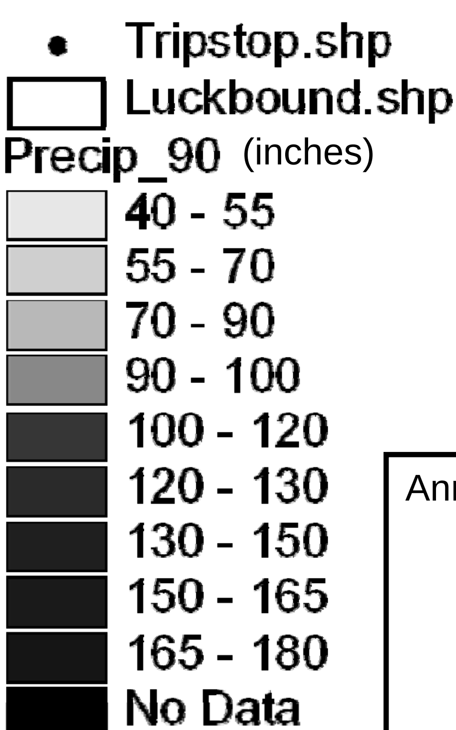


Figure 2. Physiographic map and spot annual precipitation for the Luckiamute Watershed.

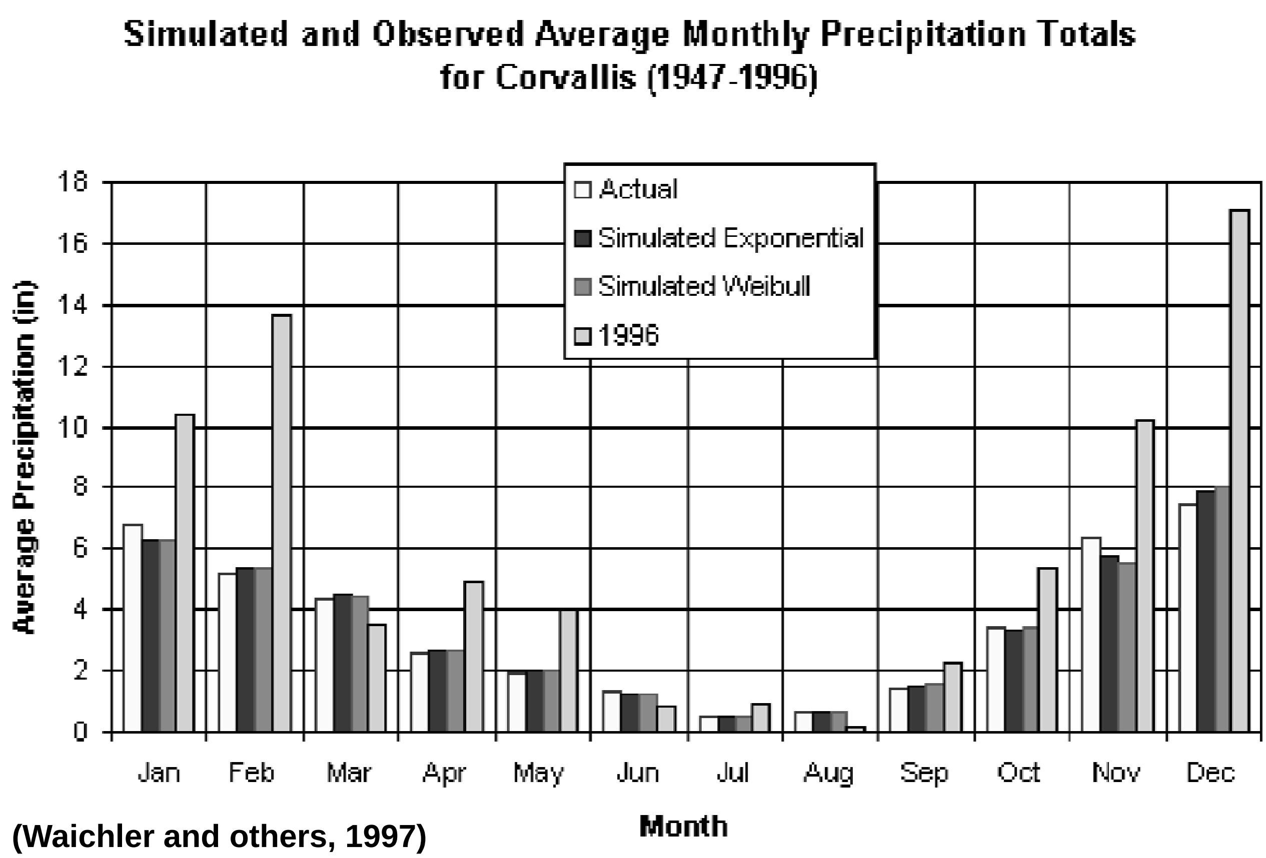




1990 Average Annual Precipitation for the Luckiamute Watershed (inches) (from the Oregon Climate Service)

Annual Precipitation
- Basin Maximum: 3600 mm (>140 in) – Divide
- Basin Minimum: 1140 mm (~45 in) – Willamette Valley
- Basin-wide Precipitation Average = 1894 mm (~75 in)
- Seasonal Precipitation Cycle (October – March)

Average Runoff = 61% of Annual Precipitation



(Waichler and others, 1997)

Water Balance of Luckiamute Watershed

Period (1961-1990)	Mean Precipitation (mm)	Precip. (Input) (m^3)	Observed Mean Discharge (cfs)	Observed Total Discharge (m^3)	Difference (Precip-Discharge) (m^3)	Difference as % of Precip. ("%LOSS")
Annual	1894	1.23E+09		7.55E+08	4.77E+08	39%
Jan	335	2.18E+08	2232.146	1.69E+08	4.86E+07	22%
Feb	258	1.68E+08	1853.276	1.27E+08	4.09E+07	24%
Mar	216	1.41E+08	1472.097	1.12E+08	2.89E+07	21%
Apr	101	6.57E+07	795.9956	5.84E+07	7.27E+06	11%
May	51.9	3.38E+07	396.072	3.00E+07	3.72E+06	11%
Jun	41.7	2.71E+07	188.61	1.38E+07	1.33E+07	49%
Jul	11.3	7.35E+06	71.32473	5.41E+06	1.94E+06	26%
Aug	23.8	1.55E+07	37.25441	2.83E+06	1.27E+07	82%
Sep	50.3	3.27E+07	49.19311	3.61E+06	2.91E+07	89%
Oct	143	9.30E+07	124.4226	9.44E+06	8.36E+07	90%
Nov	284	1.85E+08	904.1411	6.64E+07	1.18E+08	64%
Dec	378	2.46E+08	2069.228	1.57E+08	8.89E+07	36%

Water budget for Luckiamute Watershed (Waichler and others, 1997)

Tectonic Setting of the Luckiamute Watershed

- Convergent Tectonic Margin
  - Subduction of Juan de Fuca Plate Beneath North America
    - Convergent Rates: 3.5-4.0 cm/yr
  - Style of Tectonism
    - Oblique Convergence
    - Tectonic accretion
    - Clockwise Rotation
- Coast Range Orogenesis
  - Accreted Marine Volcanic and Sedimentary Rocks
  - Active Uplift Between 15-10 Ma to Present
  - Neotectonics
    - General Uplift and Eastward Tilting
- Tectonic Influence on Luckiamute
  - Luckiamute drains the eastward tilted flanks of the Coast Range (Rhea, 1993)
  - Luckiamute Watershed located at segment boundary of Juan de Fuca Subduction zone

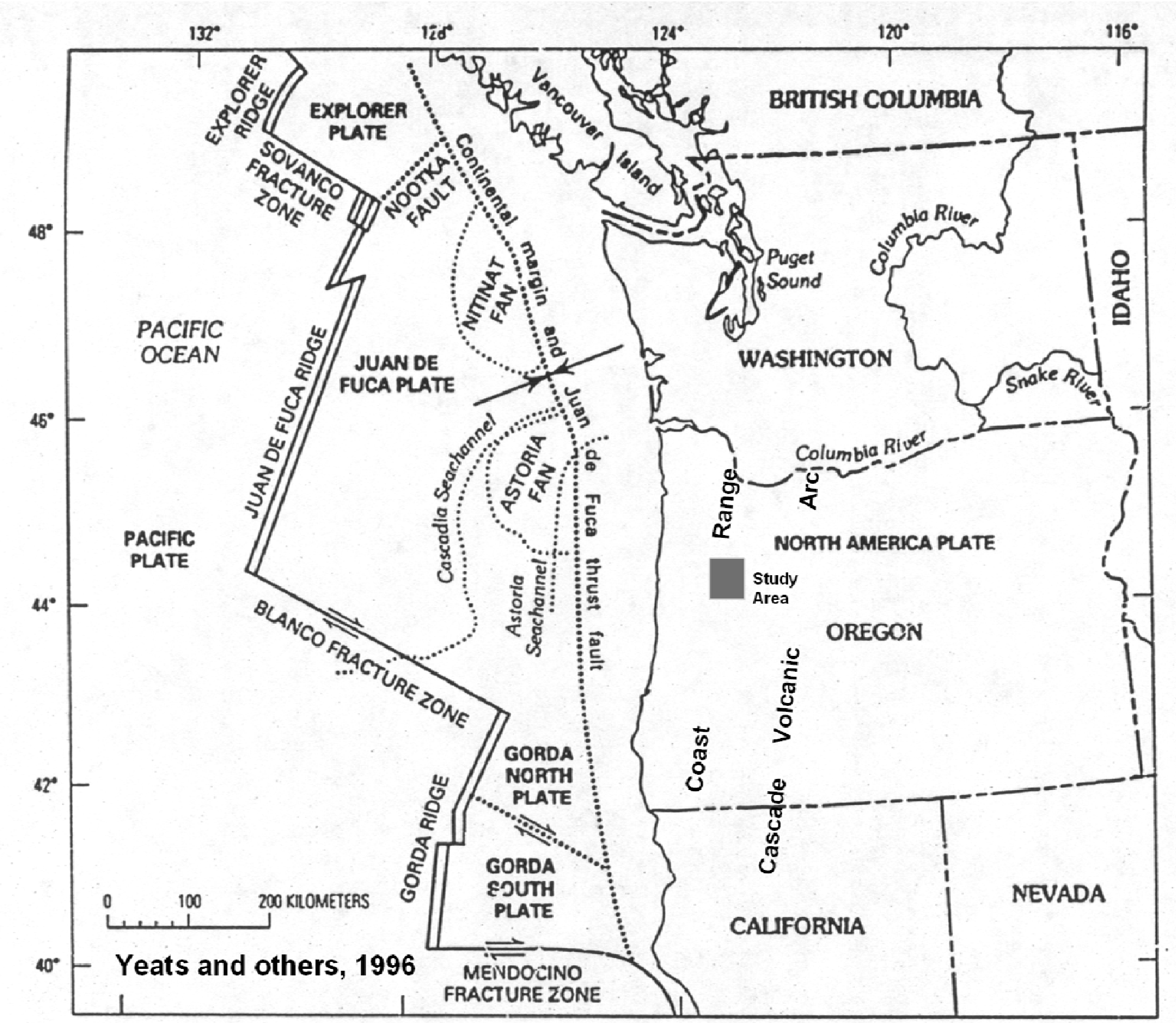
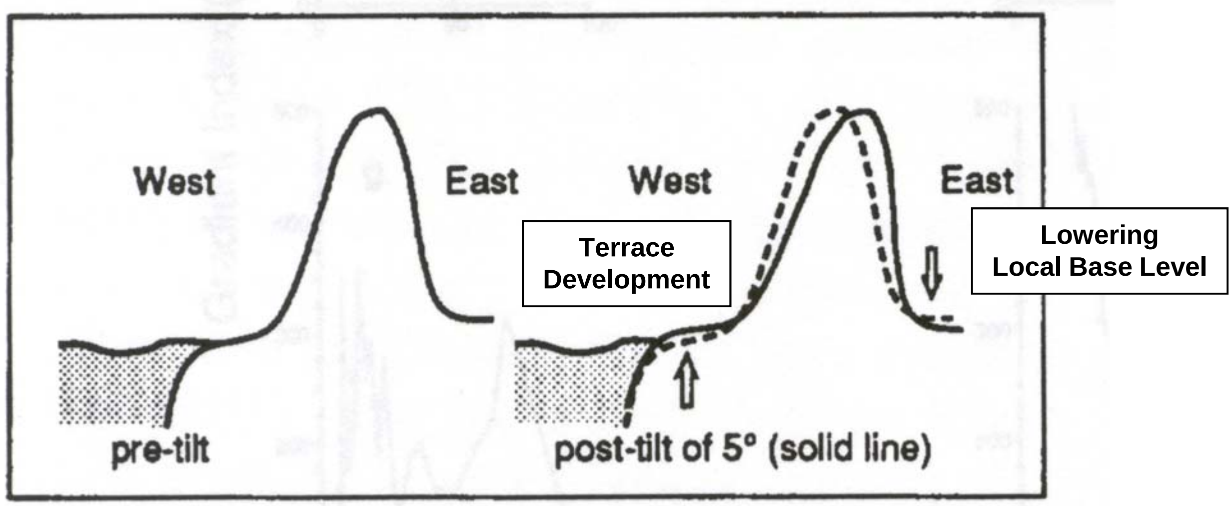
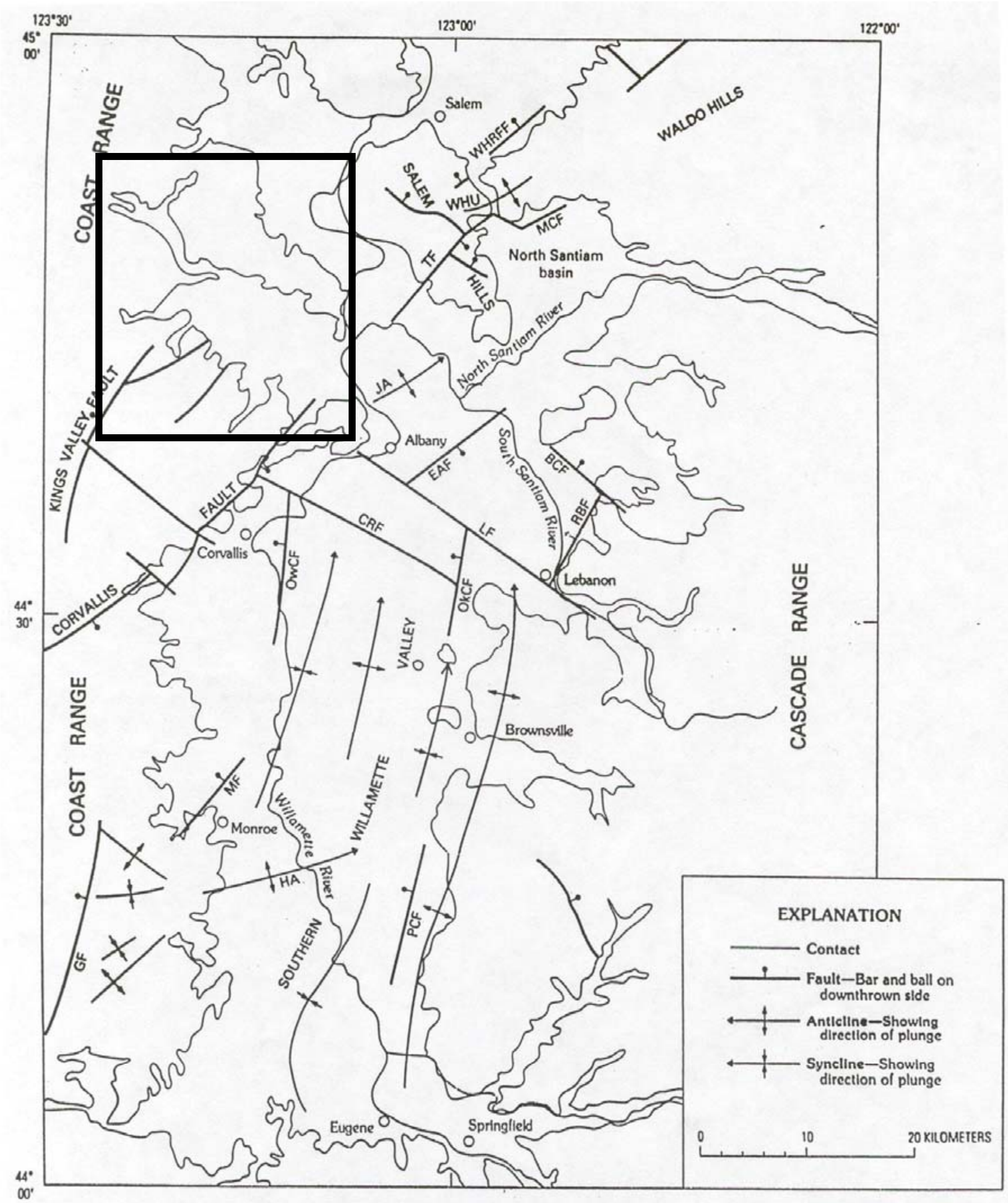
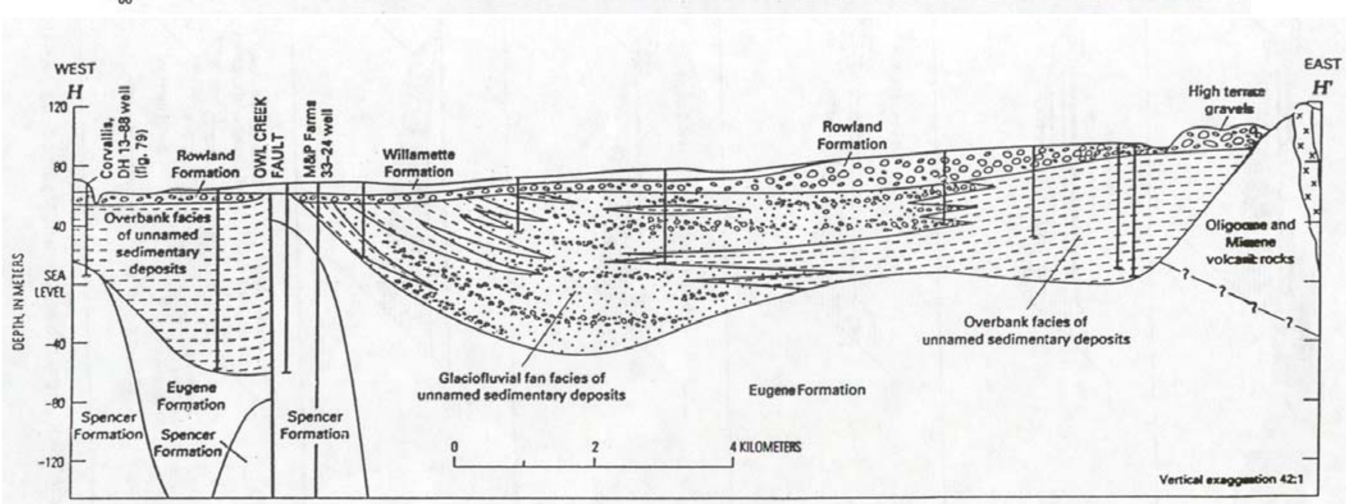


Plate tectonic configuration of the Pacific Northwest.



Cartoon showing effects of Coast Range tilting on watershed gradient (from Rhea, 1993)


123°30'
45°
00'
123°00'
122°00'
Salem
WALDO HILLS
WHRFF
SALEM
WHU
MCF
TF
HILLS
North Santiam
basin
North Santiam River
COAST RANGE
KINGS VALLEY FAULT
JA
Albany
EAF
South Santiam River
BCF
RBF
FAULT
CRF
LF
Corvallis
OwCF
OkCF
Lebanon
44°
30'
CORVALLIS
VALLEY
CASCADE RANGE
COAST RANGE
Brownsville
MF
Monroe
Willamette River
WILLAMETTE
HA
GF
SOUTHERN
PCF
Eugene
Springfield
44°
00'
EXPLANATION
Contact
Fault—Bar and ball on downthrown side
Anticline—Showing direction of plunge
Syncline—Showing direction of plunge
0
10
20 KILOMETERS


WEST
H
EAST
H'
120
80
40
SEA LEVEL
-40
-80
-120
DEPTH, IN METERS
Corvallis, DH 13-88 well (fig. 79)
Rowland Formation
OWL CREEK FAULT
M&P Farms 33-24 well
Willamette Formation
Rowland Formation
High terrace gravels
Overbank facies of unnamed sedimentary deposits
Oligocene and Miocene volcanic rocks
Overbank facies of unnamed sedimentary deposits
Glaciofluvial fan facies of unnamed sedimentary deposits
Eugene Formation
Eugene Formation
Spencer Formation
Spencer Formation
Spencer Formation
0
2
4 KILOMETERS
Vertical exaggeration 42:1

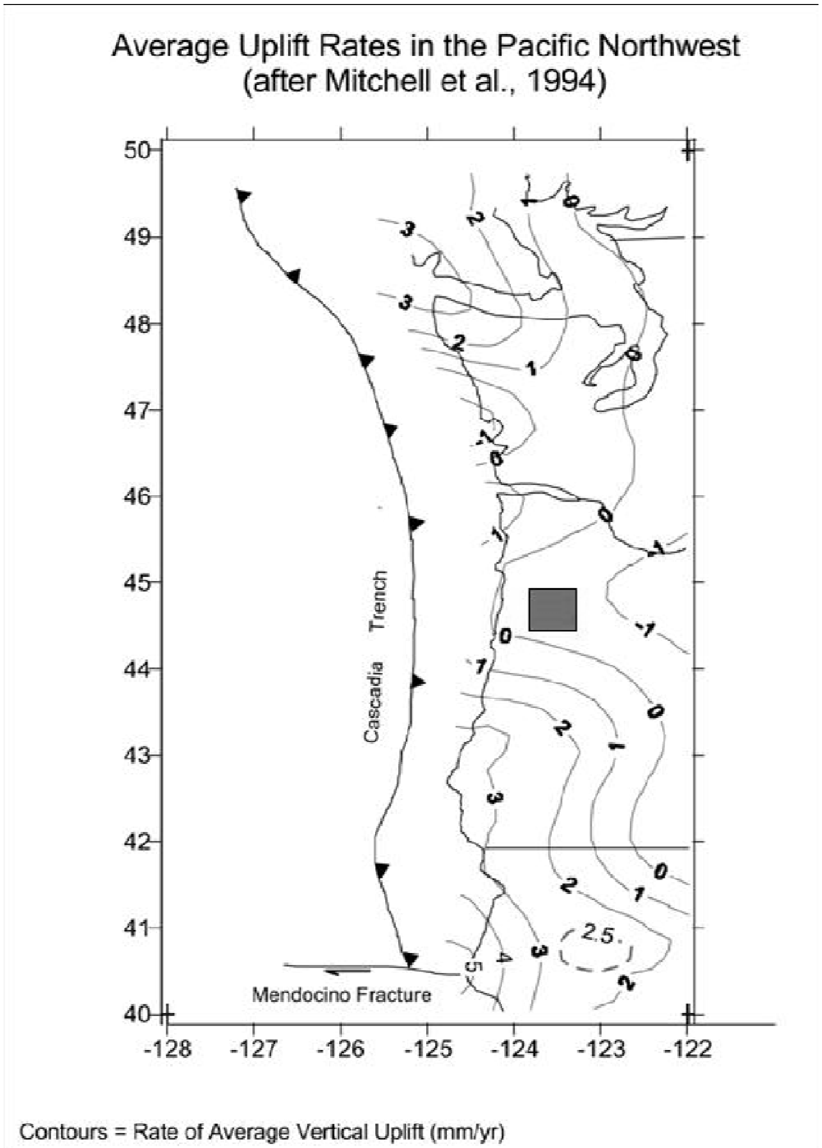
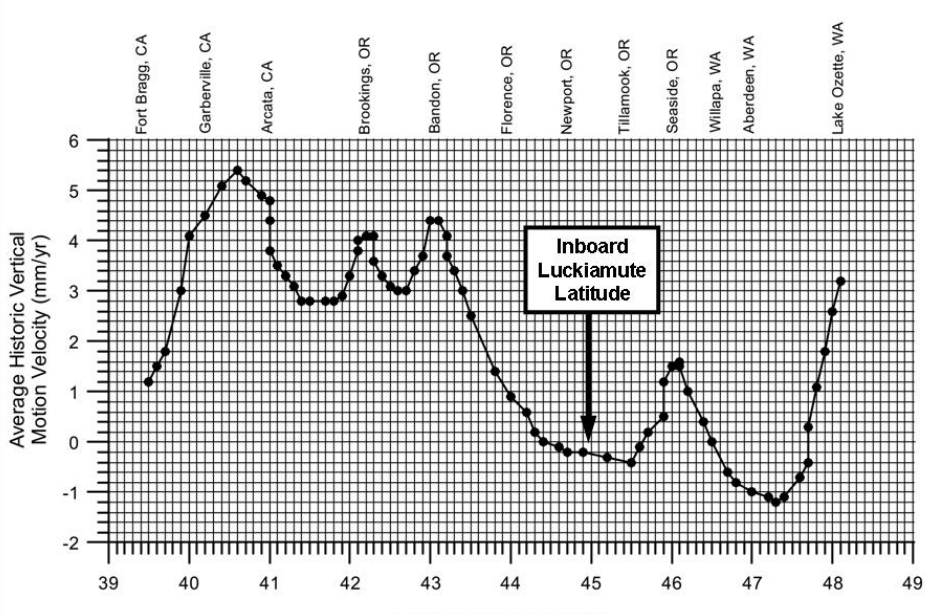


Figure 7. Plot of South-to-North Average Uplift Rate Profiles Along the Coast of the Pacific Northwest



