Final Report

‘Inimim Forest Timber Harvest Implementation Plan

USEPA Assistance Agreement: SD989040-01-0

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Grizzly Creek, ‘Inimim Forest Ecosystem

Contents

Introduction

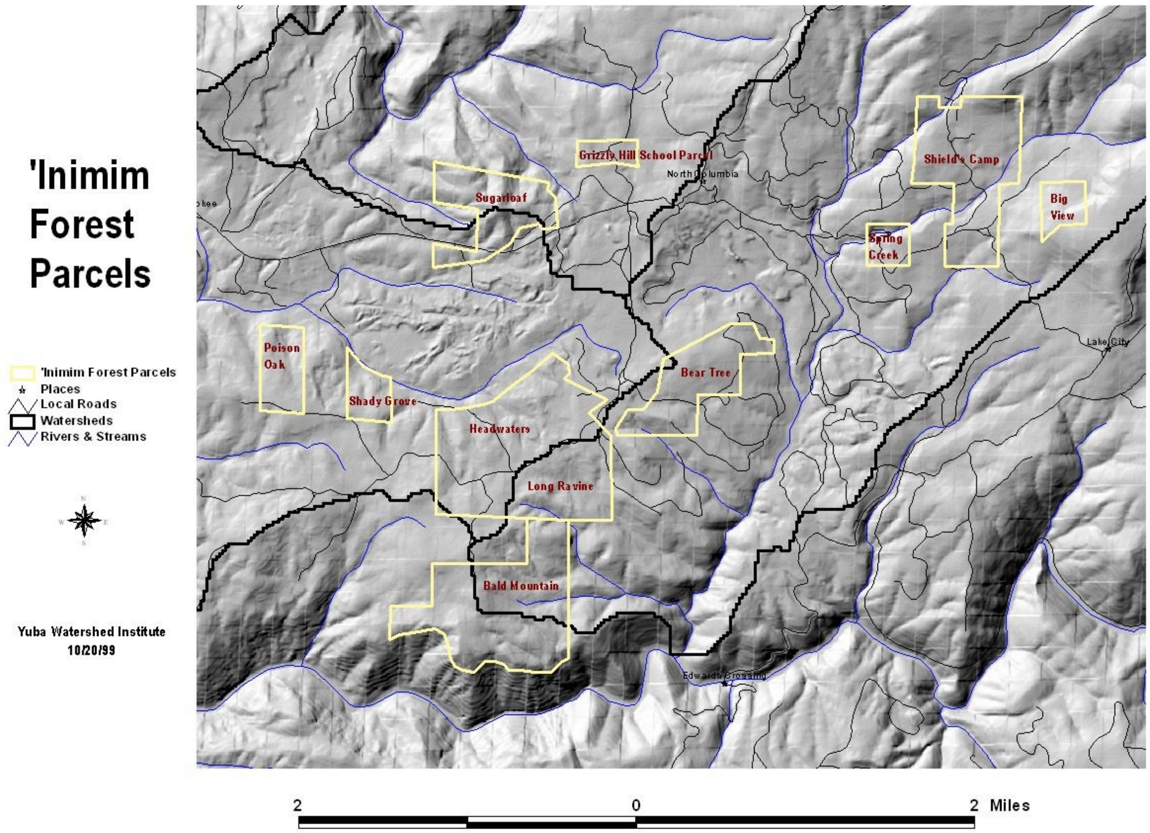


Figure 1-1

A. Background on the 'Inimim Forest

The 'Inimim Forest is 1,754 acres of US Department of the Interior Bureau of Land Management (BLM) land located just north of the South Fork Yuba River in NW Nevada County, CA. 'Inimim means pine in Nisenan, the language of the native people that lived for 1200 years in this pine and oak clad region of the westslope north Sierra Nevada, about 80 miles northeast of Sacramento.

In 1991, the BLM signed a contract with the Yuba Watershed Institute and the Timber Framer's Guild of North America regarding the cooperative management of the 'Inimim forest as a model for community-based sustainable forest management. The 'Inimim Forest Plan was completed and adopted by the BLM in 1995. It calls for the restoration of old-growth forests on the 'Inimim, and the production of an ecologically sustainable supply of old-growth timber.

In 1996, at the request of the YWI, the Institute for Sustainable Forestry (ISF, of Redway, CA) reviewed the 'Inimim Forest Plan for compliance with international standards for sustainable forest management put forward by the Forest Stewardship Council (FSC, of

Oaxaca, Mexico). The Plan failed, but ISF provided YWI with a series if conditions that, once met, would guarantee the 'Inimim Forest certification. The 'Inimim Forest would be among the first tracts of federal land in the US certified according to FSC standards.