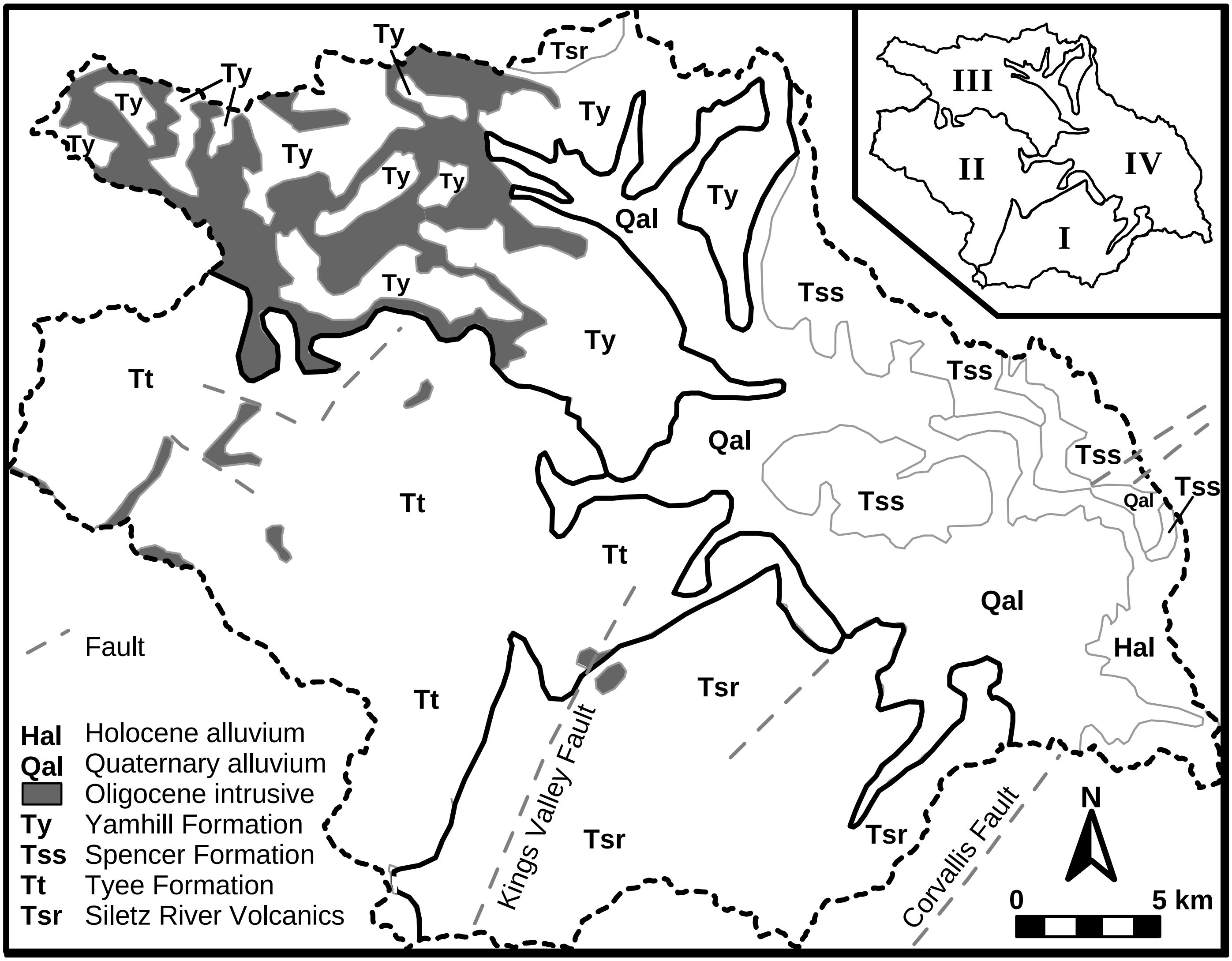
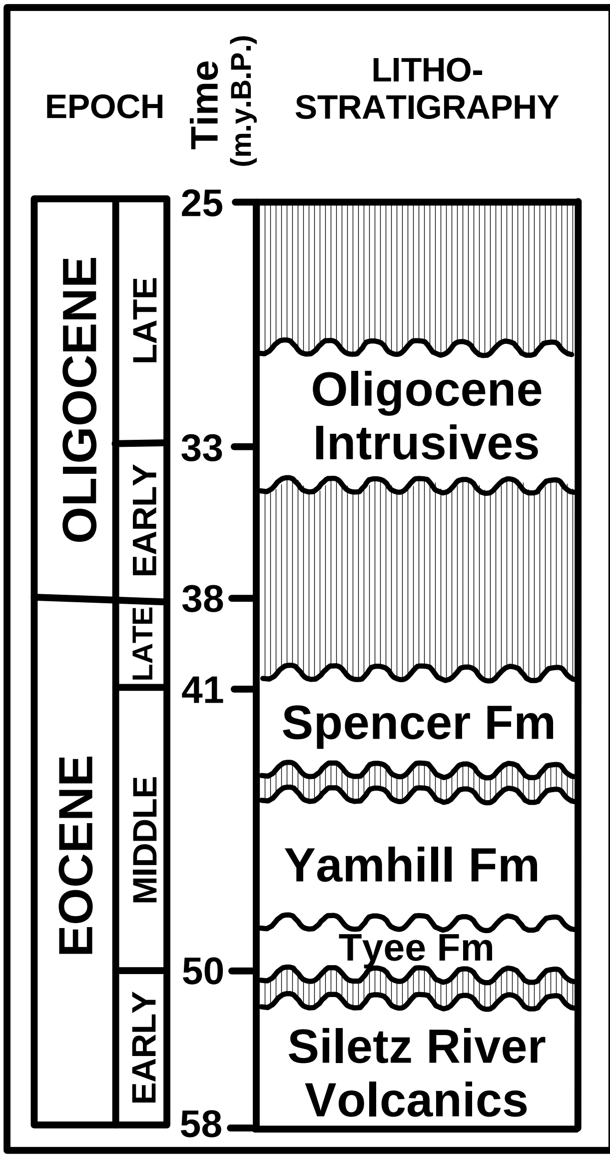


Figure 3. Bedrock geology of the Luckiamute Watershed (after Walker and MacLeod, 1991). Inset map shows grouping of recognized lithospatial domains: I = Siletz River Domain, II = Tyee Domain, III = Yamihill-Ti (Tertiary Intrusive) Domain, IV = Spencer-Valley Fill Domain.

Bedrock Geology of the Luckiamute Watershed



Qal – Quaternary Alluvium

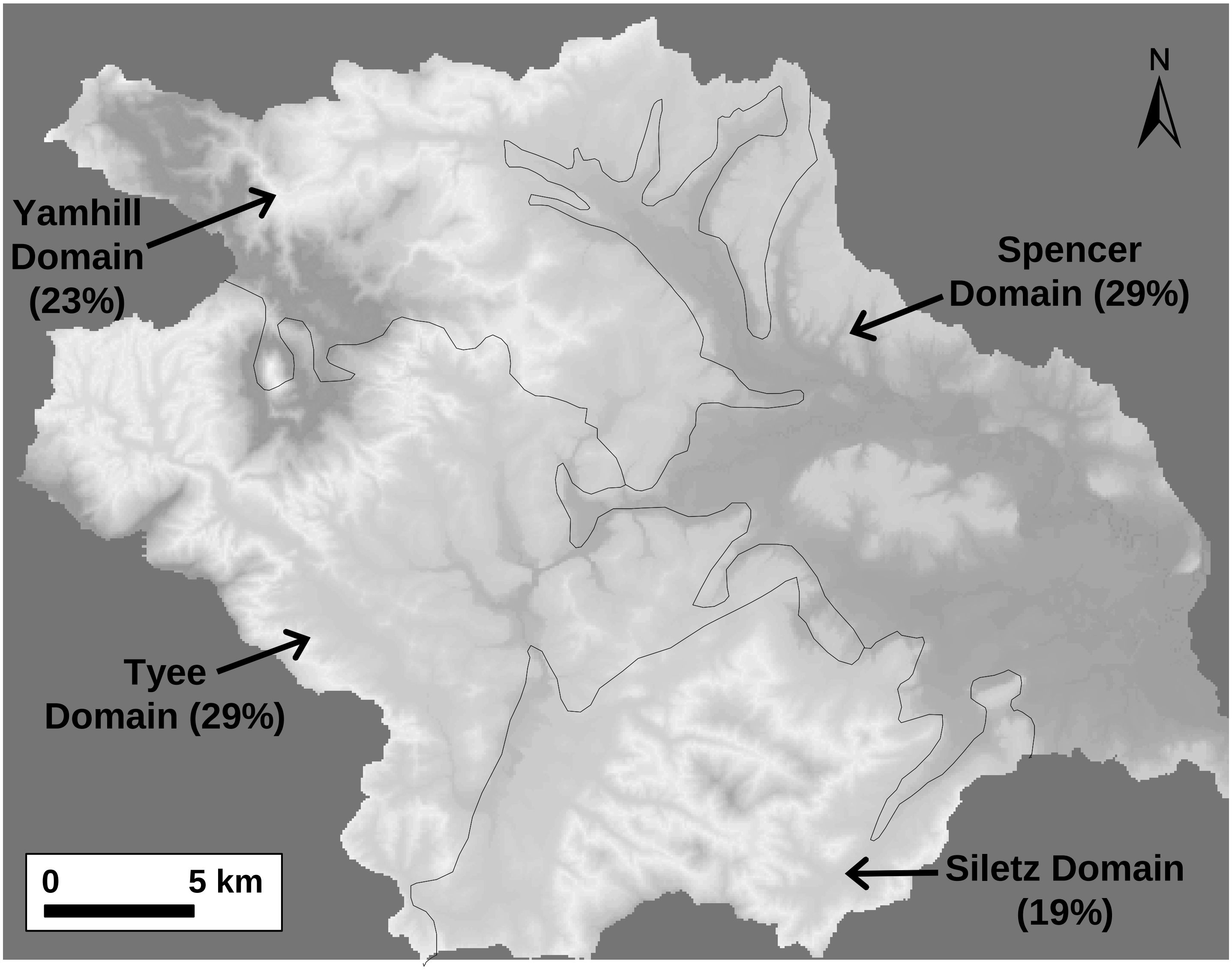
Ti – Oligocene Mafic Intrusives: Sheets, sills, and dikes of massive gabbro.

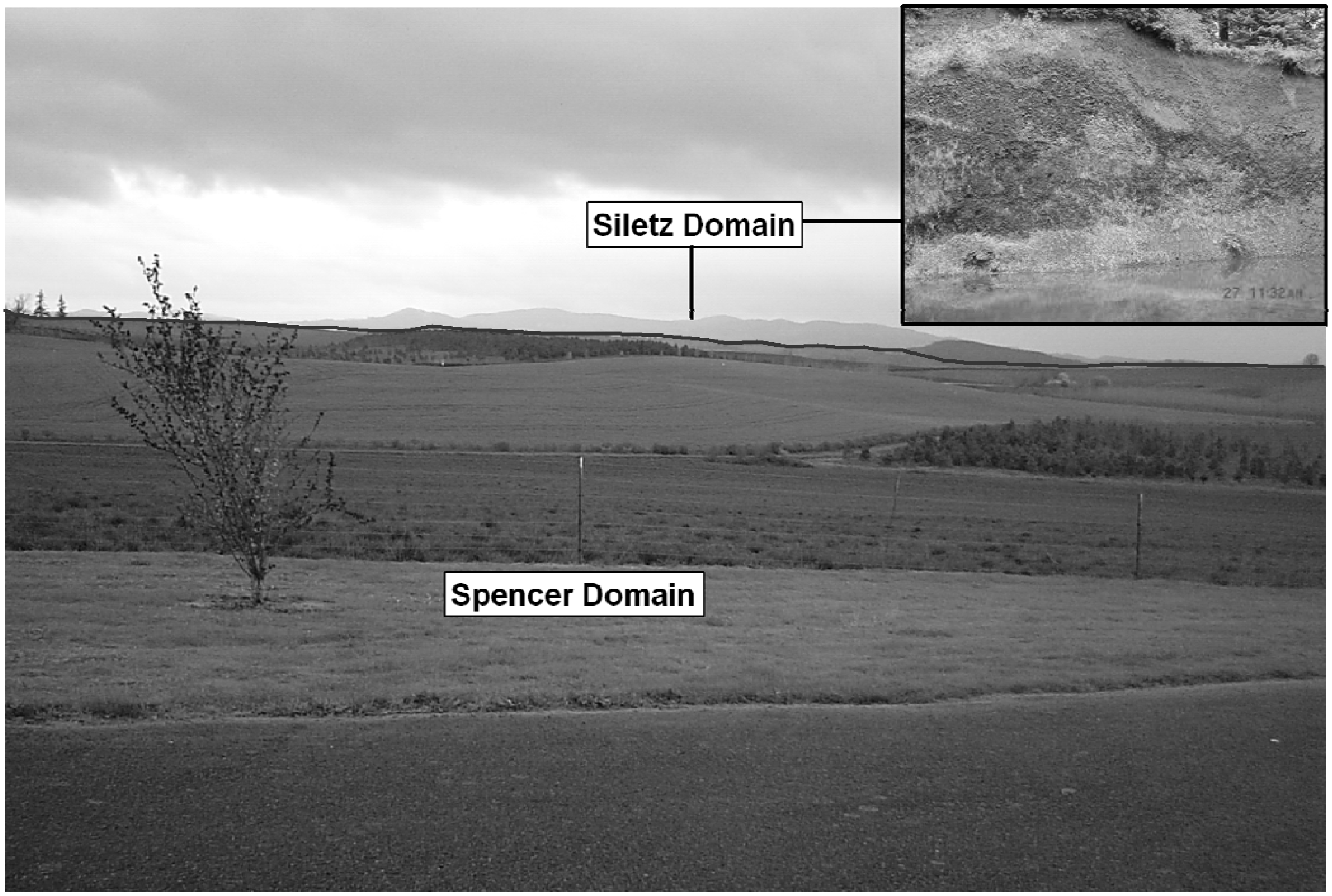
Tss – Spencer Formation: Thick- to thin-bedded marine tuffaceous sandstone, siltstone, and mudstone.

Ty – Yamhill Formation: Massive to thinly bedded marine silstone and sandtone interbeds. Locally includes interlayered basalt lava flows.

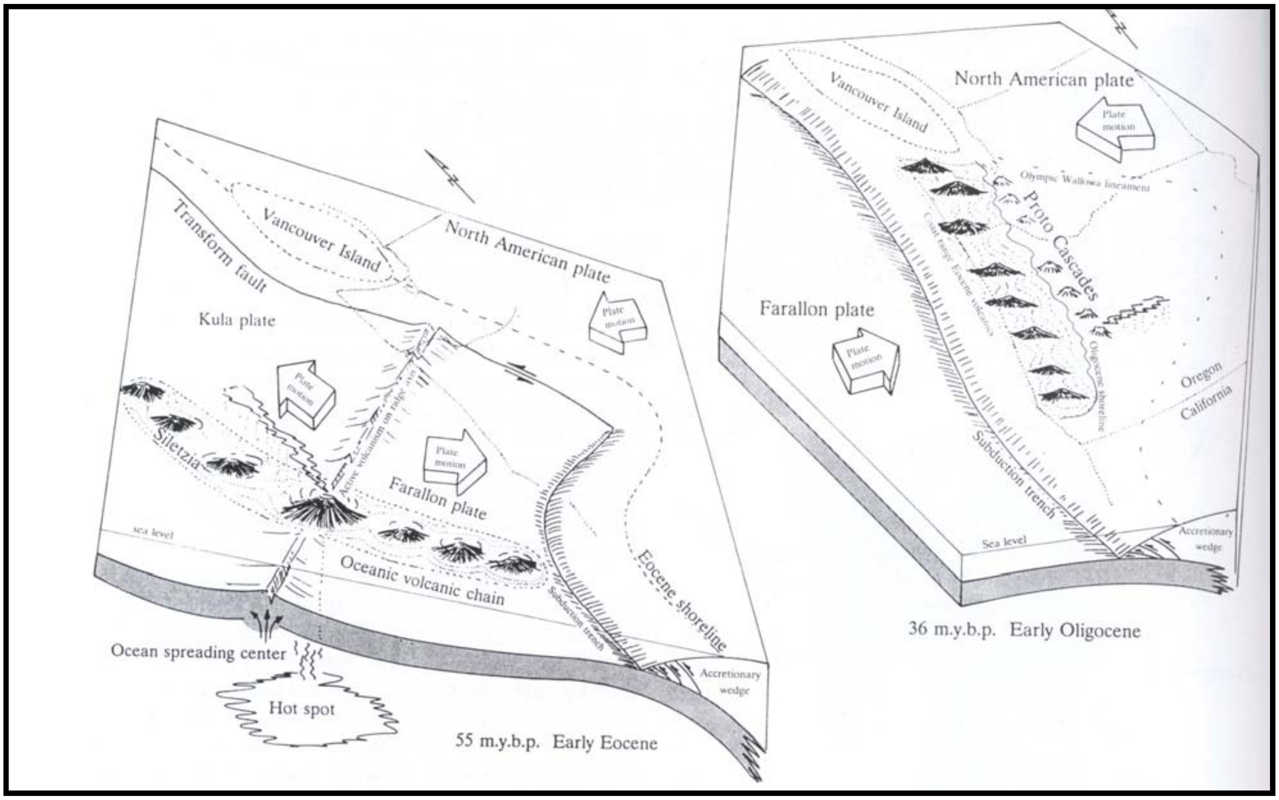
Tt – Tyee Formation: Rhythmically bedded, medium-grained feldspathic sandstone and carbonaceous siltstone. Interpreted as deposits of submarine turbidity currents and fans.

Tsr – Siletz River Volcanics: Aphanitic to porphyritic, vesicular pillow flows, tuff breccia, and lava flows. Local interbeds of basaltic siltstone and sandstone. Prevasively zeolitized and veined with calcite. Marine origin interpreted as accreted oceanic crust and seamounts.

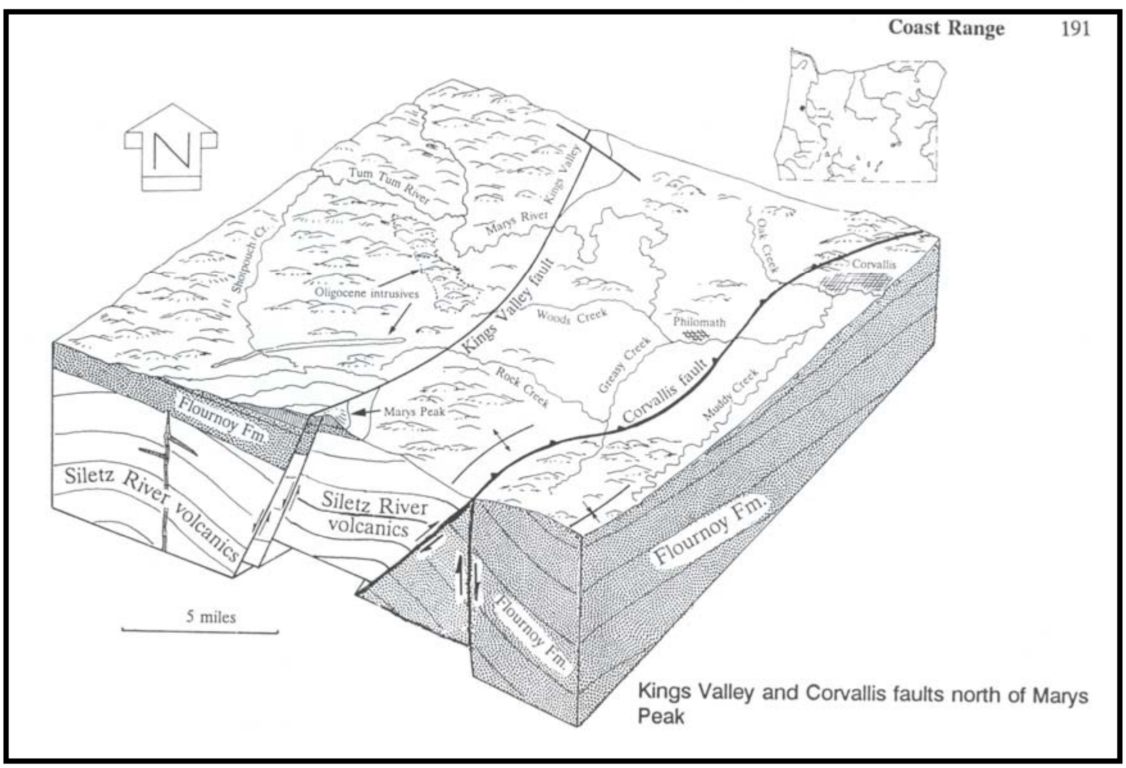

Yamhill
Domain
(23%)
Spencer
Domain (29%)
N
Tyee
Domain (29%)
0
5 km
Siletz Domain
(19%)



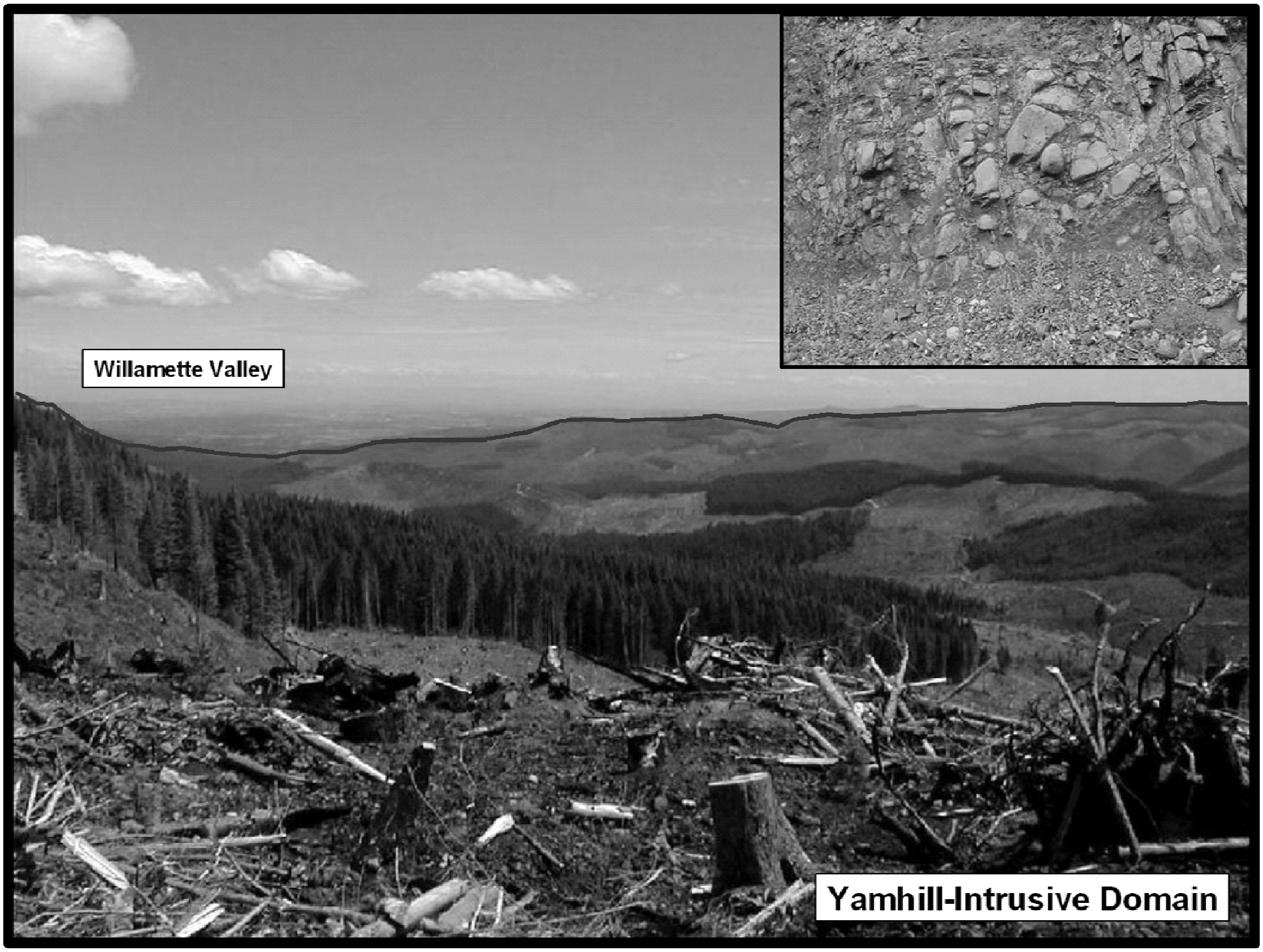
Siletz River Volcanics – Pillow Basalts

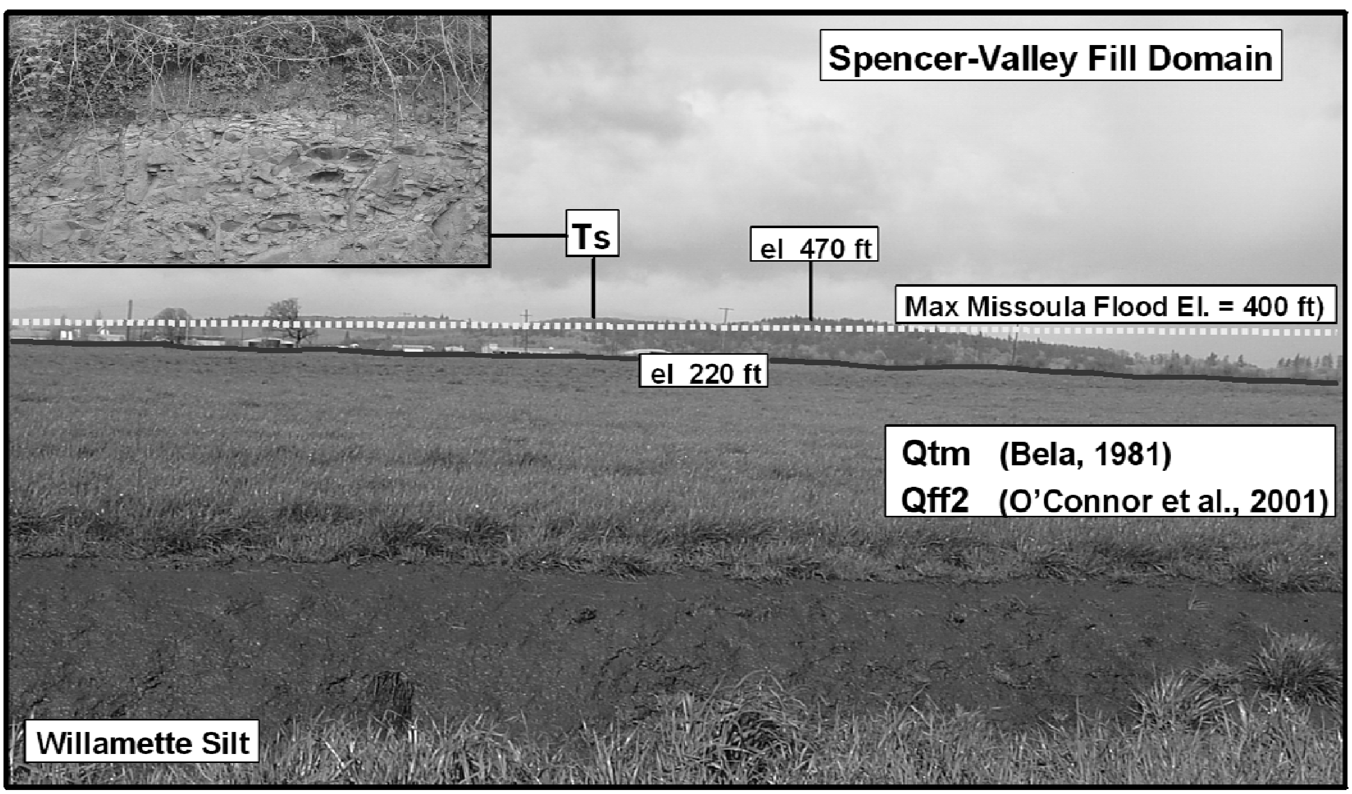


Accretionary tectonic model for Siletz River Volcanics (from Orr and Orr, 1999)



Schematic of Corvallis and Kings Valley Faults (from Orr and Orr 1999)


Willamette Valley
Yamhill-Intrusive Domain


Spencer-Valley Fill Domain
Ts
el 470 ft
Max Missoula Flood El. = 400 ft)
el 220 ft
Qtm (Bela, 1981)
Qff2 (O'Connor et al., 2001)
Willamette Silt

Tyee Domain Landscape

Geomorphology of the Luckiamute Watershed

Valley Floor-Fluvial Regime
- Landforms
  - Channel
  - Floodplain
  - Terrace
  - Small-scale Fans
  - Strath-pediment surfaces
  - Low-relief colluvial hillslopes (Spencer Fm)
- Deposits
  - Alluvial Fill (sorted sand and gravel)
  - Debris Flow Deposits (diamicton)
  - Slackwater Silts and Clay
- Processes
  - Channel Transport
  - Overbank Sedimentation

- Hillslope-Colluvial Regime
  - Landforms
    - Ridge tops
    - Hillslopes-Sideslopes
    - Hollows
    - Pediment Surfaces
  - Deposits
    - Colluvium (gravel diamicton)
    - Residuum (gravel diamicton)
  - Processes
    - Collvial Creep
    - Debris Slide / Flow
    - Tree-throw / Bioturbation

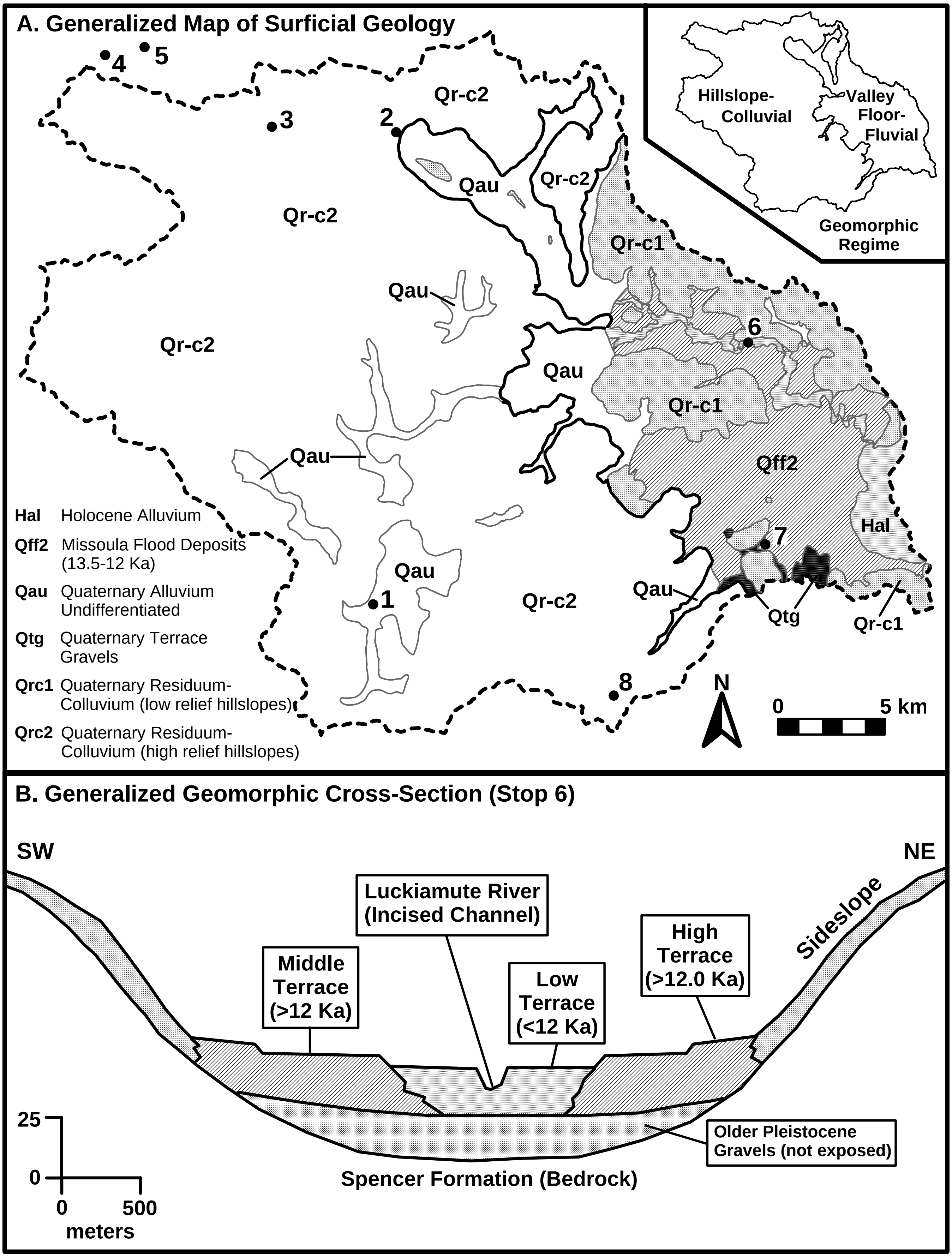
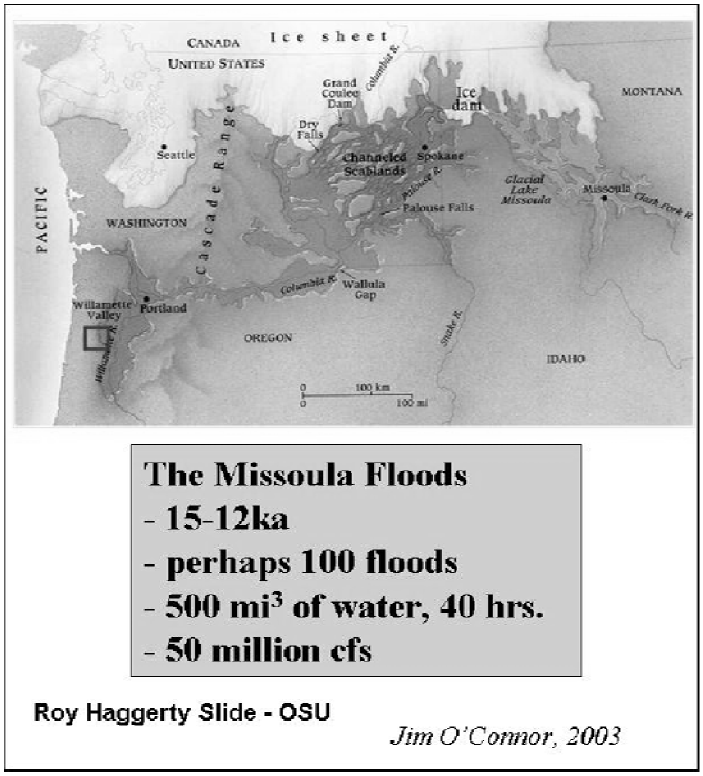
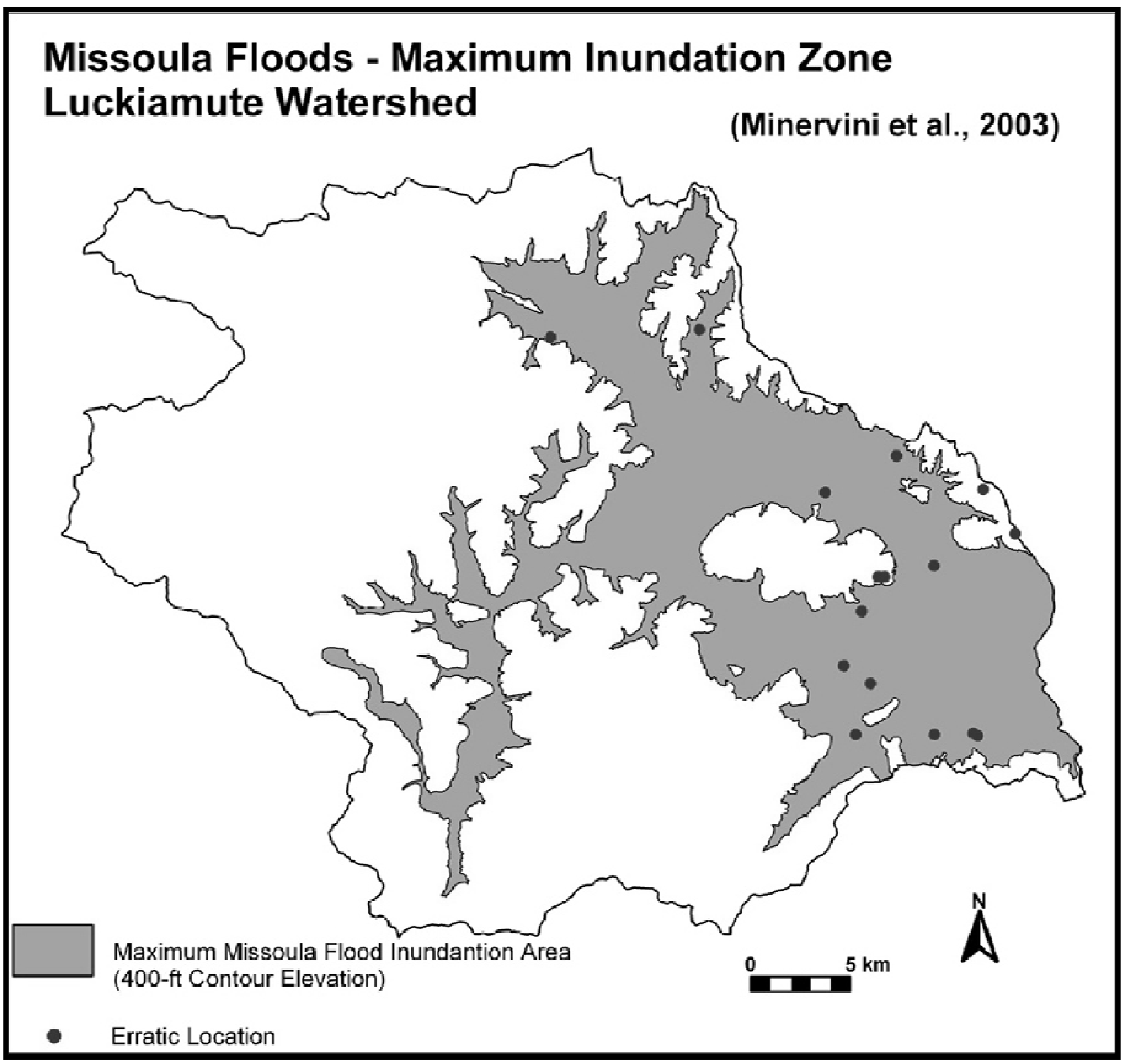
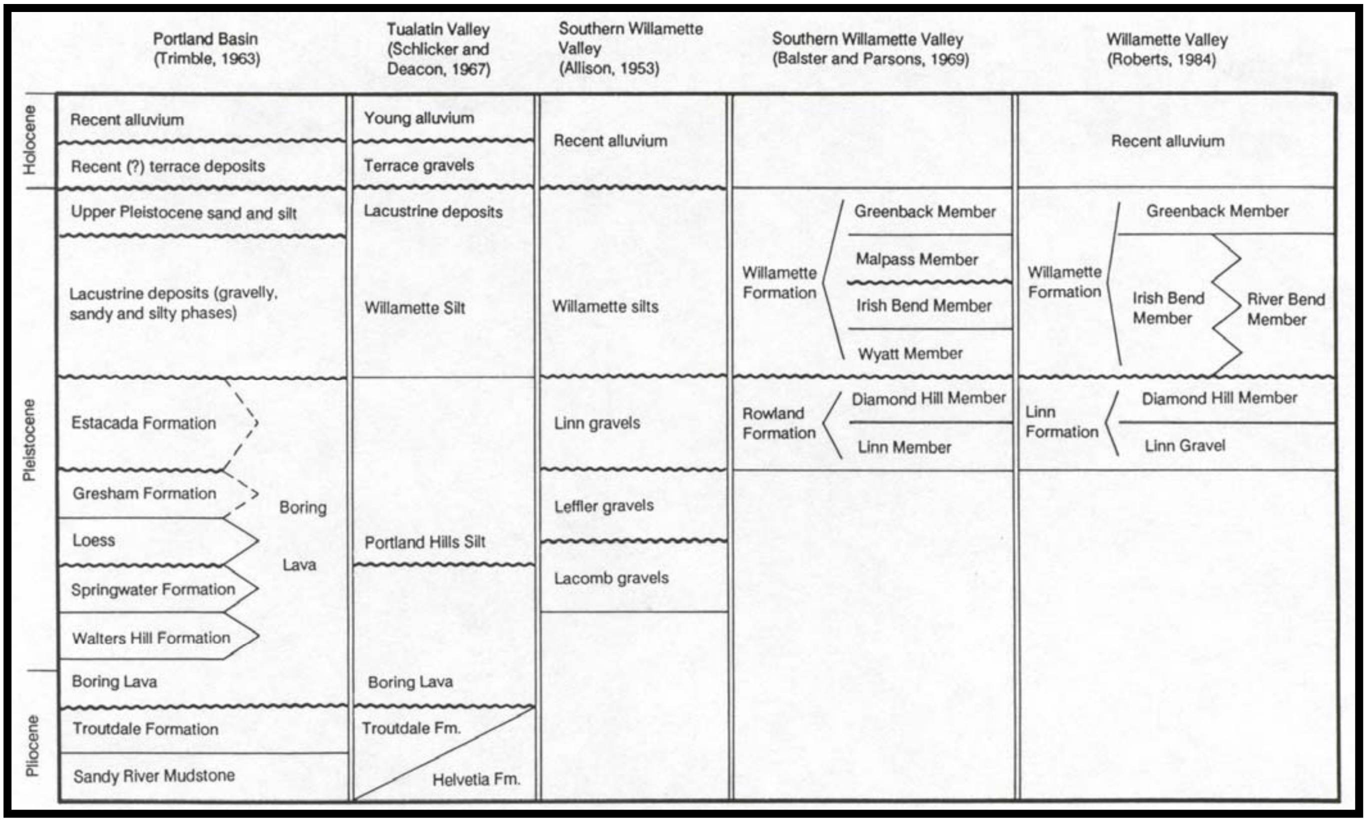
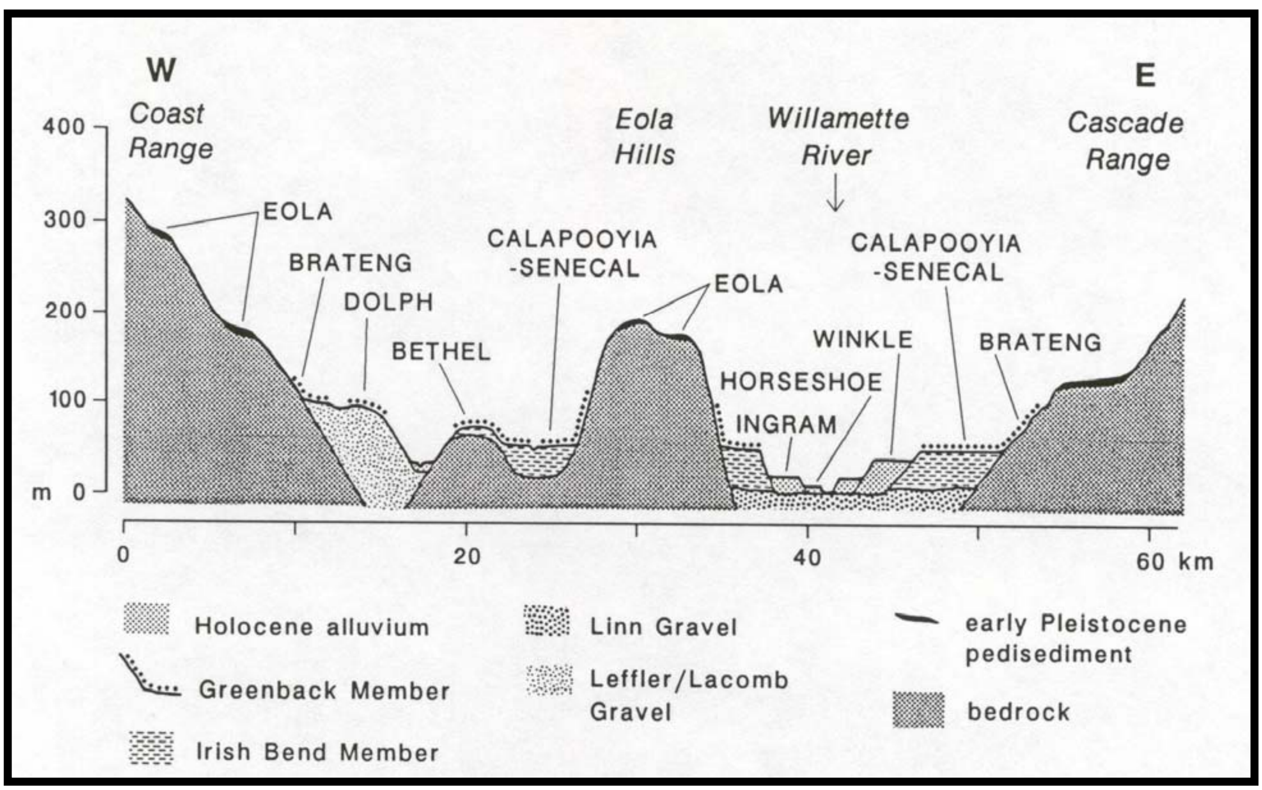


Figure 4. Surficial geology and geomorphology of the Luckiamute River Basin. Surficial map units are modified from O'Connor and others (2001), after Taylor and others (1996). Cross section shown in frame B represents generalized landform elements at Helmick State Park (Stop 6).

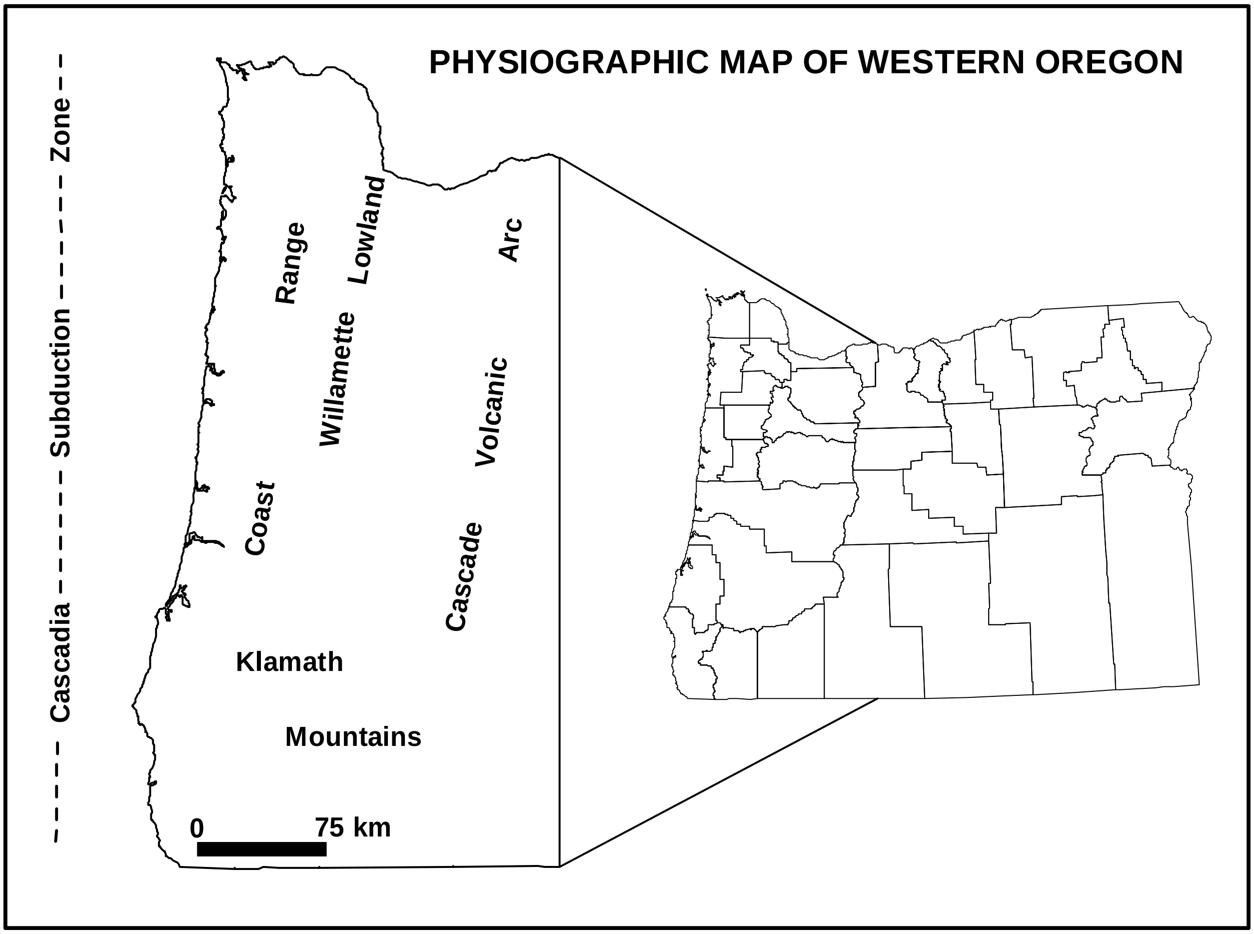

CANADA
Ice sheet
UNITED STATES
Grand Coulee Dam
Columbia R.
Ice dam
MONTANA
Dry Falls
Seattle
Cascade Range
Channeled Scablands
Spokane
Glacial Lake Missoula
Missoula
Clark Fork R.
PACIFIC
WASHINGTON
Palouse R.
Palouse Falls
Columbia R.
Wallula Gap
Willamette Valley
Portland
Willamette R.
OREGON
Snake R.
IDAHO
0 100 km
0 100 mi
The Missoula Floods
- 15-12ka
- perhaps 100 floods
- 500 mi³ of water, 40 hrs.
- 50 million cfs
Roy Haggerty Slide - OSU
Jim O'Connor, 2003


Missoula Floods - Maximum Inundation Zone
Luckiamute Watershed
(Minervini et al., 2003)
N
0 5 km
Maximum Missoula Flood Inundantion Area
(400-ft Contour Elevation)
Erratic Location





Quaternary stratigraphy and geomorphic surfaces of the Willamette Basin (from McDowell, 1991).



Oregon Coast Range

Unglaciated, forested landscape

Paleogene-Neogene marine volcanic and sedimentary rocks (Walker and MacLeod, 1991)

Long history of oblique convergence and tectonic accretion (Wells et al., 1984)

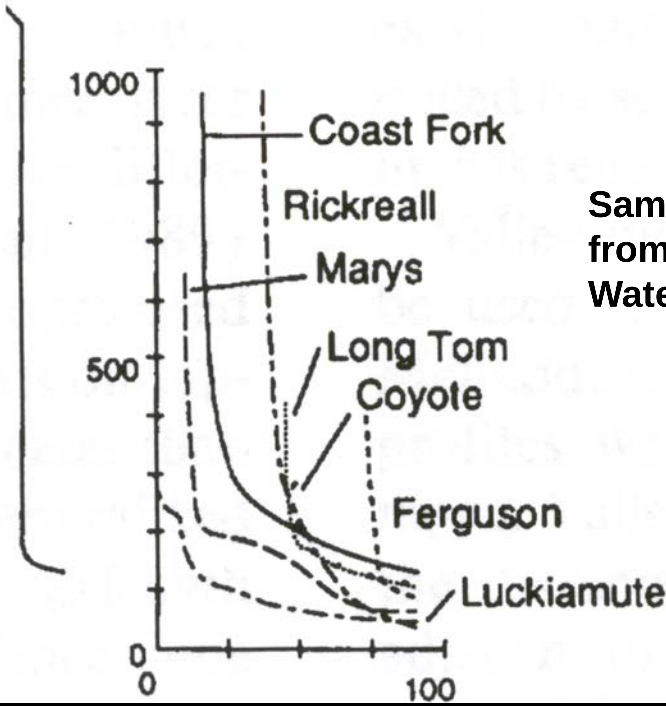
Active mountain building during the past 10-15 Ma (Snavely et al., 1993)

Pleistocene uplift rates = 0.1-0.3 mm/yr (Kelsey et al., 1996)

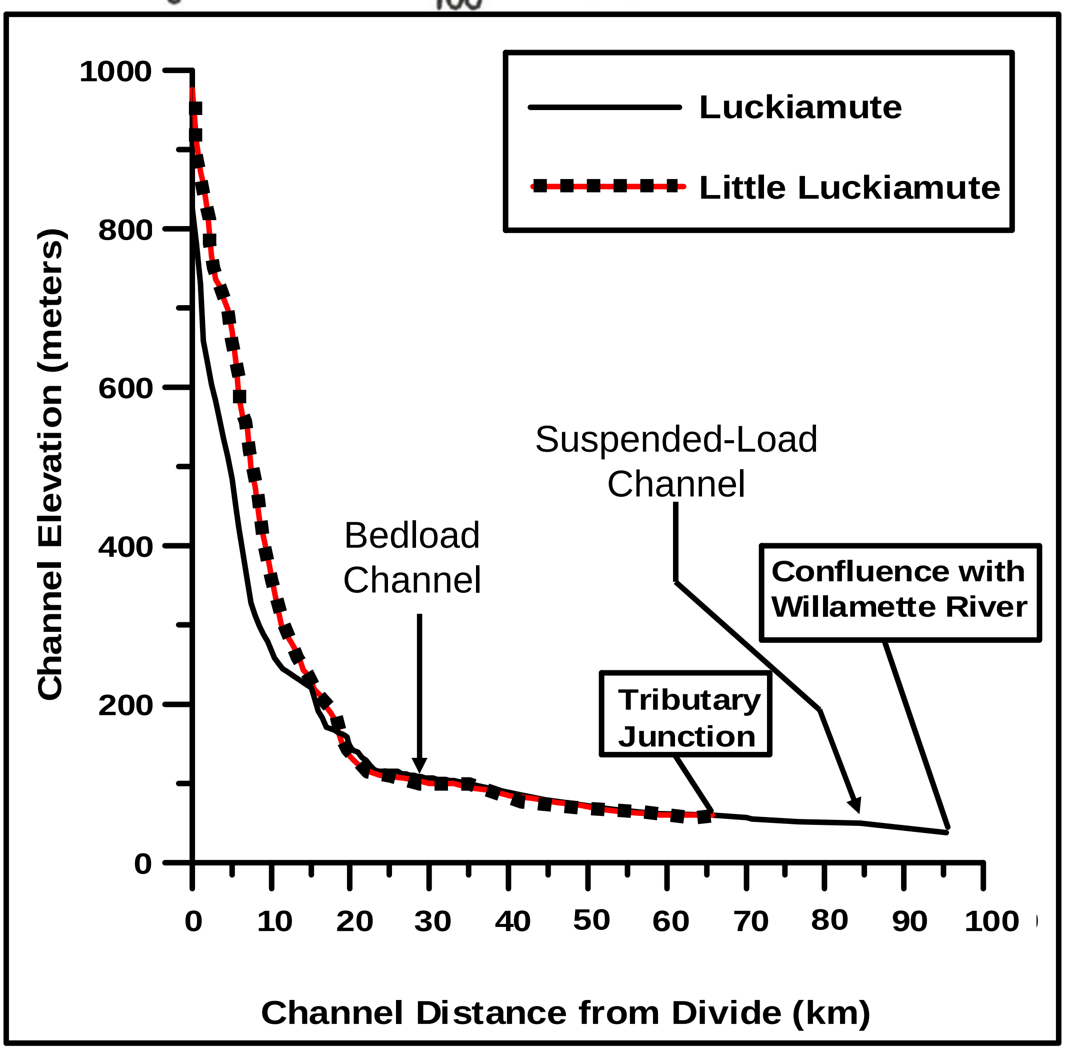
Historic uplift rates = 1-3 mm/yr (Mitchell et al., 1994)

Eastward tilting = 1 x 10^{-8} rad/yr (Adams, 1984)

Holocene erosion rates = 0.05-0.33 mm/yr (Roering et al., 2005)

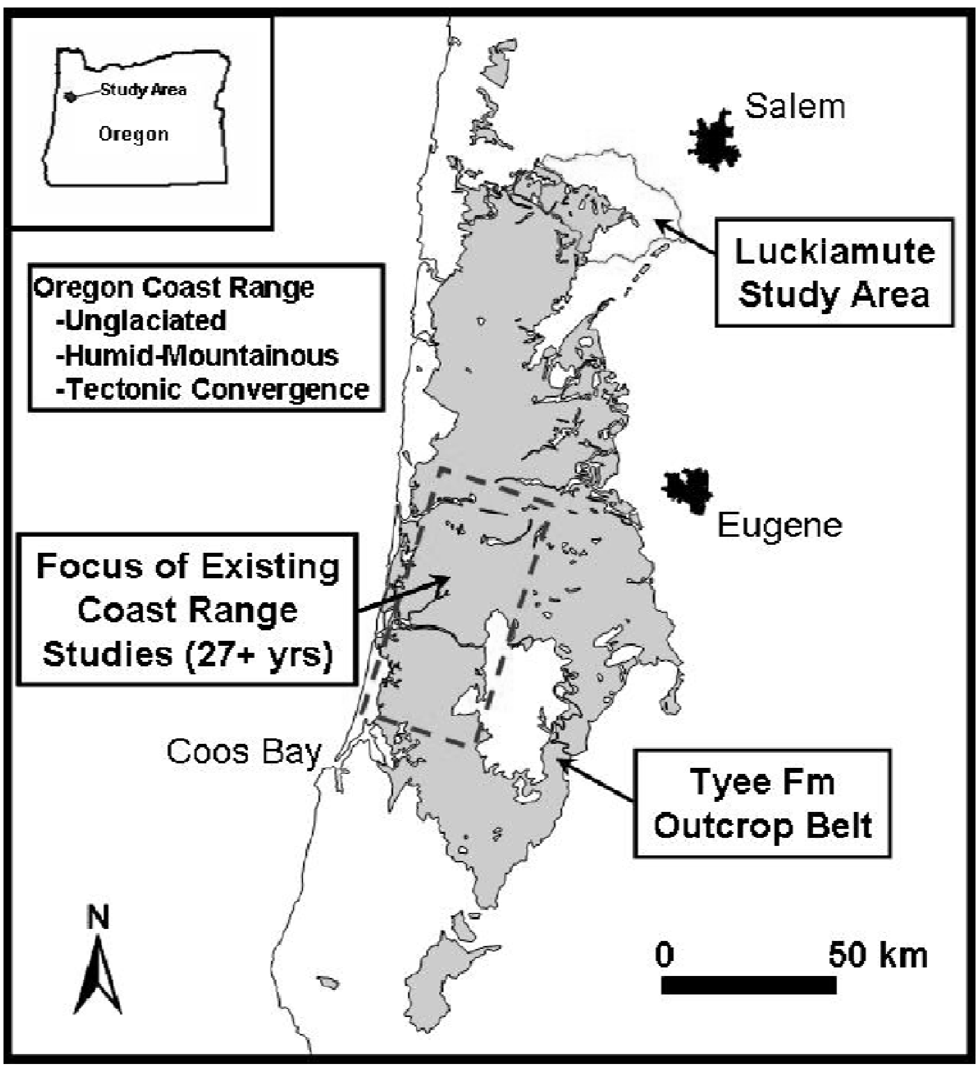


Sampling of Longitudinal Profiles from Central Coast Range Watersheds

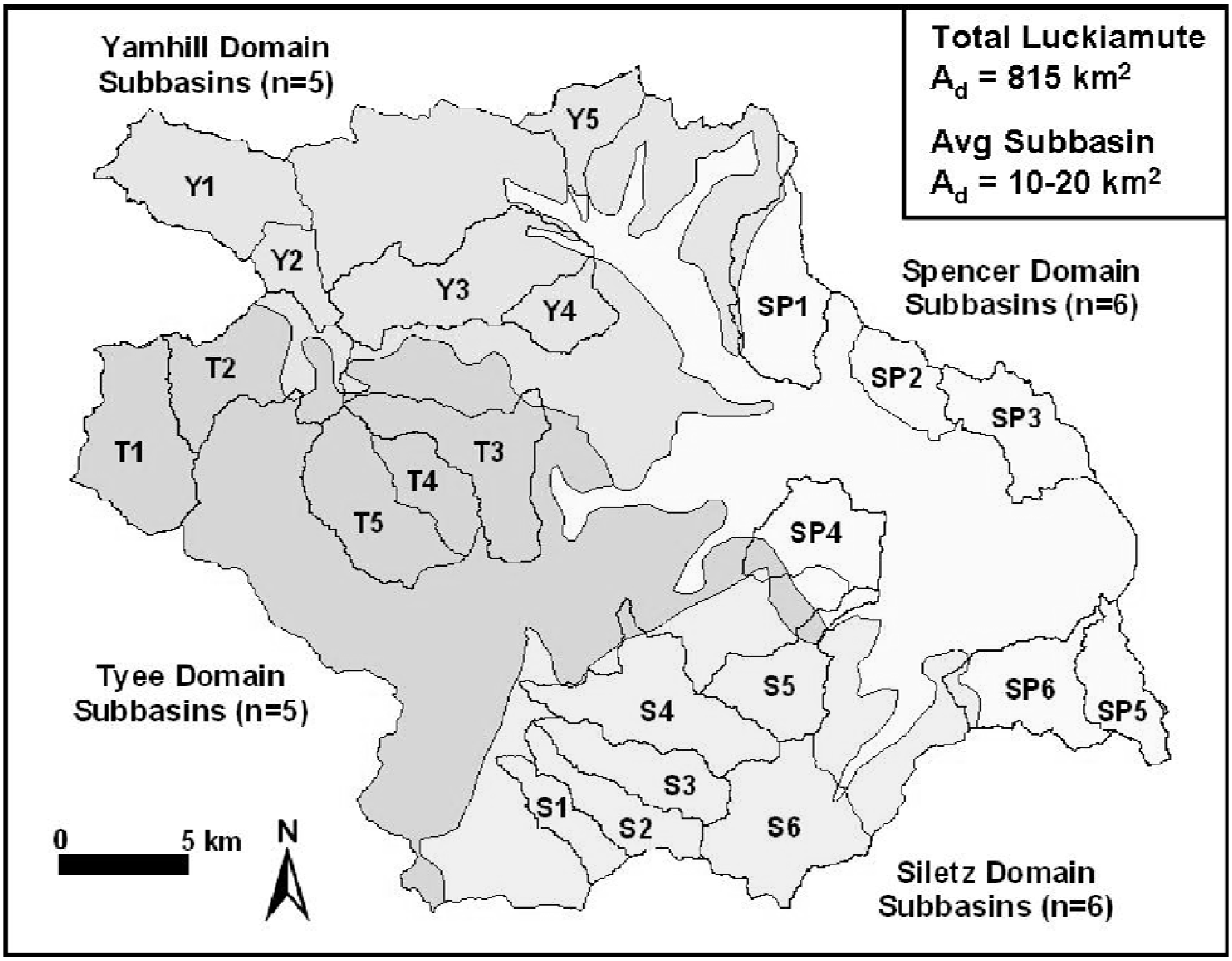


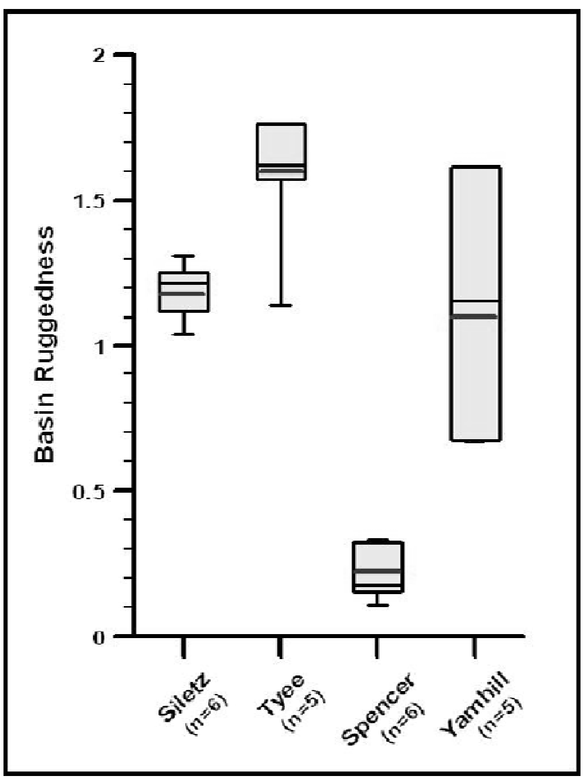
Longitudinal profile along the Luckiamute River (after Rhea, 1993).

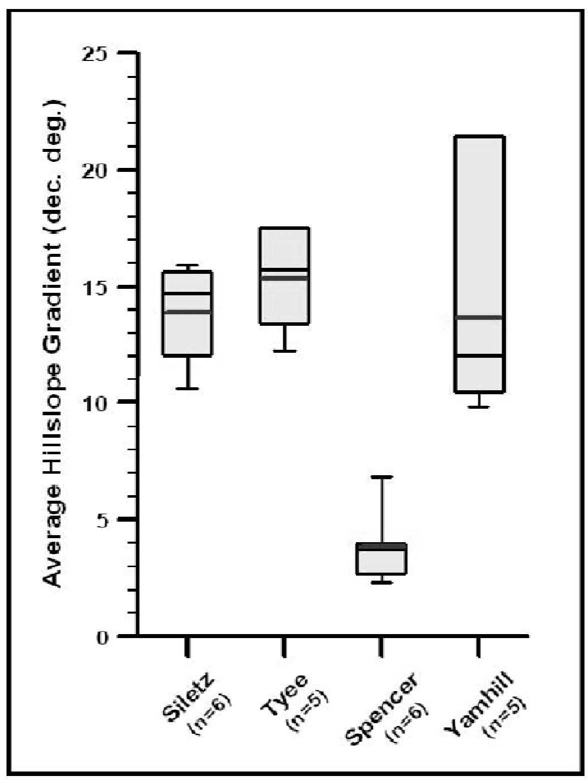
SAMPLINIG OF PREVIOUS WORK IN TYEE LANDSCAPES OF "THE OCR" University of Washington – UC Berkeley Geomorphic Offspring and Related Cousins	
Pierson (1977)	Debris flow processes
Dietrich and Dunne (1978)	Sediment budgets
Jackson and Beschta (1982)	Bedload transport
Burroughs (1985)	Landslide modeling
Dietrich and others (1986)	Hillslope processes
Montgomery and Dietrich (1988)	Landscape evolution
Benda (1990)	Debris flow processes
Benda and Cundy (1990)	Debris flow processes
Reneau and Dietrich (1990)	Debris flow processes
Reneau and Dietrich (1991)	Landscape evolution
Personius and others (1993)	Terrace chronologies
Montgomery and Dietrich (1994)	Landslide modeling
Benda and Dunne (1997)	Debris flow processes
Montgomery and others (1997)	Hillslope process experiments
Roering and others (1999)	Hillslope process experiments
Montgomery and others (2000)	Landslide modeling
Heimsath and others (2001)	Weathering processes
Schmidt and others (2001)	Slope stability
Anderson and others (2002)	Weathering processes
May (2002)	Debris flow processes
Casebeer (2003)	Sediment budgets
Lancaster and Hayes (2003)	Debris flow processes
May and Gresswell (2003)	Sediment production
Roering and others (2003)	Slope stability
Schmidt and others (2003)	Slope Stability
Kobor and Roering (2004)	Bedrock-channel processes
Roering and others (2005)	Slope processes / Landscape Evolution

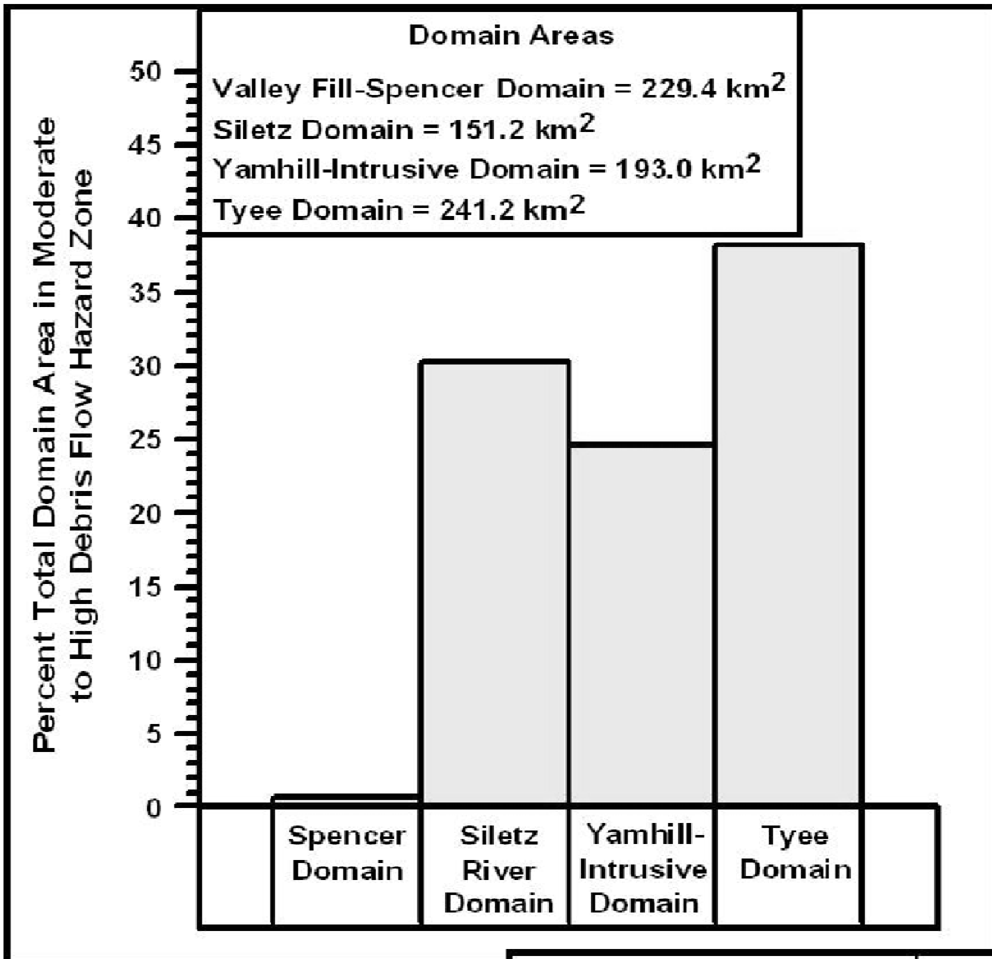


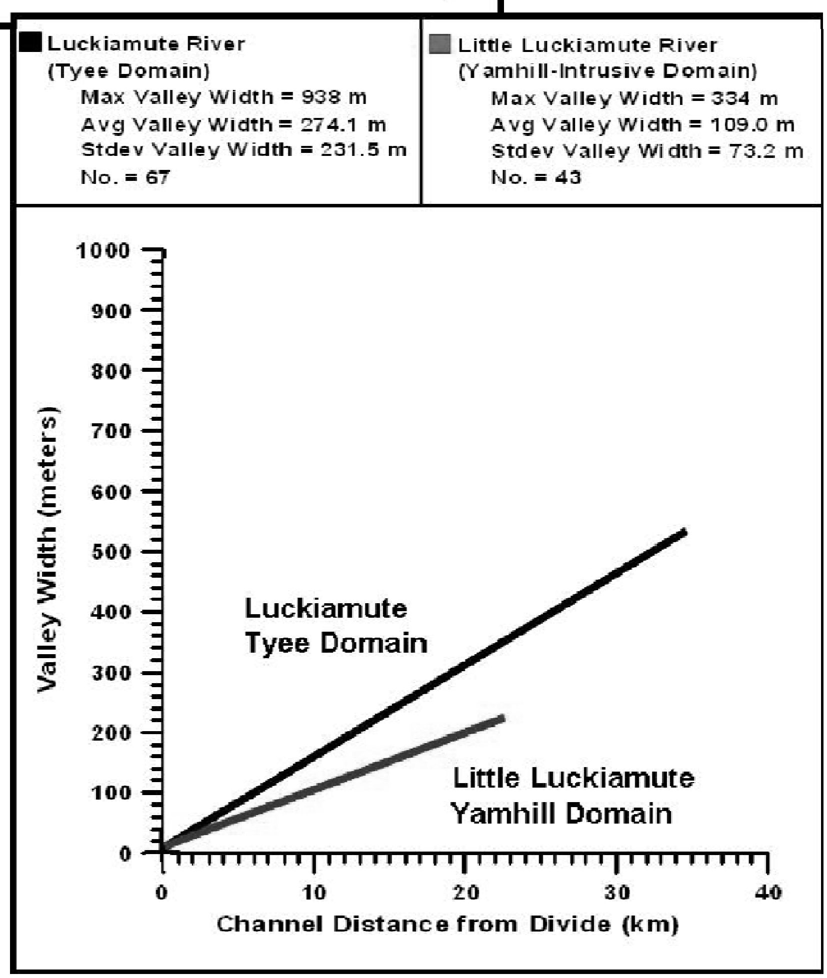
GEOMORPHIC ANALYSIS -LUCKIAMUATE STUDY AREA

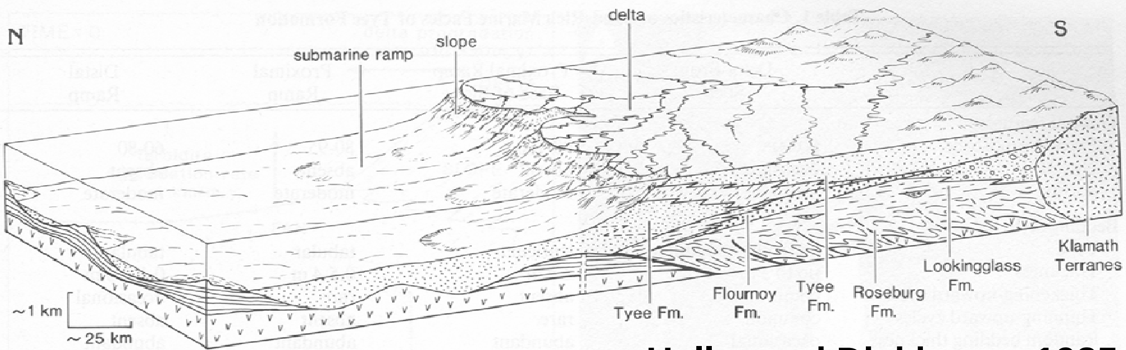






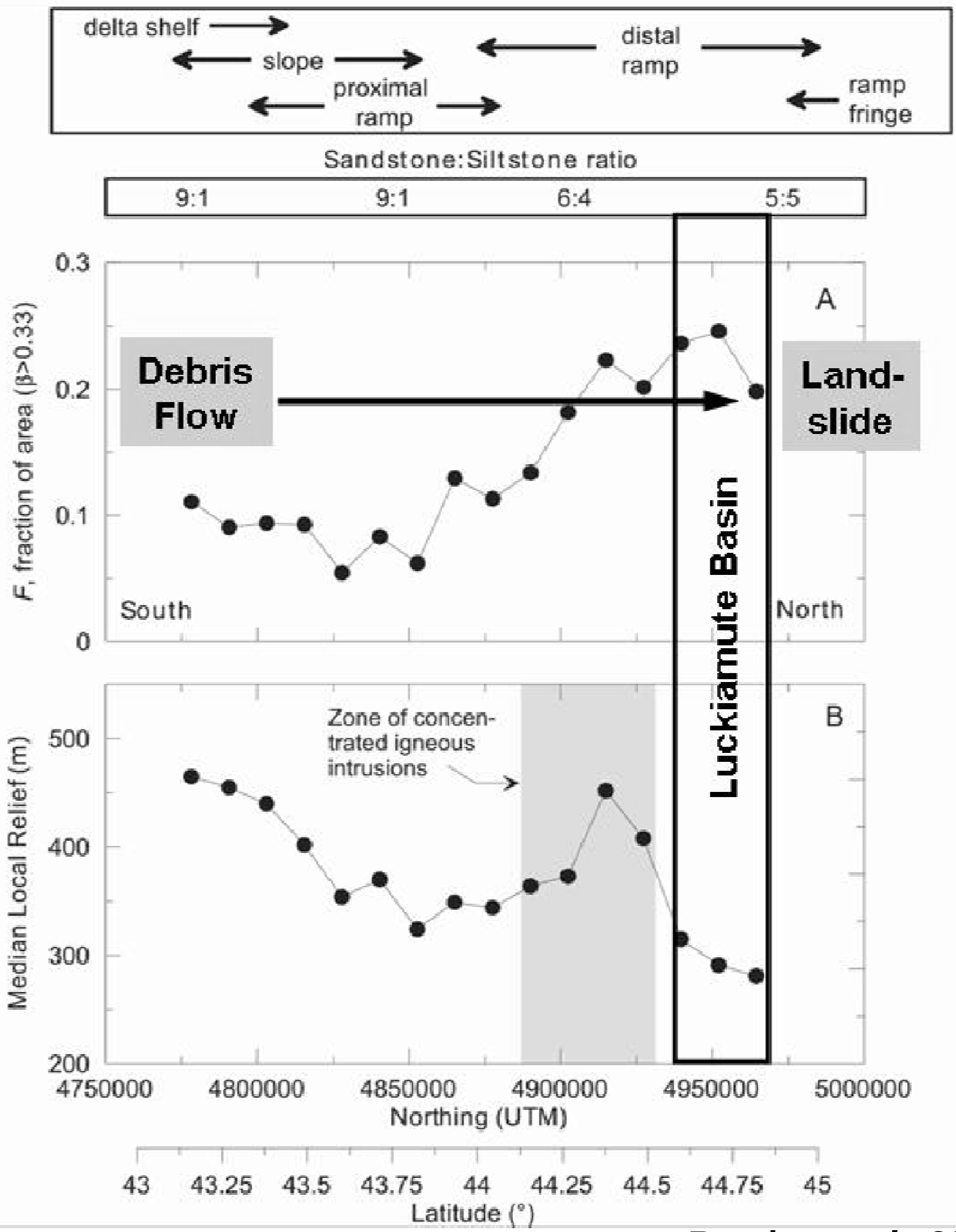

Domain Areas
Valley Fill-Spencer Domain = 229.4 km2
Siletz Domain = 151.2 km2
Yamhill-Intrusive Domain = 193.0 km2
Tyee Domain = 241.2 km2
Percent Total Domain Area in Moderate to High Debris Flow Hazard Zone
50
45
40
35
30
25
20
15
10
5
0
Spencer Domain
Siletz River Domain
Yamhill-Intrusive Domain
Tyee Domain


Luckiamute River (Tyee Domain)
Max Valley Width = 938 m
Avg Valley Width = 274.1 m
Stdev Valley Width = 231.5 m
No. = 67
Little Luckiamute River (Yamhill-Intrusive Domain)
Max Valley Width = 334 m
Avg Valley Width = 109.0 m
Stdev Valley Width = 73.2 m
No. = 43
Valley Width (meters)
1000
900
800
700
600
500
400
300
200
100
0
Luckiamute Tyee Domain
Little Luckiamute Yamhill Domain
0
10
20
30
40
Channel Distance from Divide (km)



Heller and Dickinson, 1985

Figure 8—Paleogeographic reconstruction of southern part of Oregon Coast Range during Eocene deposition of Tyee Formation (cf. Chan and Dott, 1983). See Figure 9 for actual (measured) facies relations within Tyee Formation.



Roering et al., 2005

Geomorphic Implications in the Luckiamute Basin

Tyee Domain in the Luckiamute Basin:

Steeper, rugged hillslopes
More finely dissected by low-order channels
Tendency to spawn debris flow
Lower stream-power index compared to Yamhill Domain
Higher average valley widths, increased sediment accommodation space

Working Hypotheses for Tyee Domain:

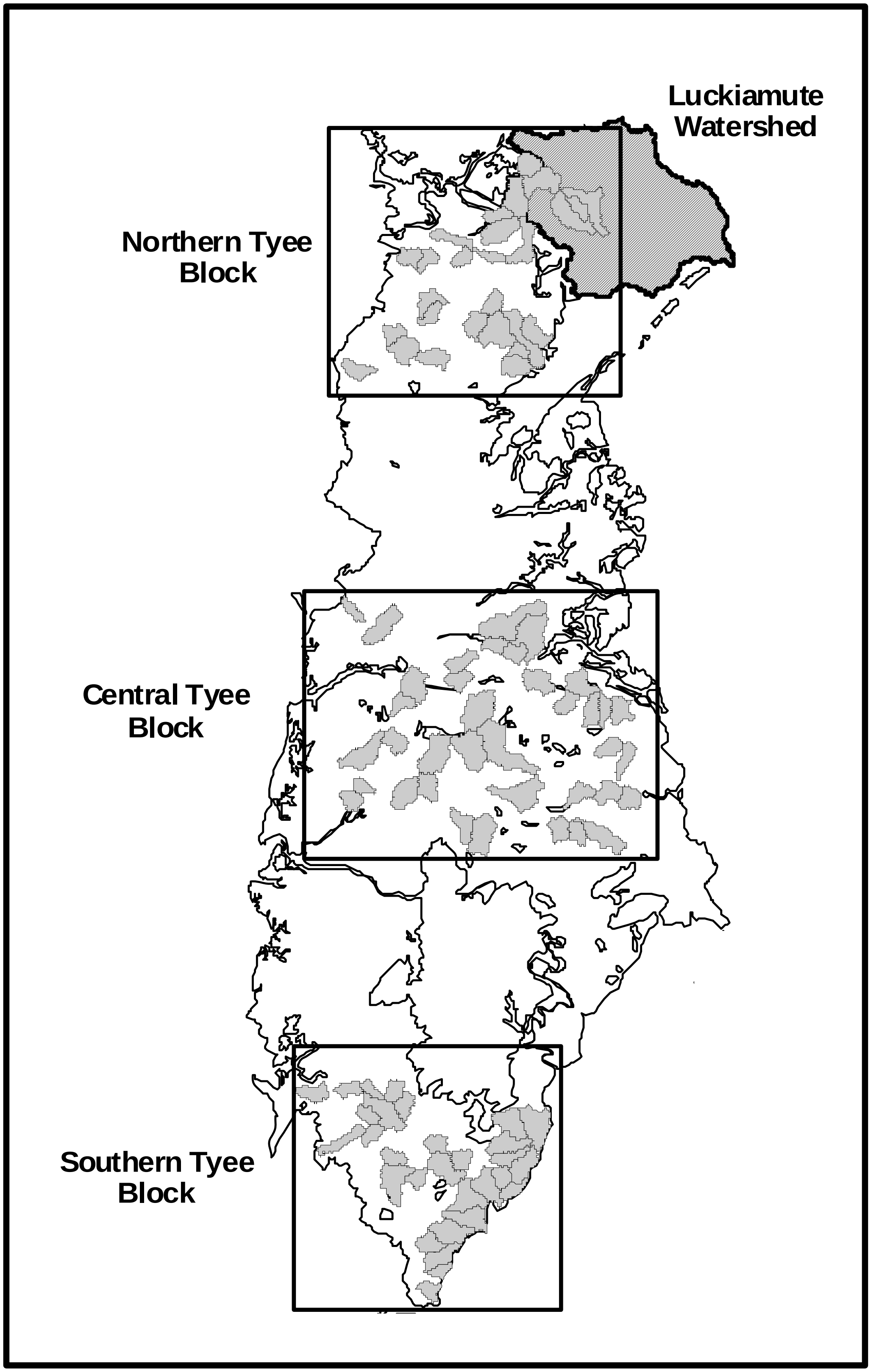
Hillslope transport rates are greater than the ability of the channel system to export sediment

Steep hillslopes and increased valley widths result in comparative decrease of net sediment-transport efficiency

The study implies that spatial variation of bedrock lithology is a primary factor controlling slope gradients, hillslope delivery rates, and resulting sediment-transport efficiency of the channel system.

The Luckiamute Watershed is uniquely positioned at the northern terminus of the Tyee outcrop belt, thus providing an opportunity for comparative geomorphic analysis.

The rich body of work from other Tyee landscapes in the OCR will serve as the platform from which to extend future research into other bedrock domains.



Ongoing Research: Extension of comparative watershed analysis southward in the Tyee Outcrop belt and northward into other bedrock domains. The Luckiamute lies at an interesting and critical geologic transition zone in the Oregon Coast Range.

Vegetation and Invasive Plant Distribution Luckiamute Watershed

What is an Invasive Plant?

Invasive plants are species that are not native to a region or country. They have the ability to compete with and replace native species in natural habitats

Predicting "Invasiveness"

The Importance of understanding life history

- Rapid initial growth and root system expansion
- Ability to outcompete neighboring plants
- High seed output (in both optimal and less-than-optimal conditions
- Morphological/physiological similarity to native species
- Varied breeding systems (e.g., possibilities for both self-pollination and outcrossing)

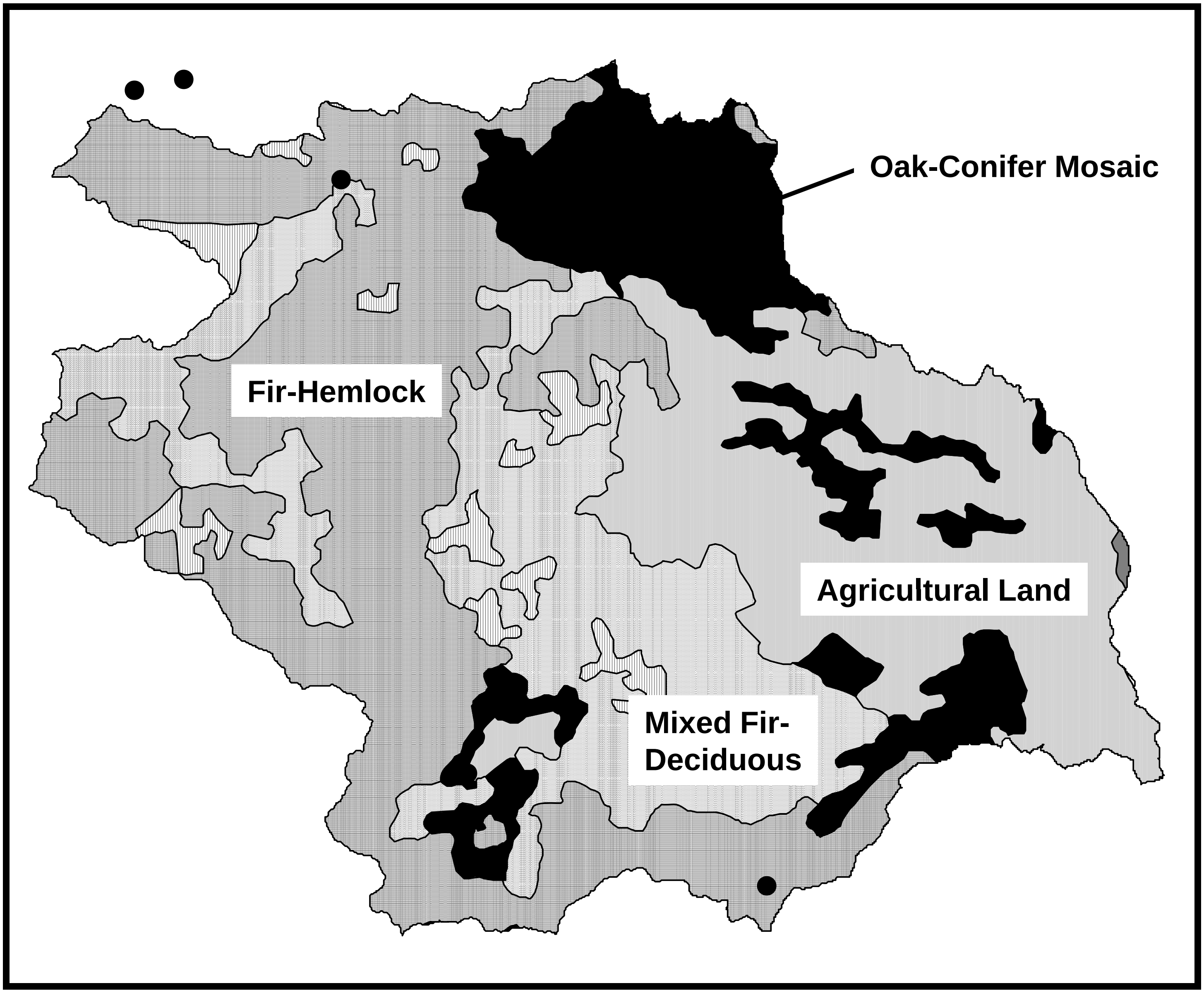
Why Invasive Plants are a Problem

- Invasive plants are a pervasive problem
  - In western Oregon
    - disruption of native habitats and annual economic losses
  - In the United States
    - annual losses of over $130 billion
- Vegetative disturbance of natural ecosystems
  - soil substrate conditions, nutrient availability, canopy shading (solar influx), and riparian hydrology
- Most abundant concentrations of invasive species
  - typically associated with human-caused disturbance
  - disturbed zones on the landscape act as primary conduits
  - understanding the controls on spatial distribution of invasive plants in the context of disturbance regime is critical for designing effective watershed conservation and restoration plans

Most Problematic Invaders in the Mid-Willamette Region:

- Himalayan Blackberry
- Knotweed
- Reed Canary Grass

Vegetation Distribution in the Luckiamute Watershed
(from Oregon State Vegetation Map)



Common Invasive Plant Species

NAME	ORIGIN
*Brachypodium sylvaticum (*false brome*)*	Africa, Eurasia
Cirsium arvense (Canada thistle)	Eurasia
Cirsium vulgare (bull thistle)	Eurasia
Daucus carota (wild carrot)	Europe
Dipsacus fullonum (common teasel)	Europe
Hedera helix (English ivy)	Eurasia, Africa
*Humulus lupulus (*common hops*)*	Europe
Hypericum perforatum (common St. Johnswort)	Europe
Phalaris arundinacea (reed canarygrass)	Agric.
*Polygonum cuspidatum (*Japanese knotweed*)*	Japan
Rubus armeniacus (Himalayan blackberry)	Armenia
Solanum dulcamara (bittersweet nightshade)	Europe
Tanacetum vulgare (common tansy)	Europe

Himalayan Blackberry (*Rubus armeniacus*):

Location:

▪Throughout the watershed in sunny and disturbed areas
▪Occurs in dense clumps and is capable of invading open spaces with their trailing stems.
▪Dispersed throughout the watershed by seed and stem fragments.

Description: **Highly Invasive**

•Can grow meters in diameter and height in just a few years.
•Stems are thick with strong upward thorns.
•Leaves occur in groups of three or five, are round to oblong and toothed, and have a white coating underneath.
•In June, small white to pink flowers will bloom
•Berries ripening from July to August.

Knotweeds (*Polygonum* spp.):

Location:

▪Found in the upper-most reaches of the watershed.
▪Have been spread throughout the watershed
▪Threatening the entire riparian zone.
▪Found in extremely dense colonies; can spread through flooding events.

Description: **Highly Invasive**

•Creeping perennials stand 10 to 15 feet tall
•Light green ovate leaves.
•Blooming of numerous greenish-white flowers occurs from July to August.
•Dies back each year with the first frost, then begins new growth from the same shoot system the following year.

While some species of Knotweed do not appear to produce fertile seeds, other species and their hybrids in the watershed may have no difficulty in doing so.

Reed Canarygrass
(*Phalaris arundinacea*):

Location:

▪Found primarily in riparian zone throughout the watershed

▪Can withstand flood seasons due to its thick shoots and extensive rhizomes

▪Has become widely dispersed throughout the watershed

  ▪Erosion along the banks and water transport

Description: **Perennial**

•Stout, largely colonial grass

•Densely clustered flowers are located on short separate branches

•Stands .5-1.5 m tall.

•Leaf blades are about 20 mm wide

•Flowering occurs May to June and seeds mature by July

Seeds do not germinate when in dense shade. Keep those native trees growing!

Luckiamute Riparian Zone Botanical Surveys

Plant Survey Site Selection

•Ideally, One hundred meters of wooded riparian zone, fairly undisturbed and perpendicular to the Luckiamute, Little Luckiamute River or Soap Creek

•Identified riparian zone by utilizing 100 year floodplain map and contacted landowners within that area

•Systematic plant surveys conducted across 20 sites to delineate:
- •invasive species occurrence
- •distribution and
- •population density

Logistical Difficulties:
Overdeveloped land
- •100 m of vegetated land perpendicular to the river is hard to find

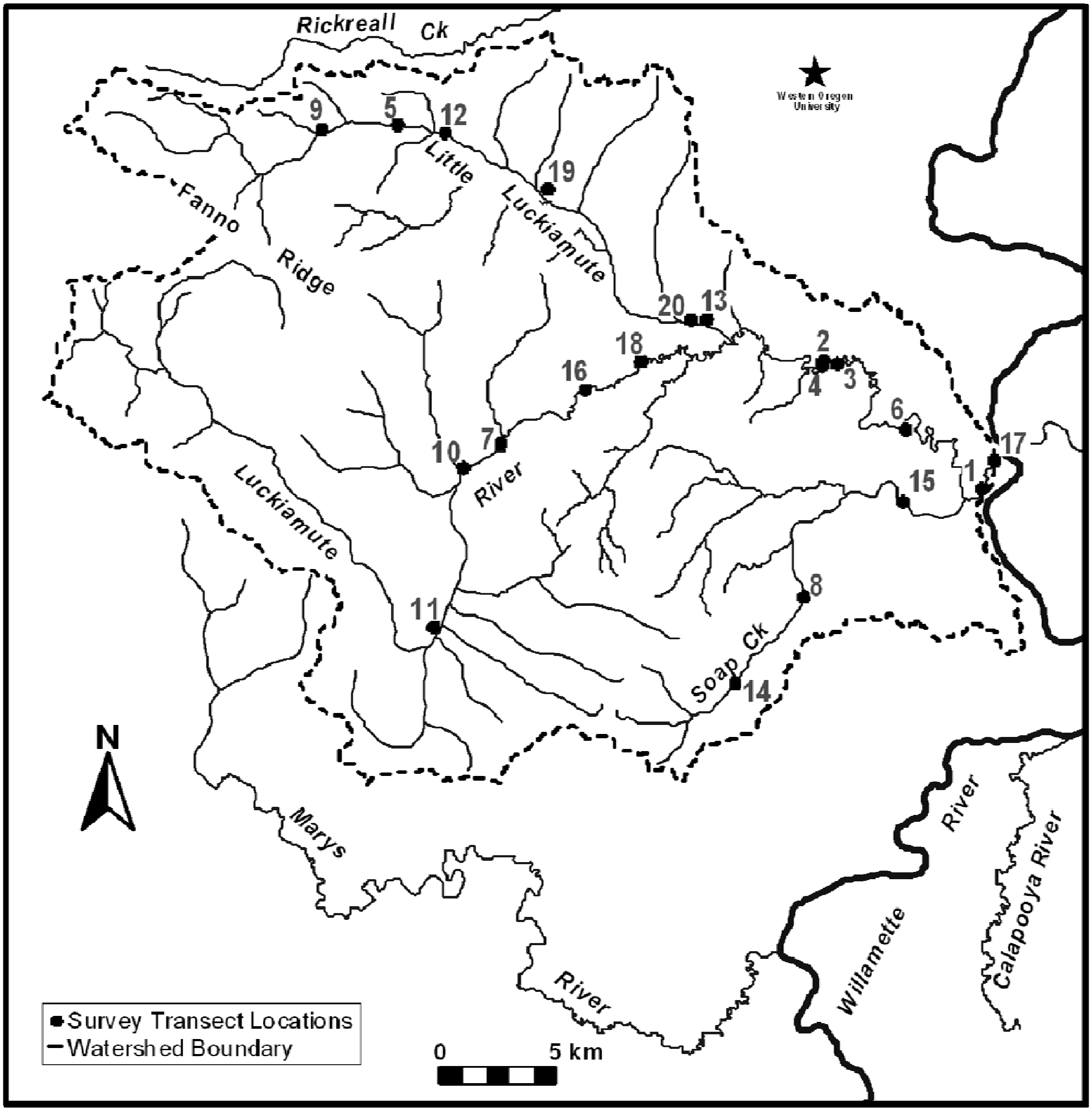
•Approval for survey access by landowners
•Adequate distribution of survey locations

Survey Procedures

Materials Used
- Tape measure
- One square meter frame

Methods
- Surveys conducted along 100 meter transects located perpendicular to the river
  - 100 m, not always available
- All plants are identified in each square meter along the transect
- Plants identified by scientific names and recorded by percent cover within each square meter
- Other data taken involves the amount of visible electromagnetic radiation along the transect
  - Usually in the 400 to 700 nm range
- GPS data was also collected along each transect
- Data then entered into the computer, compiled, graphed and analyzed

Luckiamute Watershed Invasive Plant Survey Locations



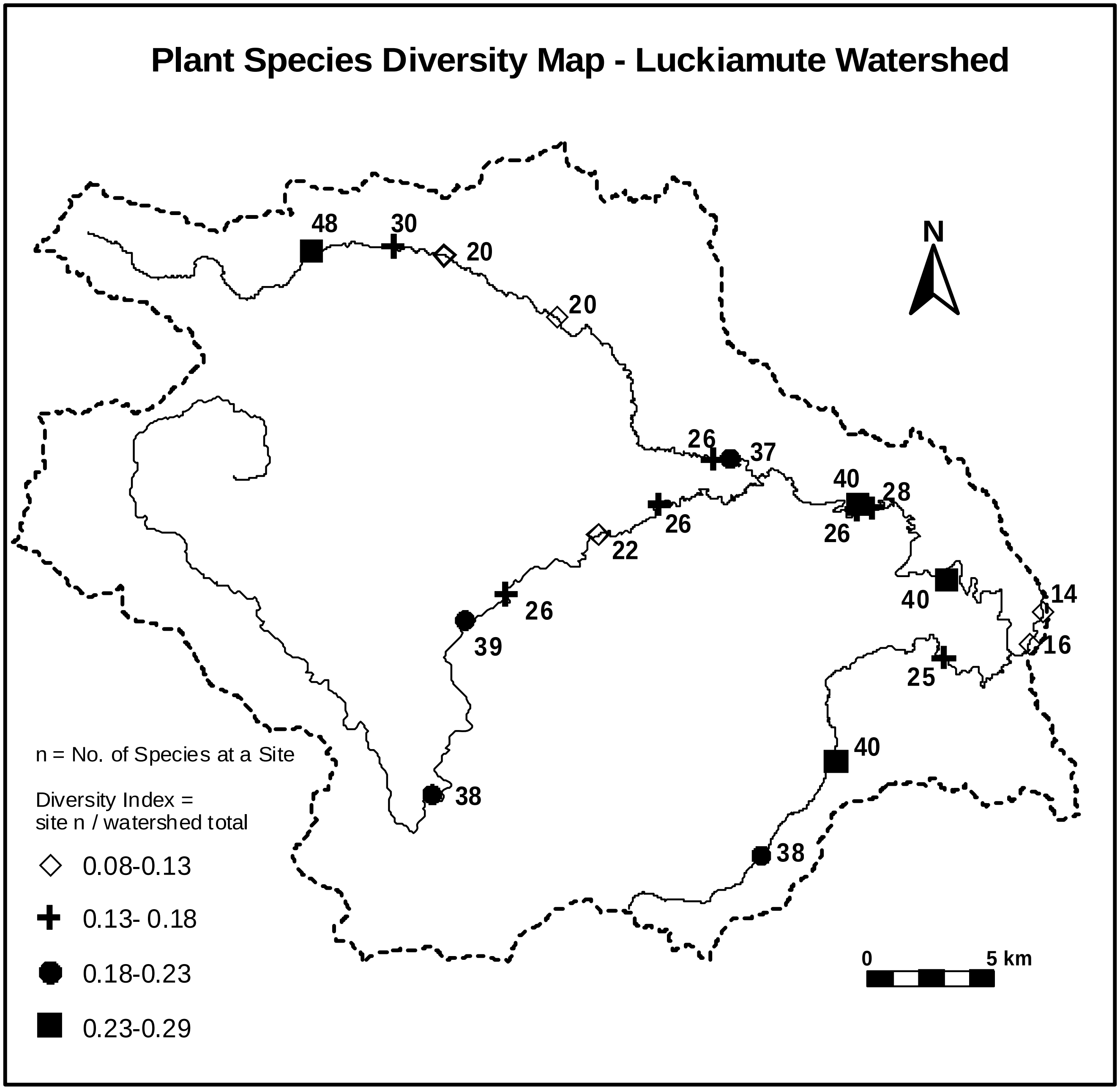
Summary of Plant Species Encountered in Riparian Understory – Luckiamute Watershed

Total No. of Species Encountered	170
Total No. of Invasive Species	55
Total No. of Native Species	75
Total No. with No Origin Data	40
Percent Invasives	32.4%
Percent Natives	44.1%
Percent Unknown Origin	23.5%
Native/Invasive Ratio	1.4

Most Common Species Encountered in Greater than 70% of Transects (total n = 20)

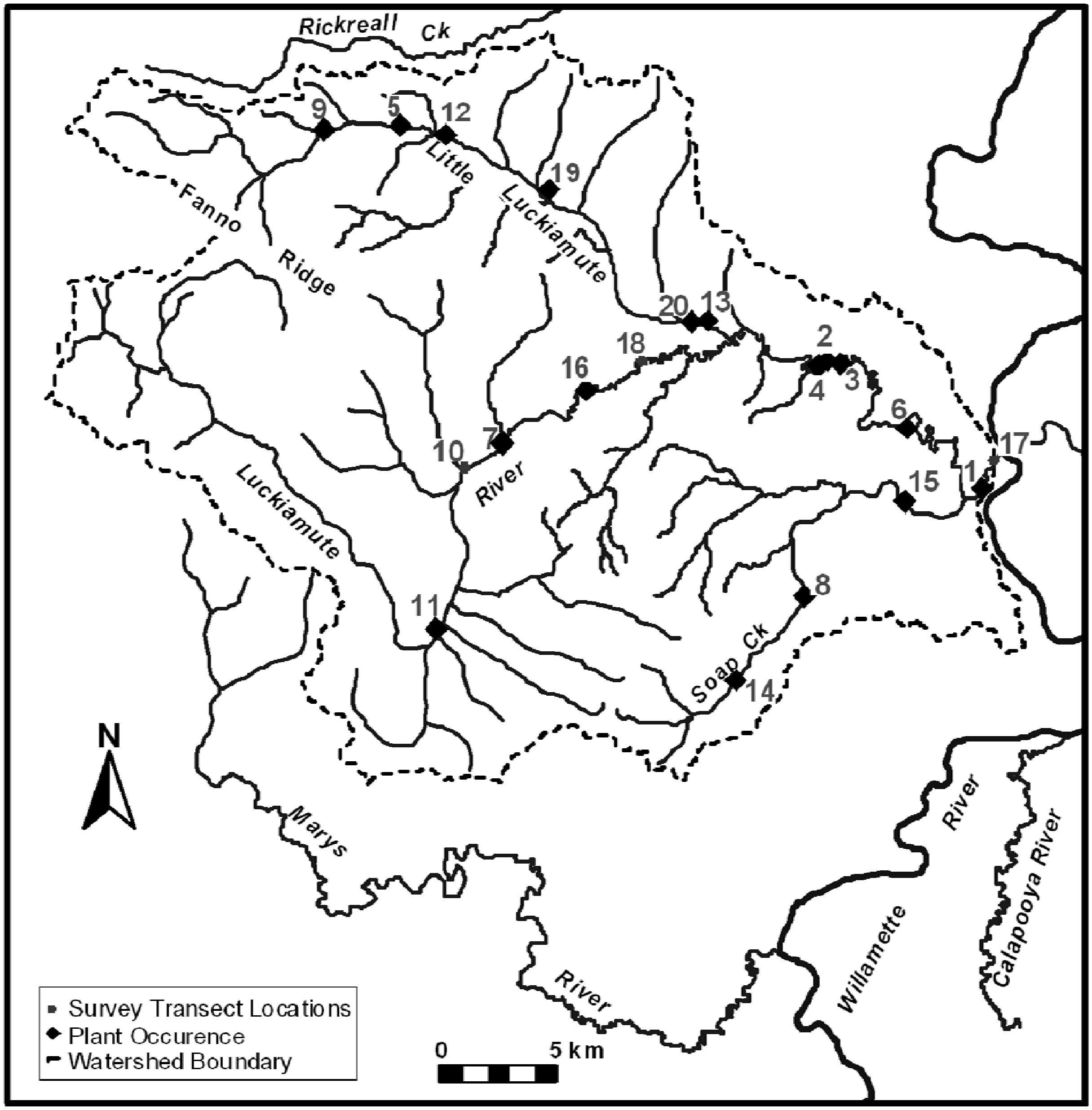
Rubus leucodermus	Blackcap	90% native
Rubus armeniacus	Himalaya blackberry	85% introduced
Symphoricarpos albus	Snowberry	85% native
Urtica dioca (gracilis)	Stinging nettle	80% native
Corylus cornuta (californica)	Western hazel	75% native
Phalaris arundinacea	Reed canarygrass	75% introduced
Polystichum munitum	Sword fern	70% native

Abies grandis Grand fir
Acer circinatum Vine maple
Acer macrophyllum Big-leaf maple
Achlys triphylla Vanillaleaf
Actaea rubra Baneberry
Adenocaulon bicolor Pathfinder
Alnus rubra Red alder
Amelanchier alnifolia Service berry
Anagallis arvensis Scarlet Pimpernel
Anemone deltoidea White windflower
Anthemis cotula Dogfennel
Apiaceae Umbel family
Aquilegia formosa Columbine
Arctium minus Common burdock
Asarum caudatum Wild ginger
Asteraceae Aster family
Athyrium felix-femin Lady fern
Berberis aquifolium Tall Oregon-grape
Berberis nervosa Mountain Oregon-grape
Bidens sp. Beggar's ticks
Brachypodium sylvaticum False brome
Brassicaceae Mustard family
Carex sp. Sedge
*Centaurea xpratensis M*eadow knapweed
Chenopodium album Lamb's quarters
Cicuta douglasii Western water hemlock
Cirsium arvense Canada thistle
Cirsium vulgare Bull thistle
Claytonia sibirica Candy flower
Clematis ligusticifolia Wild Clematis
Convovulus arvensis Bindweed
Cornus sericea Creek dogwood
Corylus cornuta (californica) Western hazel
Crataegus douglasii Western hawthorn
Crataegus sp. Hawthorn
Daucus carota Wild carrot
Delphinium trolliifolium Wood larkspur
Dicentra formosa Bleeding-heart
Digitalis purpurea Foxglove
Dipsacus fullonum Wild teasel
Epilobium angustifolium Fireweed
Epilobium ciliatum Willow-herb
Epilobium sp. Willow-herb
Equisetum arvense Common horsetail
Equisetum sp. Horsetail
Ericaceae Heath family
Euphorbia sp. Spurge
Fabaceae sp. Legume family
Fragaria vesca Wood strawberry
Fraxinus latifolia Oregon ash
Galium aparine Bedstraw
Galium sp. Bedstraw
Galium triflorum Fragrant bedstraw
Gaultheria shallon Salal
Geranium pusillum Small-flowered Geranium
Geranium robertianum Herb Robert
Geranium sp. Geranium
Glechoma hederacea Ground ivy
Gnaphalium sp. Cudweed
Goodyera oblongifolia Rattlesnake plantain
Hedera helix English ivy
Helianthus sp. Sunflower
Heracleum lanatum Cow parsnip
Heuchera micrantha Small-flowered alum-root
Heuchera sp. Alum-root
Hieracium aurantiacum Orange hawkweed
Hieracium sp. Hawkweed
Holodiscus discolor Ocean spray
Humulus lupulus Common hop
Hypericum perforatum St. John's wort
Hypochaeris radicata False dandelion
Ilex opaca American holly
Impatiens sp. Touch-me-not
Juncaceae sp. Rush family
Kickxia elatine Sharppoint Fluellin
Lactuca muralis Wall lettuce
Lactuca serriola Prickly lettuce
Lamiaceae sp. Mint family
Lapsana communis Nipplewort
Lathyrus sp. Pea
*Leucanthemum vulgare O*xeye daisy
Lilliaceae sp. Lily family
Lotus corniculatus Bird's-foot trefoil
Lotus sp. Trefoil
Lysichiton americanum Yellow skunk cabbage
Maianthemum dilatatum Wild lily-of-the-valley
Maianthemum racemosus Large false Solomon's seal
Maianthemum sp. False Solomon's seal
Malus sp. Apple
Marah oreganus Old man-in-the-ground
Melilotus sp. Sweet-clover
Melissa officinalis Lemon balm
Mentha xpiperita Peppermint
Mitella sp. Mitrewort
*Oemleria cerasiformi s*Indian peach
Osmorhiza berteroi Common sweet cicely
Oxalis oregana Oregon wood-sorrel
Penstemon sp. Penstemon
Phalaris arundinacea Reed canarygrass
Physocarpus capitatus Ninebark
Plantago aristata Long-bracted plantain
Plantago lanceolata English plantain
Plantago major Common plantain
Plantago sp. Plantain
Poaceae sp. Grass family
Polygonaceae Knotweed family
*Polygonum cuspidatum J*apanese knotweed
Polygonum lapathifolium Dock-leaved smartweek
Polypodium glycyrrhiza Licorice fern
Polystichum munitum Sword fern
Prosartes sp. Fairy bells
Prunella vulgaris Self-heal
Prunus sp. Cherry
Prunus virginiana Western chokecherry
Pseudostuga menziesii Douglas-fir
Pteridium aquilinum Western bracken fern
Quercus garryana Oregon white oak
Ranunculus sp. Buttercup
Rhamnus purshiana Cascara
Ribes sp. Gooseberry
Rosa eglanteria Sweetbriar
Rosa gymnocarpa Wood rose
Rosa nutkana Common wild rose
Rosa sp. Rose
Rubiaceae Madder family
Rubus armeniacus Himalaya blackberry
Rubus laciniatus Evergreen blackberry
Rubus leucodermus Blackcap
Rubus parviflorus Thimbleberry
Rubus spectabilis Salmonberry
Rubus ursinus Wild blackberry
Rumex acetosella Red sorrel
Rumex crispus Curly dock
Rumex sp. Dock
Salix sp. Willow
Sambucus racemosa Red Elderberry
Sambucus sp. Elderberry
Sanicula sp. Snake-root
Saxifragaceae Saxifrage family
Scirpus sp. Bulrush
Scutellaria lateriflora Common skullcap
Senecio jacobaea Tansy ragwort
Senecio sp. Groundsel
Senecio vulgaris Common groundsel
Sherardia arvensis Field madder
Solanum dulcamara Bittersweet nightshade
Solanum nigrum Europena black nightshade
Solanum sp. Nightshade
Soliva sessilis Field burrweed
Sonchus oleracea Common sow thistle
Sonchus sp. Sow thistle
Spiraea douglasii Douglas' Spiraea
Stachys cooleyae Giant hedge-nettle
Symphoricarpos albus Snowberry
Syntheris reniformis Spring queen
Tellima grandiflora Fringe-cups
Thalictrum sp. Meadow-rue
Toxicodendron diversilobum Poison oak
Trientalis latifolia Western starflower
Trifolium repens White clover
Trifolium sp. Clover
Trifolum vesiculosum Arrowleaf clover
Trillium sp. Trillium
Tsuga heterophylla Western hemlock
Urtica dioca (gracilis) Stinging nettle
Vaccinium sp. Huckleberry
Verbascum thapsus Common mullein
Veronica sp. Speedwell
Viola glabella Wood violet
Viola sp. Violet

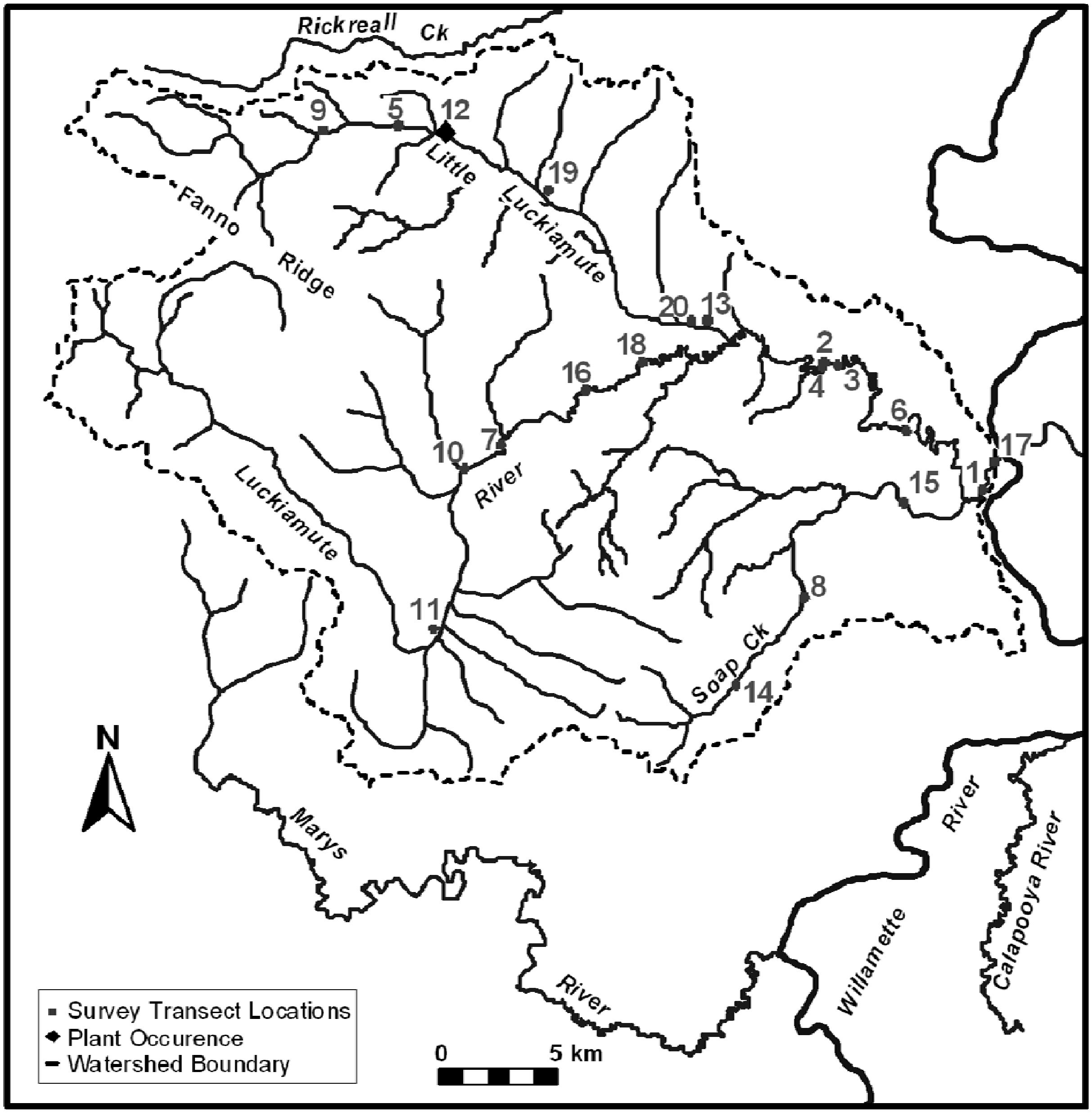


Plant Species Diversity Map - Luckiamute Watershed
N
48
30
20
20
26
37
40
28
26
26
22
26
39
40
14
16
25
40
38
38
0
5 km
n = No. of Species at a Site
Diversity Index =
site n / watershed total
0.08-0.13
0.13- 0.18
0.18-0.23
0.23-0.29

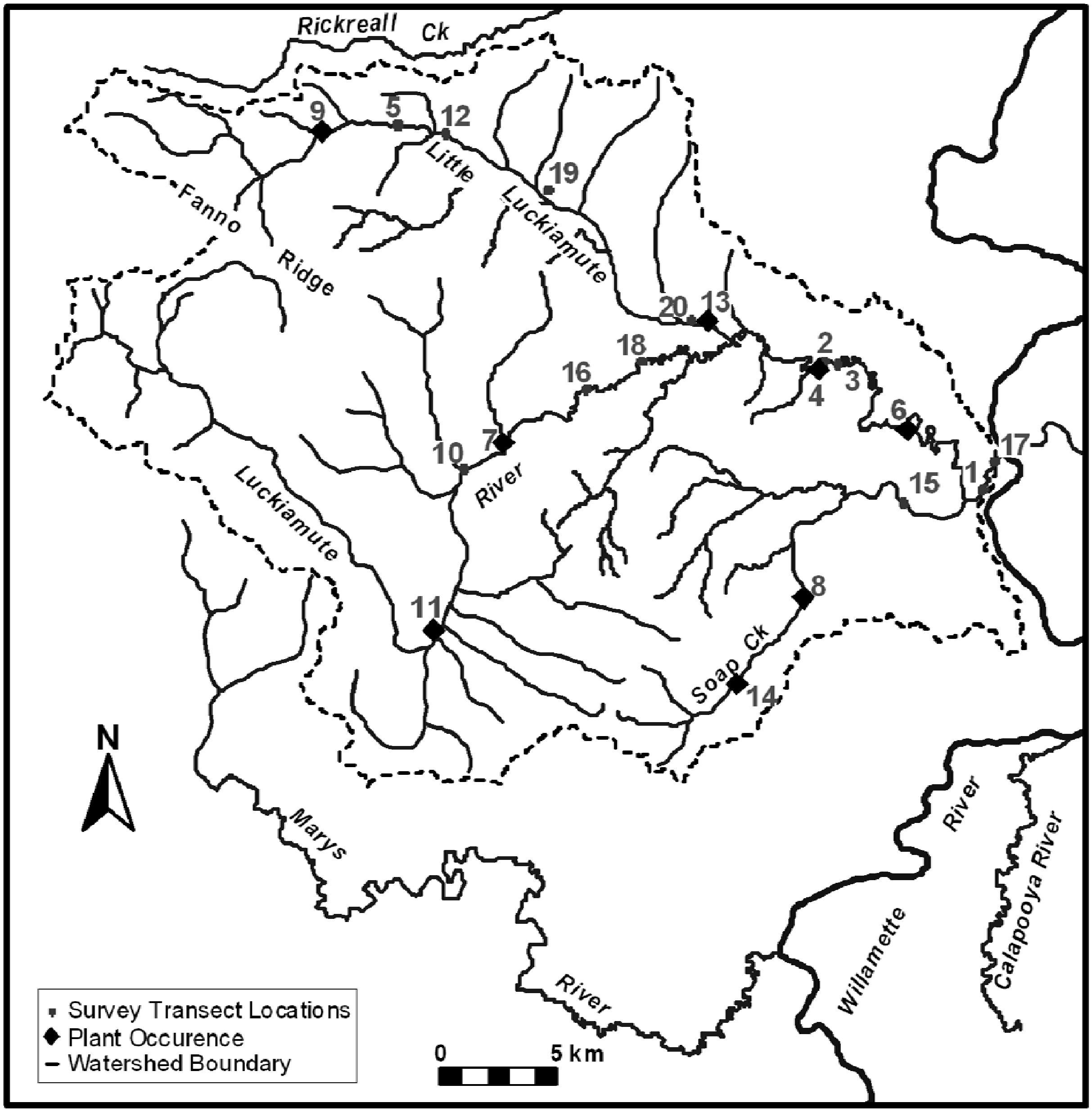
Occurence of Himalaya blackberry- Rubus armeniacus



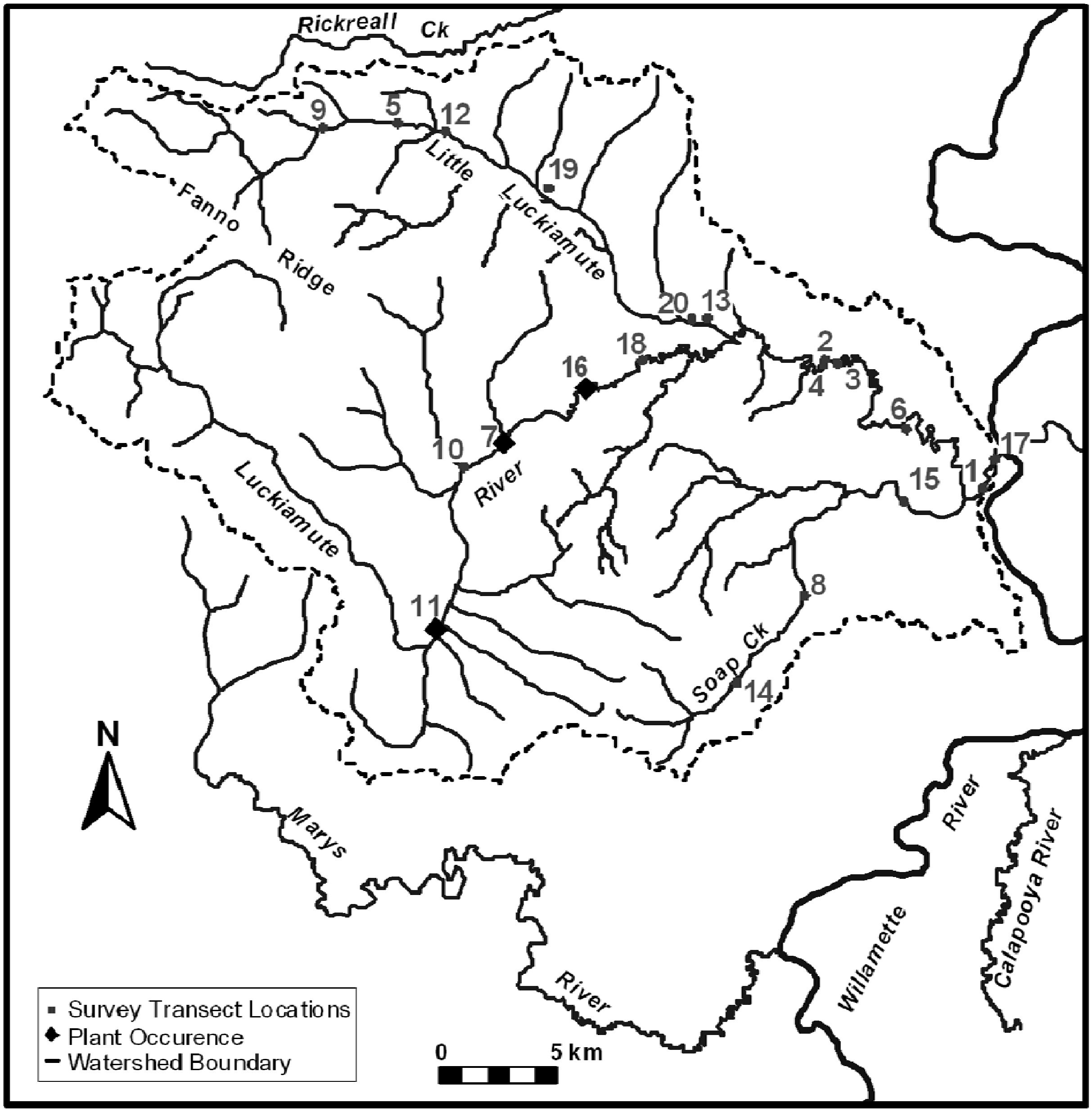
Occurence of English ivy - Hedera helix



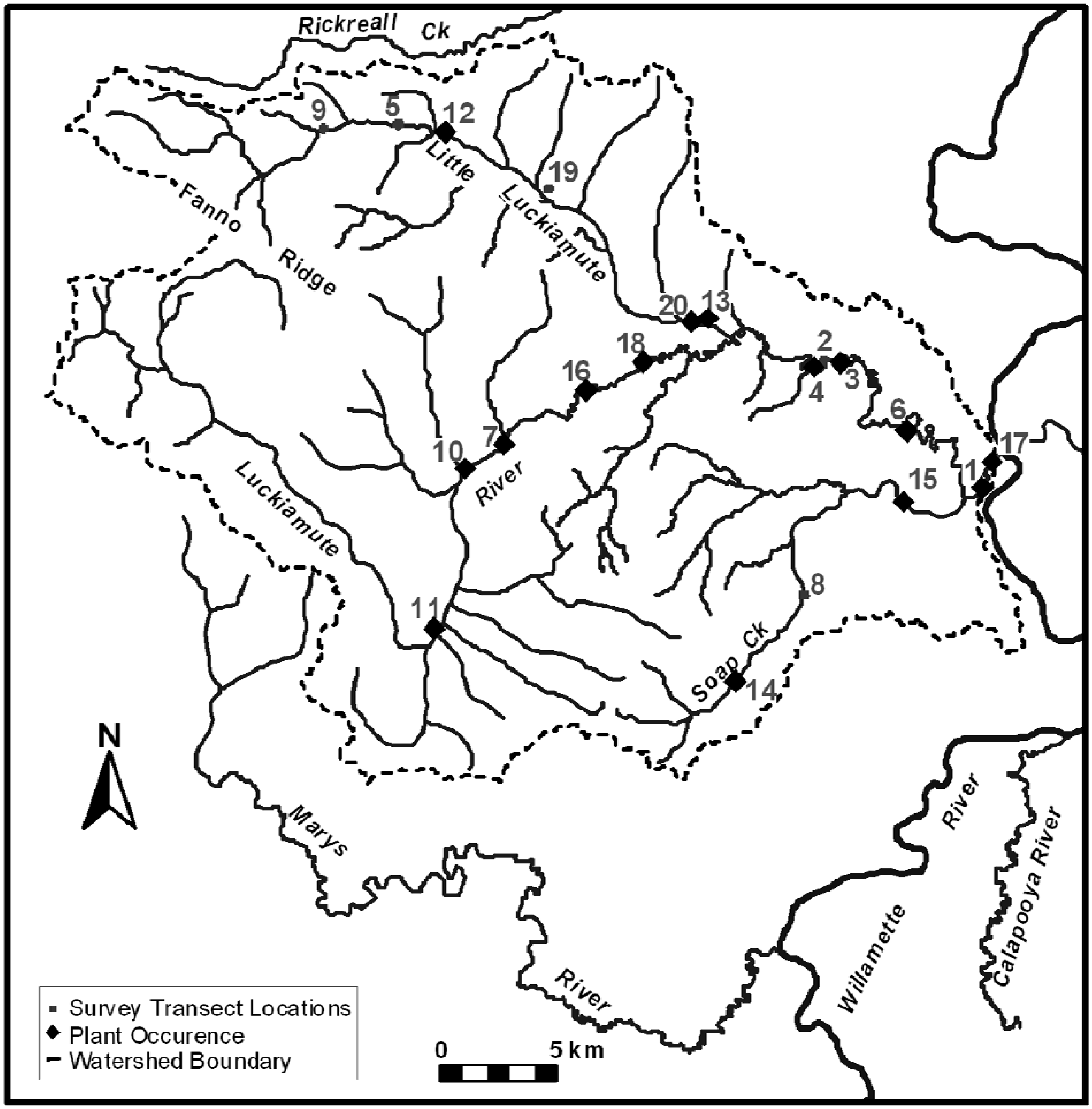
Occurence of Canada thistle - Cirsium arvense



Occurence of Knotweed - Polygonaceae



Occurence of Reed canarygrass - Phalaris arundinacea



Preliminary Conclusions, Current Status and Future Research

- Individual species "behave" as expected
  - E.g., Himalayan blackberry
- Correlation with light intensity important source of data
  - Anecdotal explanations are being quantified
- Are there differences between different sources of disturbance?
  - Preliminary data suggest yes

- Completed literature survey yielding nearly 200 relevant technical references and created a literature reference database
- Created several Geographic Information System (GIS) thematic layers
- Generated a contact list of riparian property owners along the Luckiamute
- Completed 20 field reconnaissance transects along more than 100 miles of the Luckiamute River and its tributaries
- Sponsored 7 undergraduate research assistants with stipends and transportation costs

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- Continued data analysis
- Additional baseline data collection
- Long-term monitoring
- Results that are pertinent for remediation and restoration strategies
- Serve as a regional resource for addressing invasive species questions within our community

Field Trip Stop Summaries and Diagrams

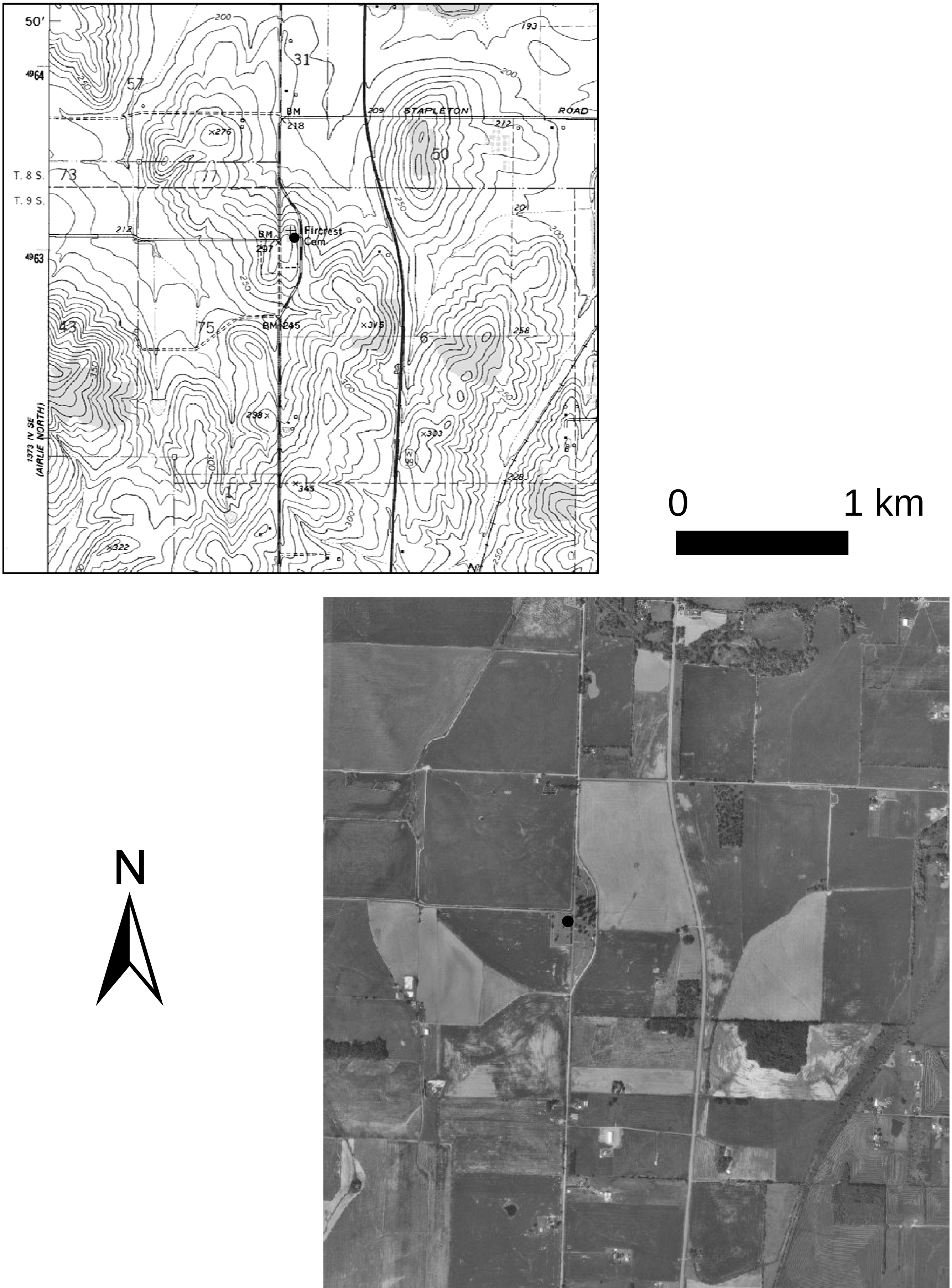
Stop 1. Fir Crest Cemetery
Geologic Overview

- •Physiographic Location
  - •North of the drainage divide between the Luckiamute and Ash Crk
- •Bedrock and Surficial Geology
  - •Stop is located in a rolling landscape underlain by Spencer Fm
  - •Stop provides overview of Mid-Willamette Valley
  - •Stop is near boundary of Tyee and Siletz River lithospatial domains
- •Content Piece – Geologic Overview
  - •Summary of physiographic, geologic, and tectonic setting

Monmouth Cultural History

The town of Monmouth was named for Monmouth, Illinois. In 1852 a group of citizens of the Illinois community crossed the plains to Oregon, and after spending the first winter at Crowley, five miles north of Rickreall, settled in 1853 near the present site of Monmouth. Members of the party gave 640 acres of land on which to establish the town and a college under the auspices of the Christian Church. The place was surveyed in 1855 by T. H. Hutchinson. The money secured from the sale of lots was devoted to the building of the Christian college, which was known as Monmouth University. At a mass meeting the people selected Monmouth as the name of the new community, in honor of their old home. In 1856 mercantile buildings were erected. The first house was build in 1857. the post office was established Feb. 25, 1859, with Joseph B.V. Butler first postmaster. In 1871, due to the influence of the church, the name of Monmouth University was changed to Christian College. The college underwent vicissitudes due to lack of funds, and was once offered to the state for a state university. In 1882 the Oregon legislature passed a bill creating the Oregon State Normal School at Monmouth, which absorbed the Christian College. The name of the school was later changed to the Oregon College of Education and more recently renamed Western Oregon State College.
McArthur, Lewis L., Oregon Geographic Names, 6th edition. Oregon Historical Society Press, Portland, Oregon, 1992, p.575.

Stop 1: Geologic Overview at Fir Crest Cemetery



En Route to Stop 2

- Drive through Spencer Fm-Valley Fill Domain

- Note agricultural land use

Stop 2. Helmick State Park

- Physiographic Location
  - Lower Luckiamute River, 18 km upstream from watershed outlet into the Willamette River

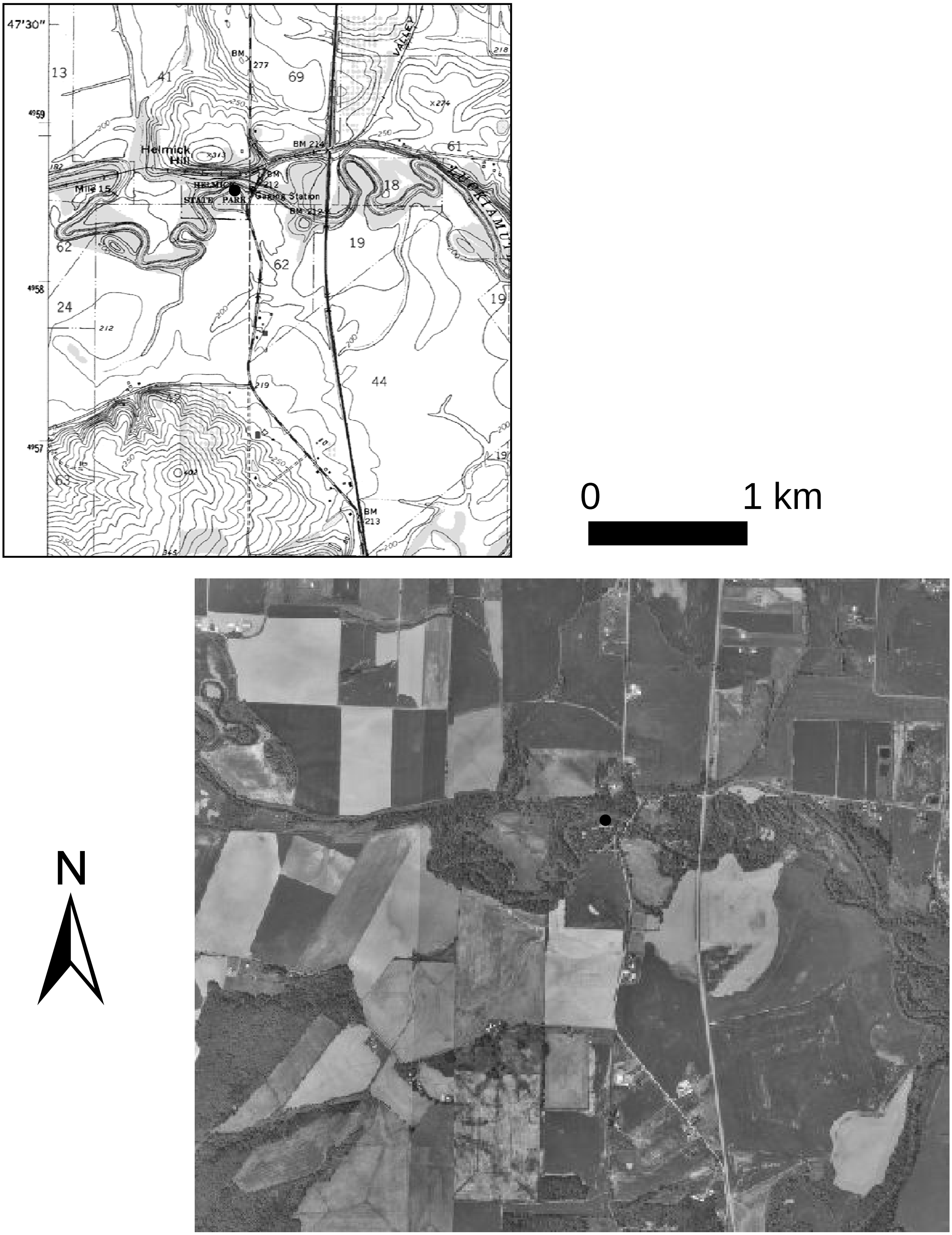
- Bedrock and Surficial Geology
  - Stop is located in the Spencer Fm-Valley Fill lithospatial domain
  - Note incised channel characteristics and low terraces

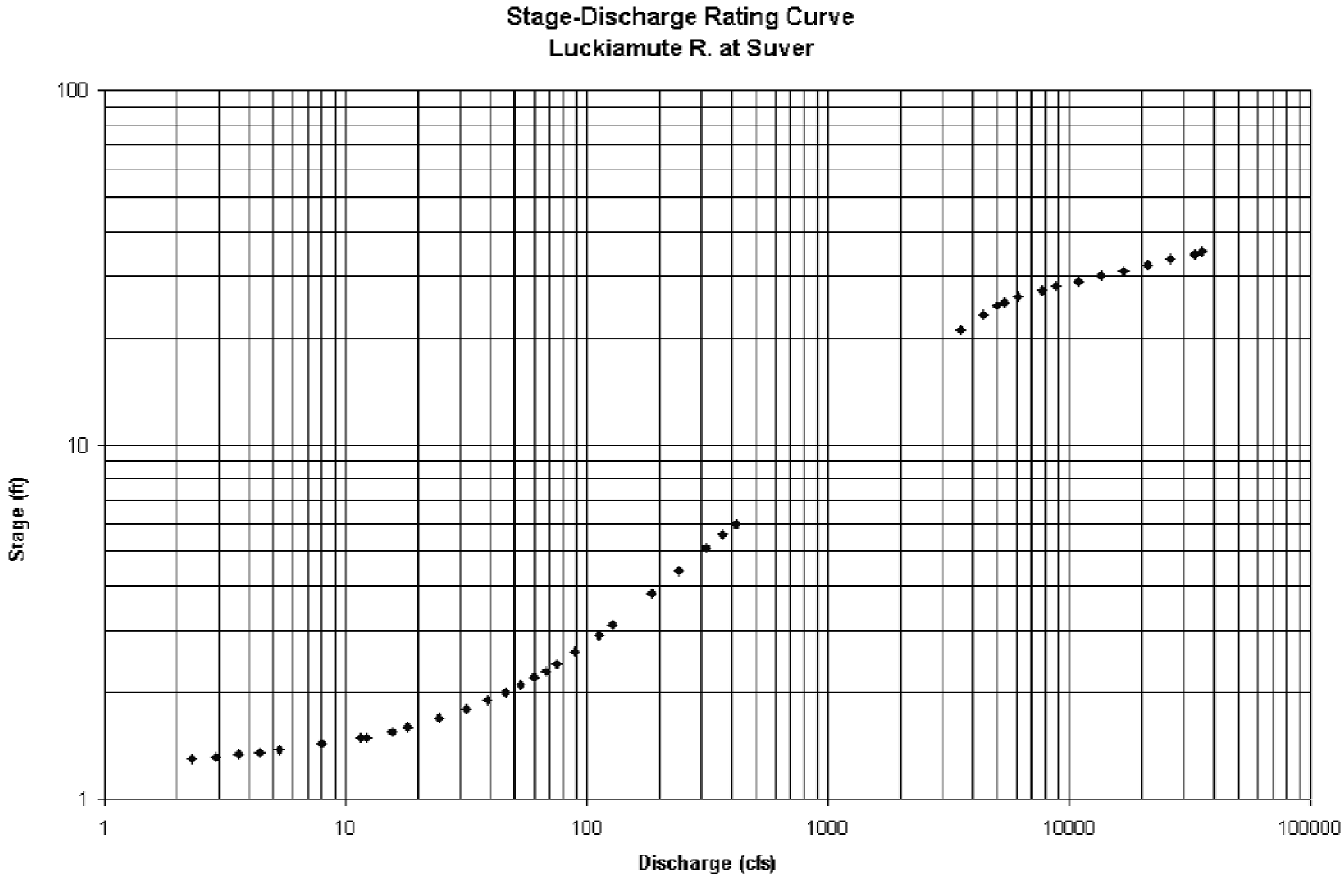
- Content Piece – Geomorphology, Hydrology, and Field Botany
  - Field Botany and Invasive Plant Surveys
  - Geomorphic Surfaces
  - Flood Hydrology
    - USGS Suver Gaging Station
    - Recurrence intervals and seasonal discharge patterns

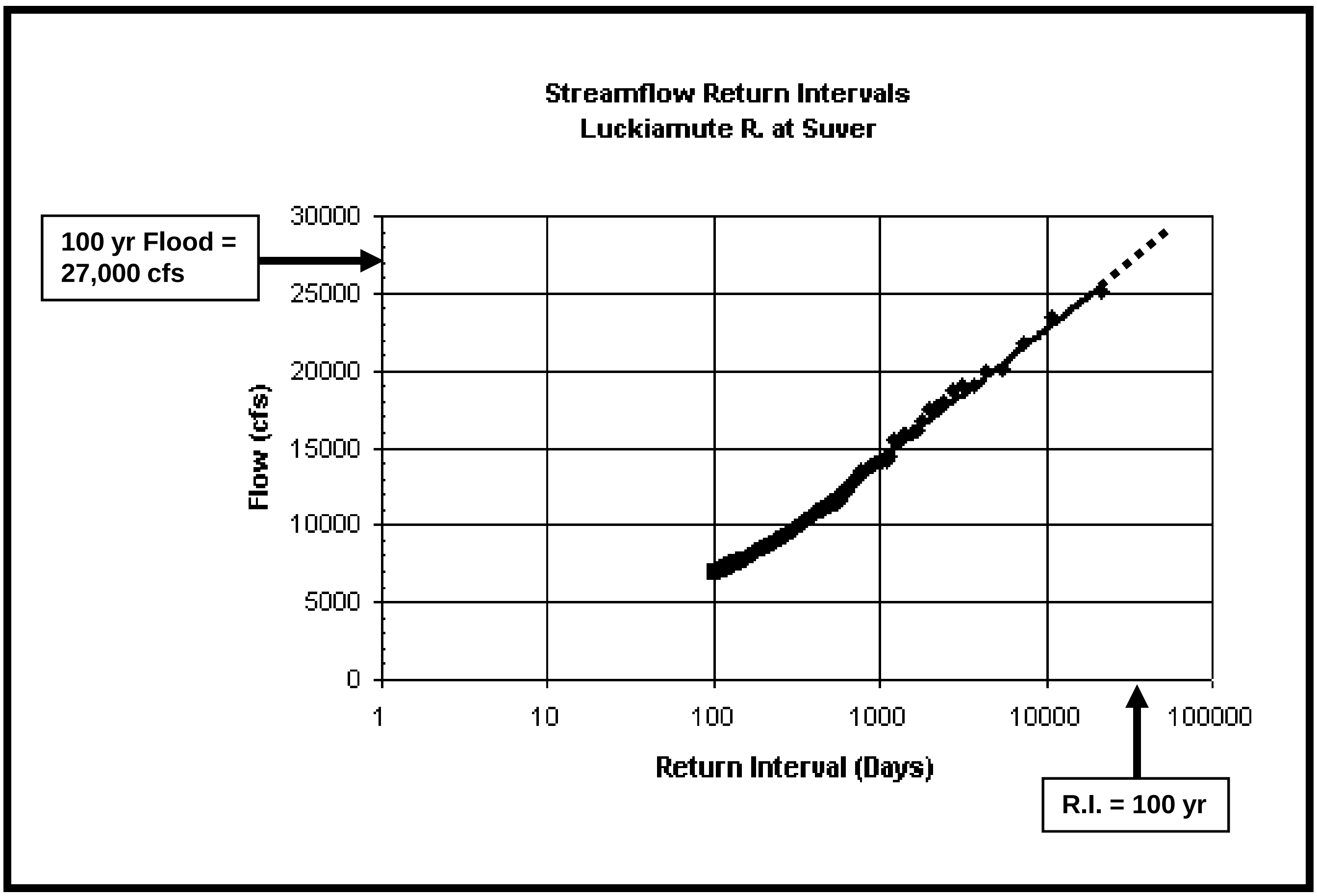
The Helmick Family and Cultural History

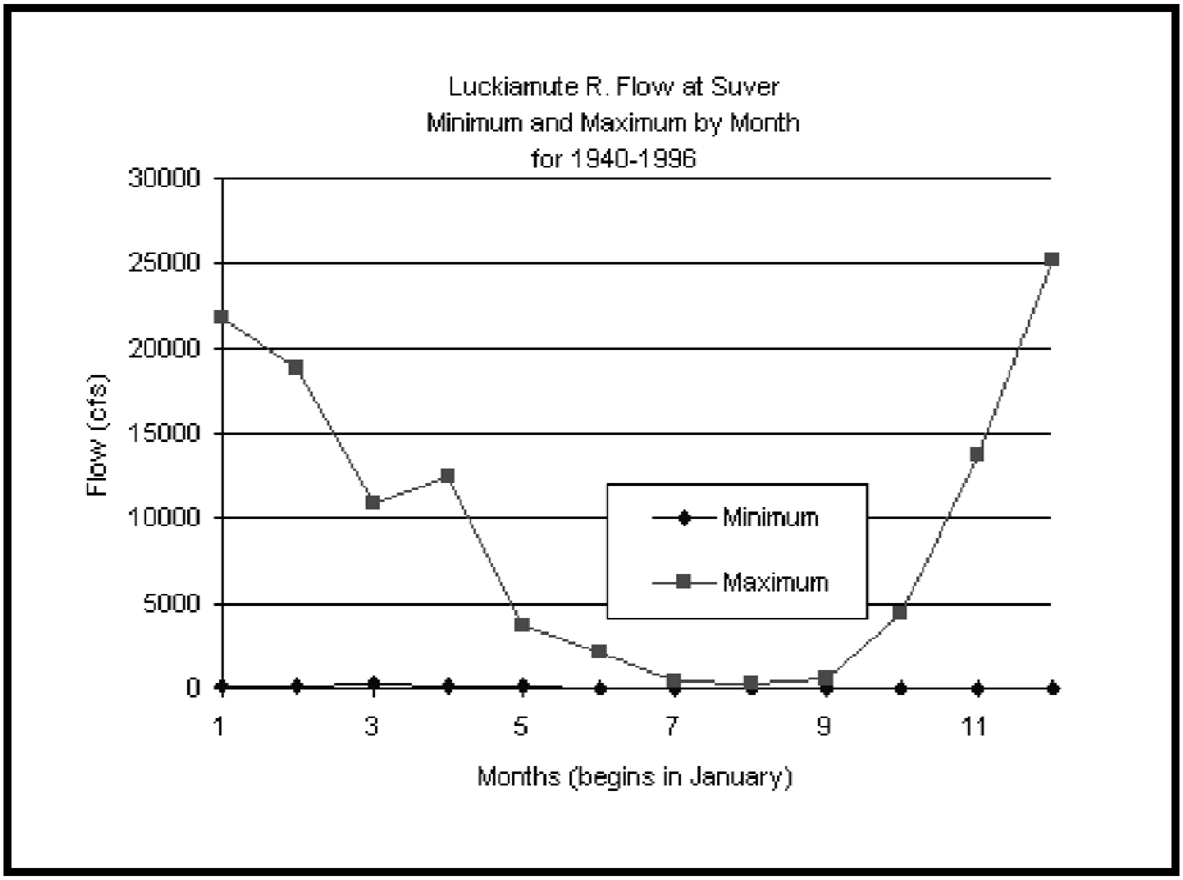
Helmick Hill is just west of the point where the Pacific Highway West crosses Luckiamute River. It was named for Henry Helmick, a pioneer of 1845, who with his wife Sarah took up a donation land claim on the Luckiamute in 1846. Their home was at the base of the hill. Helmick died in 1877. In 1924 Mrs. Helmick presented to the state land adjacent to the highway for a park which was dedicated with appropriate honors, and named Sarah Helmick State Park. She celebrated her 100th birthday on July 4, 1923.
McArthur, Lewis L., Oregon Geographic Names, 6th edition. Oregon Historical Society Press, Portland, Oregon, 1992, p.405.

Stop 2: Luckiamute River, Helmick State Park



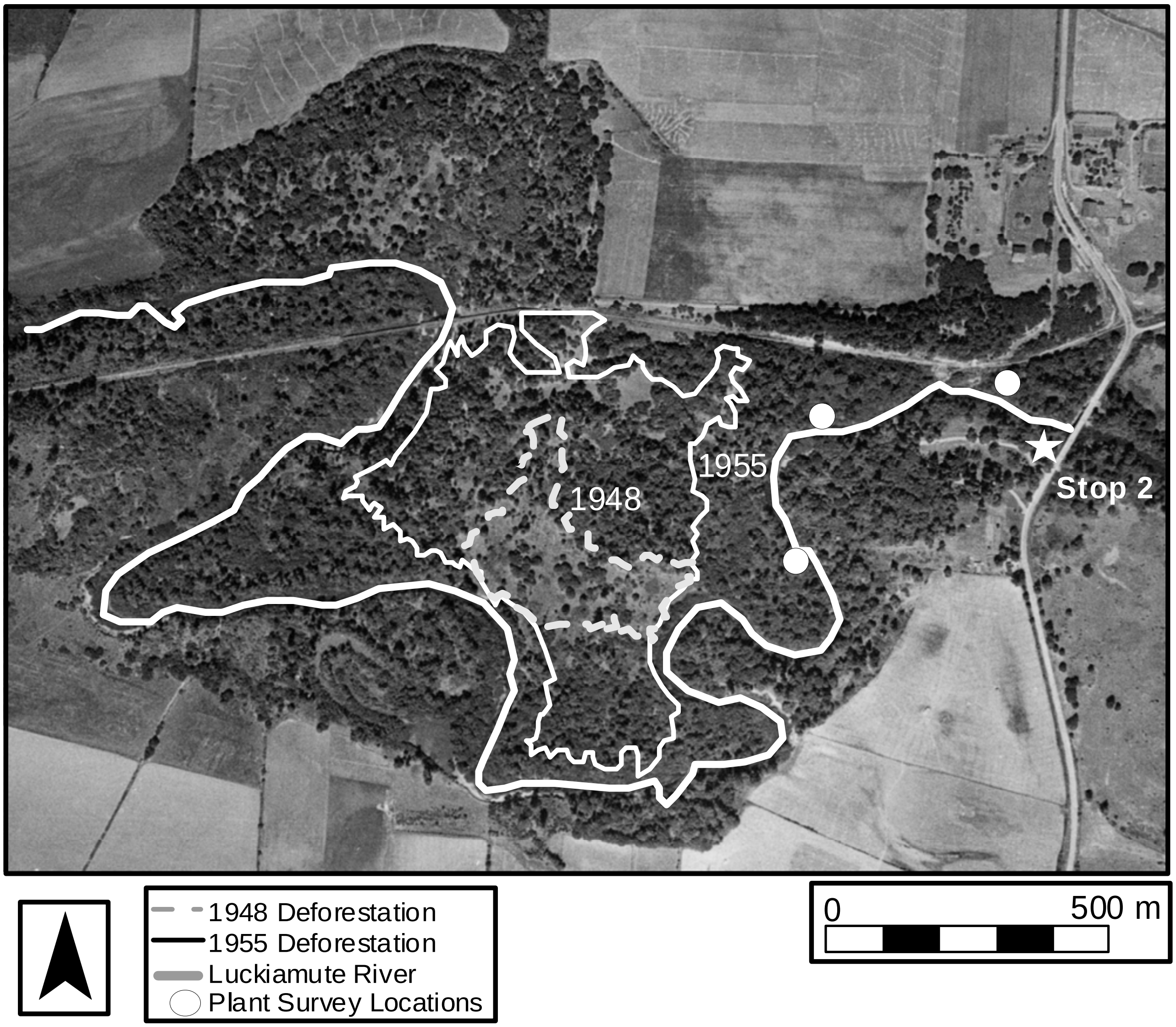

Stage-Discharge Rating Curve
Luckiamute R. at Suver
Stage (ft)
Discharge (cfs)
100
10
1
1
10
100
1000
10000
100000


Streamflow Return Intervals
Luckiamute R. at Suver
100 yr Flood = 27,000 cfs
Flow (cfs)
30000
25000
20000
15000
10000
5000
0
1
10
100
1000
10000
100000
Return Interval (Days)
R.I. = 100 yr



Discharge characteristics for Luckiamute River, Helmick State Park (from Waichler and others, 1997).

Helmick State Park
Example of Riparian Cover Change



Results of Plant Survey Transect 3 – Field Stop 2 - Helmick Park

Field Stop 2 - Helmick State Park Plant Data - Percent Species Cover Per Square Meter Quadrat

Transect Quadrat (meters from stream channel)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Acer circinatum																									
Acer macrophyllum																									
Carex sp.	1	10	1																						
Cornus sericea		2	60	25		10	15		3	2	5		2	2	2									15	
Corylus cornuta subsp. *californica*																									
Galium sp.																									
Helianthus sp.	2																								
Heracleum lanatum																									
Lamiaceae sp.	10	5					1																		
Maianthemum racemosus subsp. *amplexicaule*																							8	15	5
Melilotus sp.													1												
Oemleria cerasiformis																									
Phalaris arundinacea		40	5																						
Physocarpus capitatus											1	10				75	60	30							
Poaceae sp.	30						1																		
Prosartes sp.																									
Rhamnus purshiana																									
Rubus armeniacus																									
Rubus leucodermis																									
Rubus parviflorus																								25	35
Rubus spectabilis							3	40	3										1				15	30	15
Salix sp.		40																20							
Sambucus racemosa																									
Solanum nigrum																									
Solanum sp.												1													
Symphoricarpos albus																									
Tellima grandiflora								1																1	
Urtica dioca subsp. *gracilis*																									

Species	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Acer circinatum																									
Acer macrophyllum																									
Carex sp.																									
Cornus sericea									10		5		2	15											
Corylus cornuta subsp. *californica*																						1	2		
Galium sp.																									
Helianthus sp.																									
Heracleum lanatum																	12	1							
Lamiaceae sp.																									
Maianthemum racemosus subsp. *amplexicaule*												2			1										
Melilotus sp.																									
Oemleria cerasiformis																		20	3					10	3
Phalaris arundinacea													2	30		1									
Physocarpus capitatus																									
Poaceae sp.															35	30									
Prosartes sp.																									
Rhamnus purshiana																									
Rubus armeniacus																							25		
Rubus leucodermis								10					5		35		25	30	15	15	10	75	15	20	15
Rubus parviflorus	40	40	60	30	60	80	75	85	40	30	50	35	2	3	3	10		5	60	60	75	20	15	10	
Rubus spectabilis	7		10	20		20	20	5	8	25	30	5											3	5	
Salix sp.																									
Sambucus racemosa																									
Solanum nigrum																									
Solanum sp.																									
Symphoricarpos albus																									
Tellima grandiflora																	2								
Urtica dioca subsp. *gracilis*																									

Transect Quadrat (meters from stream channel)

Species	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Acer circinatum			7	25	8	5	10	30	10	10	20			1							5		5		10
Acer macrophyllum																									
Carex sp.																							2		
Cornus sericea			4			3	1	5	10			10	5	5	5										
Corylus cornuta subsp. *californica*																1	5	5	30	30	40	40	3		
Galium sp.																							1		
Helianthus sp.																									
Heracleum lanatum																									
Lamiaceae sp.																									
Maianthemum racemosus subsp. *amplexicaule*		2	4																			3	2	30	
Melilotus sp.																									
Oemleria cerasiformis						2	4	1	2	5	15														
Phalaris arundinacea																									
Physocarpus capitatus													1	1	2	7	3								
Poaceae sp.																									
Prosartes sp.																									
Rhamnus purshiana															1			5		5					
Rubus armeniacus																									
Rubus leucodermis																									5
Rubus parviflorus																									
Rubus spectabilis	7	15																						5	20
Salix sp.																									
Sambucus racemosa																5	5								
Solanum nigrum																								1	
Solanum sp.																									
Symphoricarpos albus																									
Tellima grandiflora																									
Urtica dioca subsp. *gracilis*																						1	2	1	

Species	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Acer circinatum	20	10													20	2	5								
Acer macrophyllum																			10	10			15	10	
Carex sp.					10	3			1	5								1							
Cornus sericea																									
Corylus cornuta subsp. *californica*												15	15	20	5	10		5	35	15					
Galium sp.																									
Helianthus sp.																									
Heracleum lanatum																									
Lamiaceae sp.																									
Maianthemum racemosus subsp. *amplexicaule*					10								6	10	7	5	4				2				
Melilotus sp.																									
Oemleria cerasiformis																									
Phalaris arundinacea																		5						5	20
Physocarpus capitatus																									
Poaceae sp.																									
Prosartes sp.								10	10																
Rhamnus purshiana																									
Rubus armeniacus	1		30	20			20	40	10	10	30	10	25	6	5									10	20
Rubus leucodermis						15	15	15	25	30			10	10	10		15	15	15	30	25	20	15		
Rubus parviflorus																								10	15
Rubus spectabilis	50	60	45	15	60	20	40	15	15	15	30	10				10	5								
Salix sp.																									
Sambucus racemosa																									
Solanum nigrum																									
Solanum sp.																									
Symphoricarpos albus				10	2							5	1	5				5		5		5	30	20	
Tellima grandiflora																									
Urtica dioca subsp. *gracilis*																									

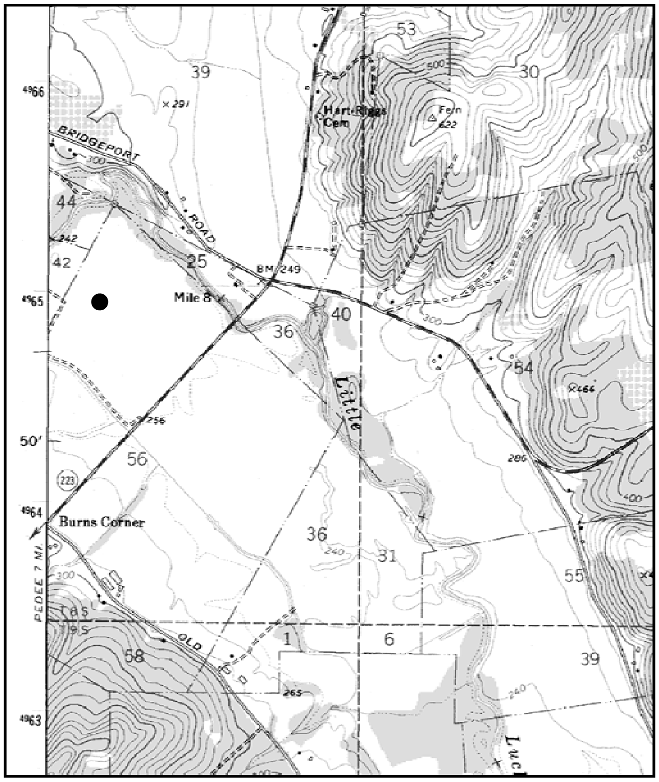
Stop 3. Little Luckiamute Crossing-Kings Valley Hwy

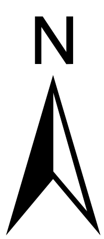
- Physiographic Location
    - Little Luckiamute River (northern watershed)

- Bedrock and Surficial Geology
    - Stop is located in the Spencer Valley-Fill Domain
    - View of upper watershed, into Yamhill-Intrusive Domain

- Content Piece – Invasive Plant Distribution

Stop 3: Little Luckiamute Crossing, Kings Valley Highway





Results of Plant Survey Transect 19 – Field Stop 3 – Little Luckiamute Crossing

Field Stop 3 - Bridgeport Plant Data - Percent Species Cover Per Square Meter Quadrat

Transect Quadrat (meters from stream channel)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Carex sp.				4	1					7	3									2	2	2	3	3	3	4	4	3												4		5
Fraxinus latifolia																																				5						2
Galium triflorum																						1	1	2	4		2	2														
Heracleum lanatum																				2	4	4											2	1				3	3			
Malus sp.																																										
Marah oreganus														2	1												2										2	3	3	8		
Melissa officinalis																					2													1								
Oemleria cerasiformis																																										
Physocarpus capitatus																																									1	7
Polystichum munitum	9	13											3	12	28	15	12	4	1	2	1	4		1	5	2		15	10	35	70	65	40	15	4		2	5	15	12	15	2
Quercus garryana																																										
Ribes sp.																																										
Rosa sp.	20	11	14	12	7	5	11	9		5	5																		4	2	8	5			5	10	10		10	4	5	
Rubus armeniacus	17	22	14	23	12	25	5	10	24	17	20	12	5	9	13	10	11	12	15	8	2	15	18	7	10	13	15	7	8	7	5	8	18	5	10	7	8	5		10		3
Rubus laciniatus				2	4																												4	12	8	7	10	7	4			
Rubus leucodermis	8	4	8	3		6	4	8	5	4		4	2	1	1					3	4														4	5		8	4		10	3
Symphoricarpos albus	6	7	3	6	1	6	3	2	2	2	5	6	12		3	3	2	1	3	3														2				3				
Tellima grandiflora																						2					2															
Toxicodendron diversilobum																																						5	12	8	4	
Urtica dioca subsp. *gracilis*																																										

Transect Quadrat (meters from stream channel)

Species	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
Carex sp.			3	5	5		2	2	3				3																													
Fraxinus latifolia																2																										
Galium triflorum																																										
Heracleum lanatum																																										
Malus sp.								3	9				12																													
Marah oreganus	8										5	4			7	6	15																									
Melissa officinalis																																										
Oemleria cerasiformis		4	6		2	2				3	5	5	5																													
Physocarpus capitatus																																										
Polystichum munitum			12					12		6	4	18	4	2			3																									
Quercus garryana														10	12																											
Ribes sp.										5																																
Rosa sp.																																										
Rubus armeniacus	12	8	10	15	15	18	22	12	15	12	12			5																												
Rubus laciniatus																																										
Rubus leucodermis		8	8	5	8	9	20	7	20	15	18	20	10	10	12	15	12																									
Symphoricarpos albus	15	10		8																																						
Tellima grandiflora																																										
Toxicodendron diversilobum																																										
Urtica dioca subsp. *gracilis*																																										

Stop 4. Falls at Falls City

- Physiographic Location
  - Little Luckiamute River (northern watershed)

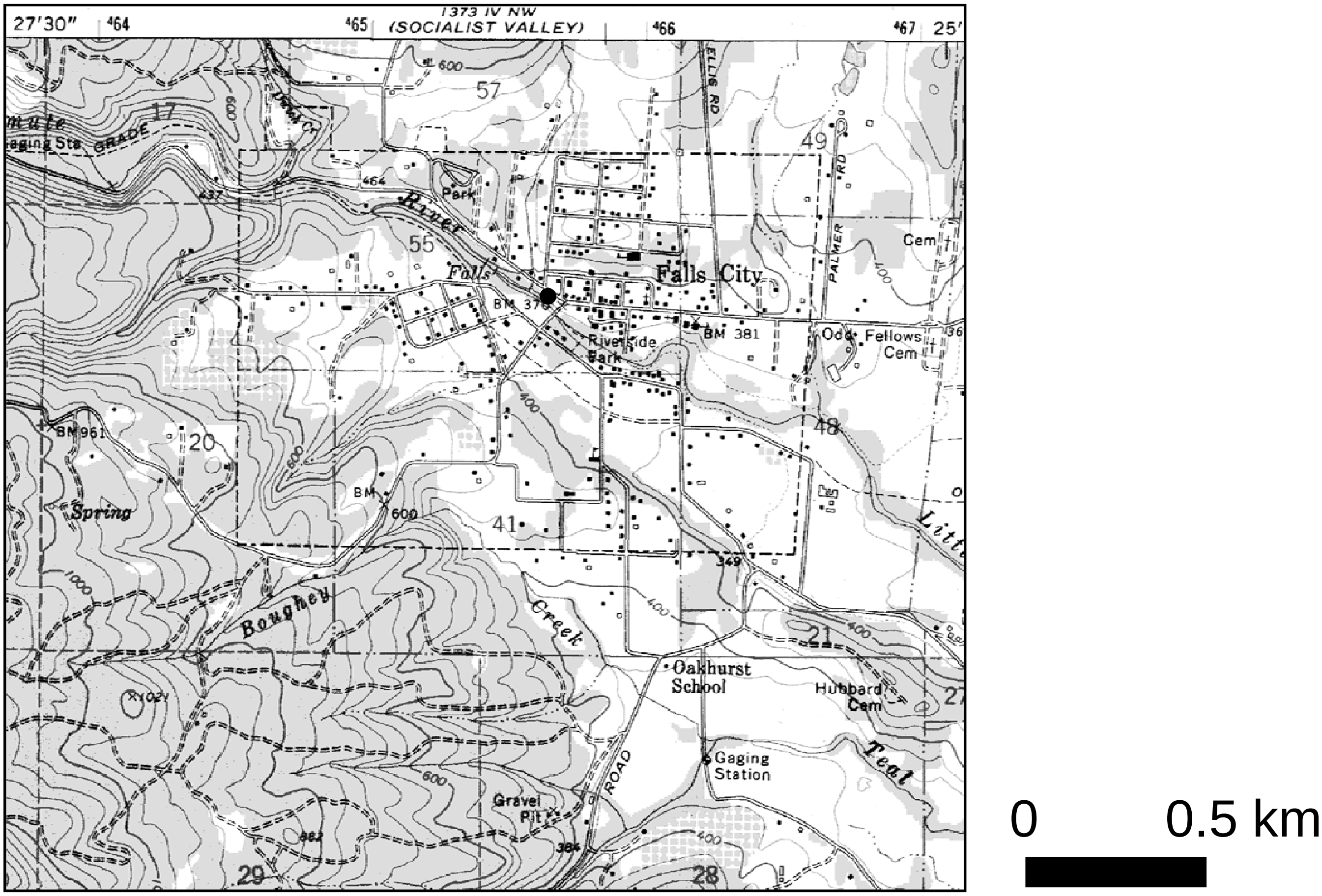
- Bedrock and Surficial Geology
  - Stop is located at prominent knick point of Little Luckiamute
  - Stop is located in the Yamhill-Intrusive lithospatial domain

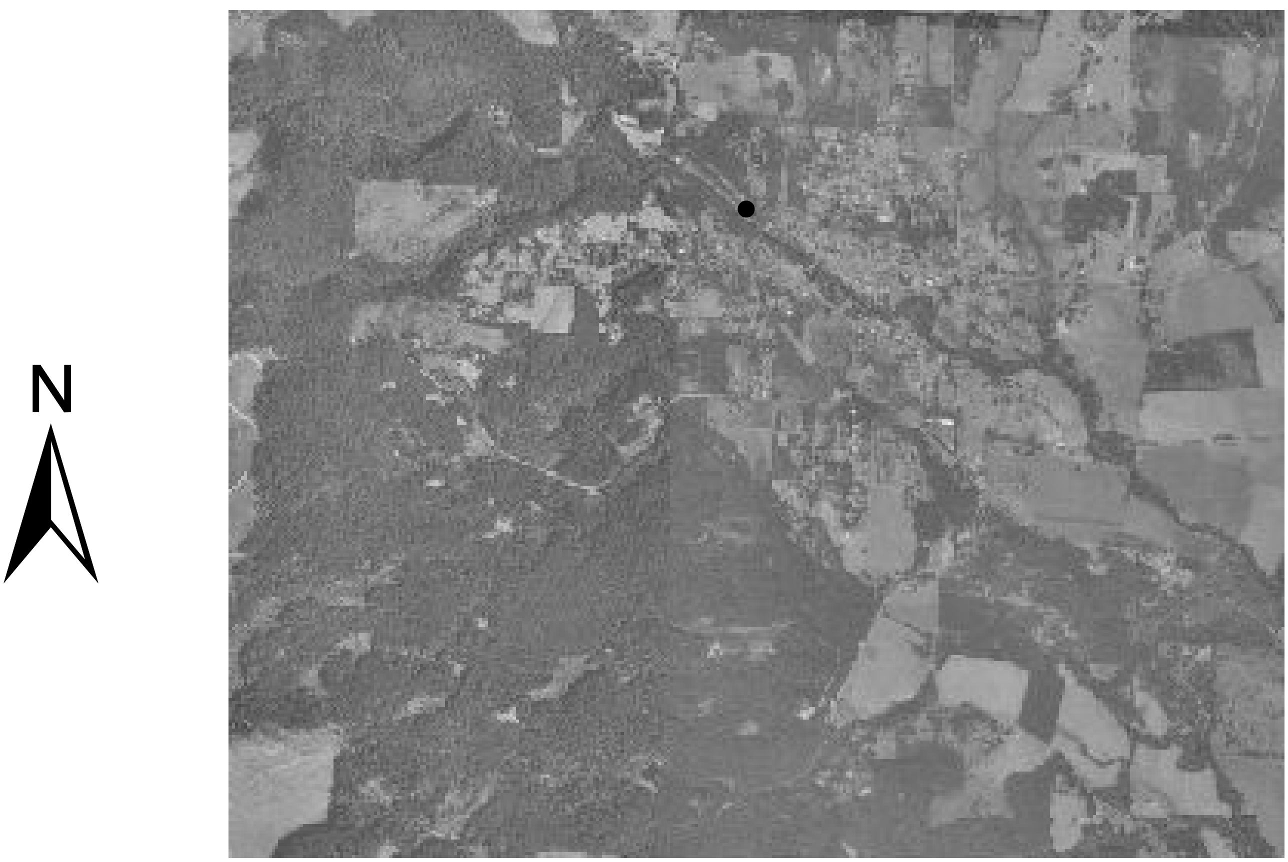
- Content Piece – Fluvial Erosion Dynamics and Invasive Plant Work
  - Knickpoint = hydraulic step in gradient
  - Falls are fracture and bedrock controlled
  - Headward erosion, block plucking, and wall-rock undercutting
  - Stream Stream Power = (Discharge) x (Gradient) x (Specific Wt.)
    - Stream Power > Load = Erosion
    - Stream Power < Load = Deposition
  - Little Luckiamute Channel Condition at Stop 2
    - Channel under capacity with respect to sediment load
    - Power > sediment load

Falls City Cultural History

This town was named for the falls in Little Luckiamute River, which are near the west edge of the community. The name was proposed at the meeting which was held to initiate proceedings for incorporation. This place was originally served from a post office called Syracuse, situated between Dallas and the present site of Falls City. Syracuse post office was established in Feb. 1885, with Frank K. Hubbard first postmaster. The name of the office was changed to Falls City in Oct. 1889, and the office was doubtless moved at the time. It is said that the name Falls City was suggested by a family that had previously lived in Falls City, Nebraska.
McArthur, Lewis L., Oregon Geographic Names, 6th edition. Oregon Historical Society Press, Portland, Oregon, 1992, p.305.

Stop 4: Little Luckiamute River, the Falls at Falls City





Results of Plant Survey Transect 12 – Field Stop 4 – Falls at Falls City

Field Stop 4 - Falls City Plant Data - Percent Species Cover Per Square Meter Quadrat

Transect Quadrat (meters from stream channel)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Acer circinatum								5	5		2		3	4			2																											
Acer macrophyllum																													1															
Athyrium felix-femina	40	15	3	2	9	6	12	13	9	3	8	12	15	50	50	35	20	7	5	3																								
Dicentra formosa																1	1	1																										
Hedera helix									2	1			1																2															
Lysichiton americanum					3	3	5	6	3	4	3	15	16		5	7	3																											
Maianthemum dilatatum	5	2															2																											
Phalaris arundinacea	1		1	2																																								
Poaceae			1																																									
Polystichum munitum																	3									3	15	17	2															
Prunella vulgaris				2																																								
Pteridium aquilinum var. *pubescens*																					3	6	2	3	4	1	25	3																
Rubus armeniacus	4	6	4	3	5					1								6	90	85	65	70	80	65	60	40	10	15	10															
Rubus leucodermus																													2															
Rubus spectabilis																													1															
Rubus ursinus				2									5	2	1			3																										
Saxifragaceae	7	12	5	2	1			1	2			1	3	2		1																												
Solanum dulcamara		1																																										
Stachys cooleyae			1			1	1				1																																	
Trifolium sp.			2	2	1	1		1																																				
Vaccinium sp.																		1																										

Transect Quadrat (meters from stream channel)

Species	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Acer circinatum																																												
Acer macrophyllum																																												
Athyrium felix-femina																																												
Dicentra formosa																																												
Hedera helix																																												
Lysichiton americanum																																												
Maianthemum dilatatum																																												
Phalaris arundinacea																																												
Poaceae																																												
Polystichum munitum																																												
Prunella vulgaris																																												
Pteridium aquilinum var. *pubescens*																																												
Rubus armeniacus																																												
Rubus leucodermus																																												
Rubus spectabilis																																												
Rubus ursinus																																												
Saxifragaceae																																												
Solanum dulcamara																																												
Stachys cooleyae																																												
Trifolium sp.																																												
Vaccinium sp.																																												

Stop 5. Black Rock

- •Physiographic Location
  - •Little Luckiamute River (northern watershed)

- •Bedrock and Surficial Geology
  - •Stop is located in the Yamhill-Intrusive lithospatial domain
  - •Yamhill Formation outcrops in channel bottom
  - •Note colluvial hillslopes, alluvial deposits, channels, floodplains, terraces

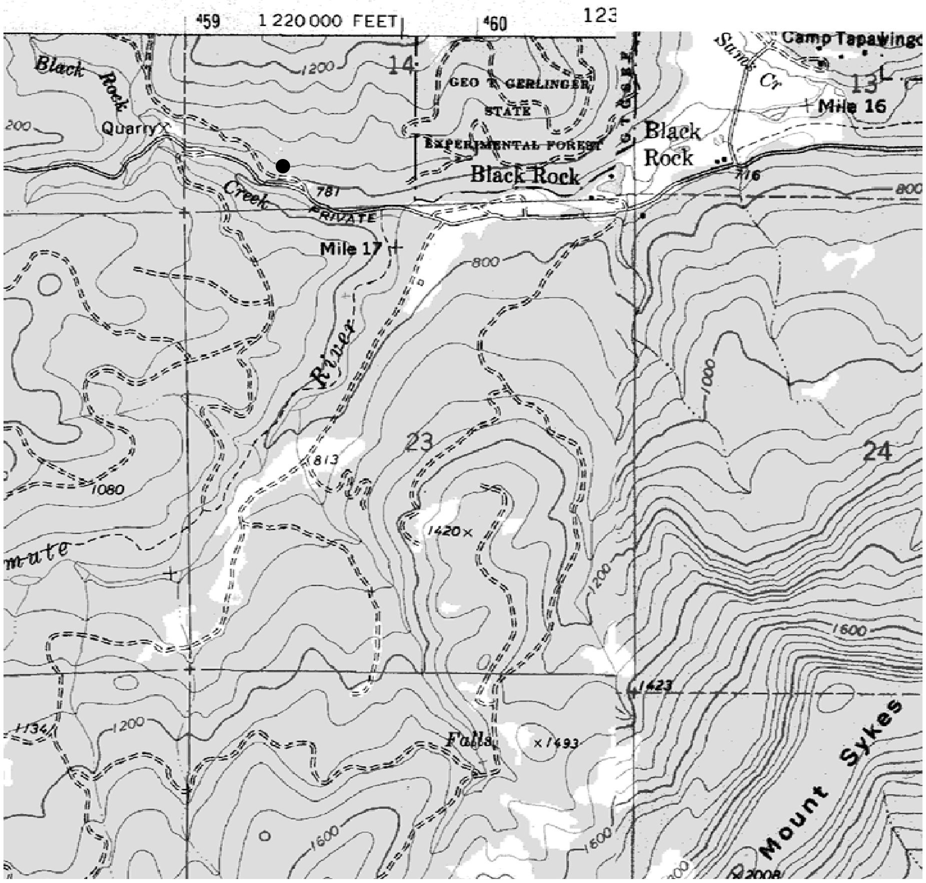
- •Content Piece – Field Botany
  - •Botanical Survey Techniques
  - •Invasive Plant Species
  - •Riparian Habitat

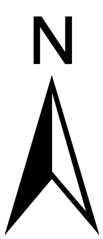
Black Rock Cultural History

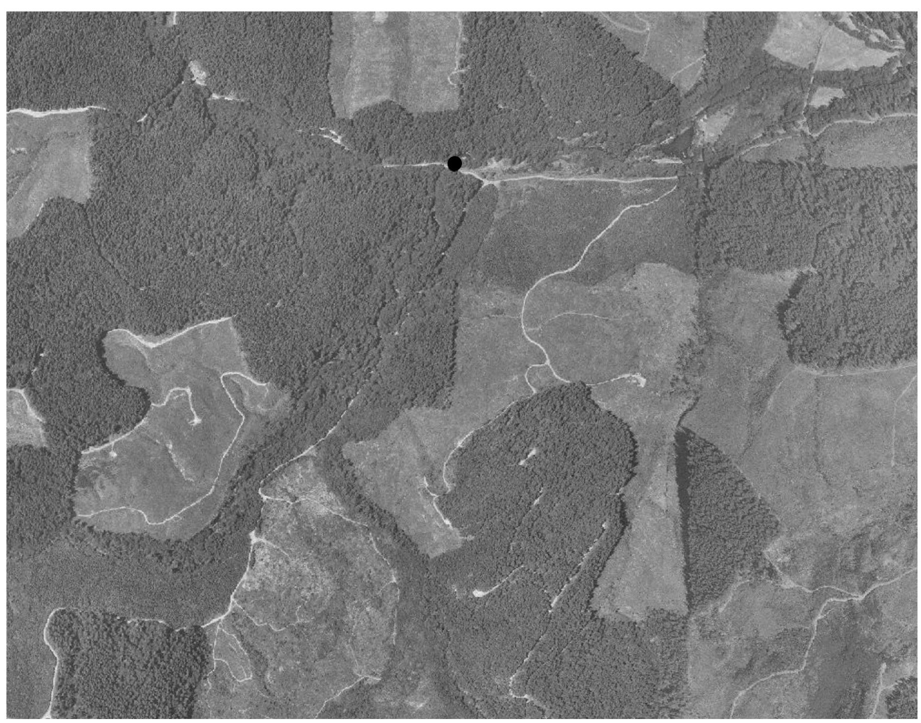
Black Rock was the western terminus of the Southern Pacific Company branch line west from Dallas. It was on the Little Luckiamute River. It is generally believed the town was named because of an exposed ledge of black shale rock. The railroad was taken up after World War II and when the compiler visited the area in 1984, there was little evidence of civilization.

McArthur, Lewis L., Oregon Geographic Names, 6th edition. Oregon Historical Society Press, Portland, Oregon, 1992, p.75.

Stop 5: Little Luckiamute River, Black Rock







Results of Plant Survey Transect 19 – Field Stop 5 – Black Rock

Field Stop 5 - Black Rock Plant Data - Percent Species Cover Per Square Meter Quadrat

Transect Quadrat (meters from stream channel)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Acer circinatum																				4	4		1										17	35	27	25		15	15	12	3									
Acer macrophyllum																				6	4				23	8				25	15											1								
Adenocaulon bicolor															2																																			
Alnus rubra																12	18									1			1		1																			
Asarum caudatum																										1	1							1			1													
Berberis nervosa																															3	1								3					7	4	4		5	6
Cirsium arvense																																													3	2	1			
Cirsium vulgare	5																																																	
Claytonia sibirica																										1																								
Corylus cornuta subsp. californica																																																4		
Digitalis purpurea	3	4																																																
Epilobium ciliatum						2																																1												
Galium aparine																																		1														1		
Holodiscus discolor																																																		
Lapsana communis			2	3																																														
Leucanthemum vulgare																																																		
Oemleria cerasiformis					1	5	2	10						5	15			2										1																						
Osmorhiza berteroi														1						1	1	1																	1											
Oxalis oregana																				2	7		1	3	6	3	4	7	6		1	1			1															
Poaceae sp.	25	25	25	7	10	15								3	5	1	1	1	1	2	2	1	1	1	1							1	15	10	1	1	6	8	10	8						2	4		4	
Polystichum munitum			25	7		10	90	22	75	85	85	75	85	72	15	75	40	22	60	12	10	70	12																		90	95	55	35						25
Prosartes sp.												5								5					2																									
Pseudotsuga menziesii																																2								6	2									2
Pteridium aquilinum var. pubescens																																												1	2	10	6	15	5	30
Rubus armeniacus																																		4	5	1														
Rubus laciniatus																																											4	7						
Rubus parviflorus															10			10		4	2		1	4	15	3			1																					
Rubus ursinus		1	5	5								5	7	8	15	4	4		2		1		5	3	2	6	5	2	4			5	5	2		1	6	5	5	9	1	7		6	6	5	8	5	4	2
Tellima grandiflora	6														1			1	1									1					2			1	5													
Vaccinium sp.																																												2	2					

Transect Quadrat (meters from stream channel)

Species	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Acer circinatum																																																		
Acer macrophyllum																																																		
Adenocaulon bicolor																																																		
Alnus rubra																																																		
Asarum caudatum																																																		
Berberis nervosa	2	2	6	10	8	20	30	25	12		4	4						30	40	35	35	30	15	25	20	20	12	25	20	35	35	30	70	30	25	30	50	35	40	25	20	20	20	17	12	7				
Cirsium arvense																																																		
Cirsium vulgare																																																		
Claytonia sibirica																																																		
Corylus cornuta subsp. californica							2	4	15	15	5						5															20	1	20	5	5								4	15					
Digitalis purpurea																																																		
Epilobium ciliatum																																																		
Galium aparine																																																		
Holodiscus discolor																												5																						
Lapsana communis																																																		
Leucanthemum vulgare																																							2	1										
Oemleria cerasiformis																																																		
Osmorhiza berteroi																																																		
Oxalis oregana																																																		
Poaceae sp.																																																		
Polystichum munitum	10	1	4	10				5		15							15	3				10	25	5	25	6	20		20	6			1	2													3			
Prosartes sp.																																																		
Pseudotsuga menziesii		15	10	4	3	4	2			10	15	30	35	15	25	30	10	5	5			5	5	5	7	25	5	4	4						4						10			10	5		5	7	7	7
Pteridium aquilinum var. pubescens	8																																	3	20	9	1	15	5											
Rubus armeniacus																																																		
Rubus laciniatus																																					4	4	4	3										
Rubus parviflorus																																																		
Rubus ursinus	1								4	1	4	3	1							1											1					1	4	2		2		4					2			
Tellima grandiflora																																																		
Vaccinium sp.																		1						1																										

THANKS FOR YOUR PARTICIPATION ON THE LUCKIAMUTE WATERSHED FIELDTRIP!

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