In May 1998, the USEPA awarded YWI $49,935 for partial support of $99,934 project proposed by YWI, wherein an implementation plan for the 'Inimim forest would be completed. This implementation plan, made with extensive in-kind contributions from state and federal agencies and extensive voluntary aid from the local community, was completed in late September 1999. The 'Inimim Forest Plan will now meet the FSC standard for certified ecologically sustainable forest management, and the first timber operations will begin in summer 2000.

B. Overview of the Implementation Plan

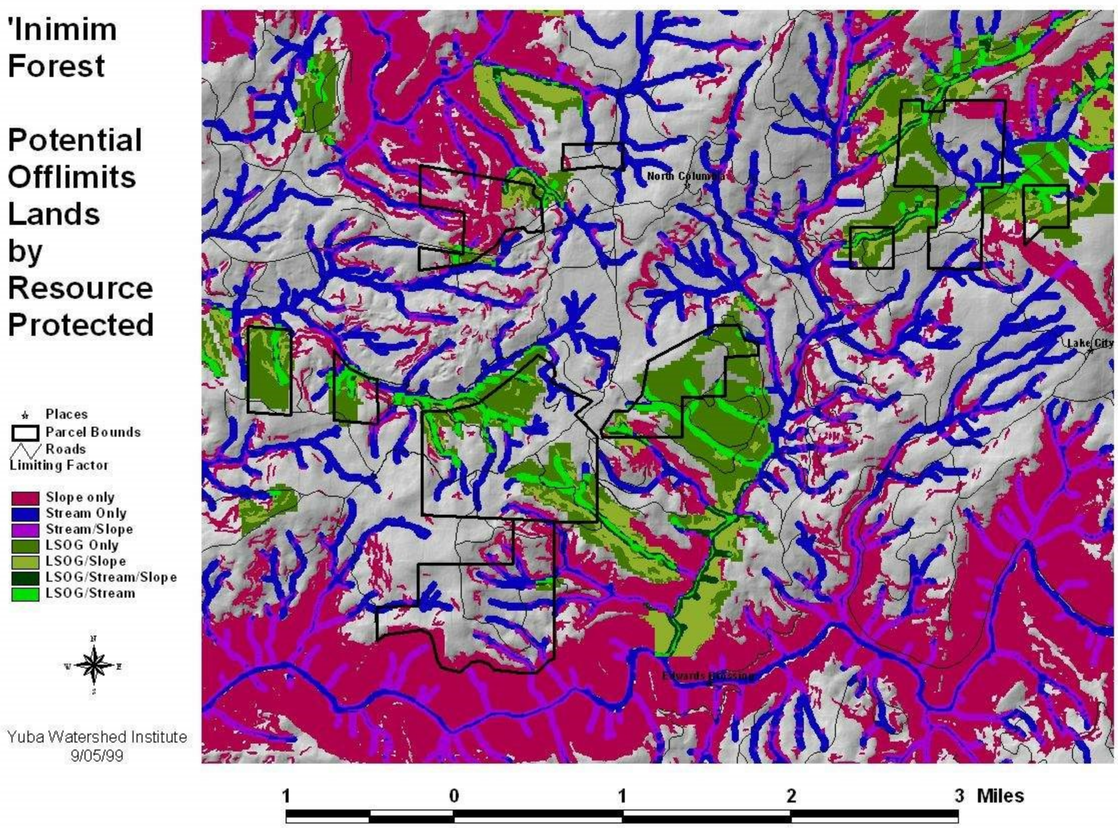


Figure 1-2

Detailed study of the three planning watershed, 20,864 forest landscape surrounding the 'Inimim Forest reveals that it supports 31% of the surviving old-growth and near old-growth forest. Two of the planning watersheds, Spring and Grizzly Creeks, are in relatively excellent ecological condition. The third, Shady Creek is severely damaged, primarily due to historic hydraulic mining in its headwaters. All mapped old-growth and near old-growth forests will be protected in the 'Inimim, save for a limited subset of near old-growth on three upland sites (far from the streams). These will be managed, starting out at decade three (year 2030), for sustained yield production of quality old timber.

Forest management on the 'Inimim will be limited to a subset of lands (708 acres or 40% of the 'Inimim) that are gently sloping productive upland soils outside of surviving old-growth forests. Within these lands, 33 management compartments have been established. Each compartment is accessed by the existing road system, and features a designated landing and set of skid trails. All logging equipment will be restricted to the landing and skid trail system, minimizing impact to soils and watersheds. The permanent skid trails do not cross the stream systems at any point, even in the uppermost regions (swales), that do not show signs of water movement.

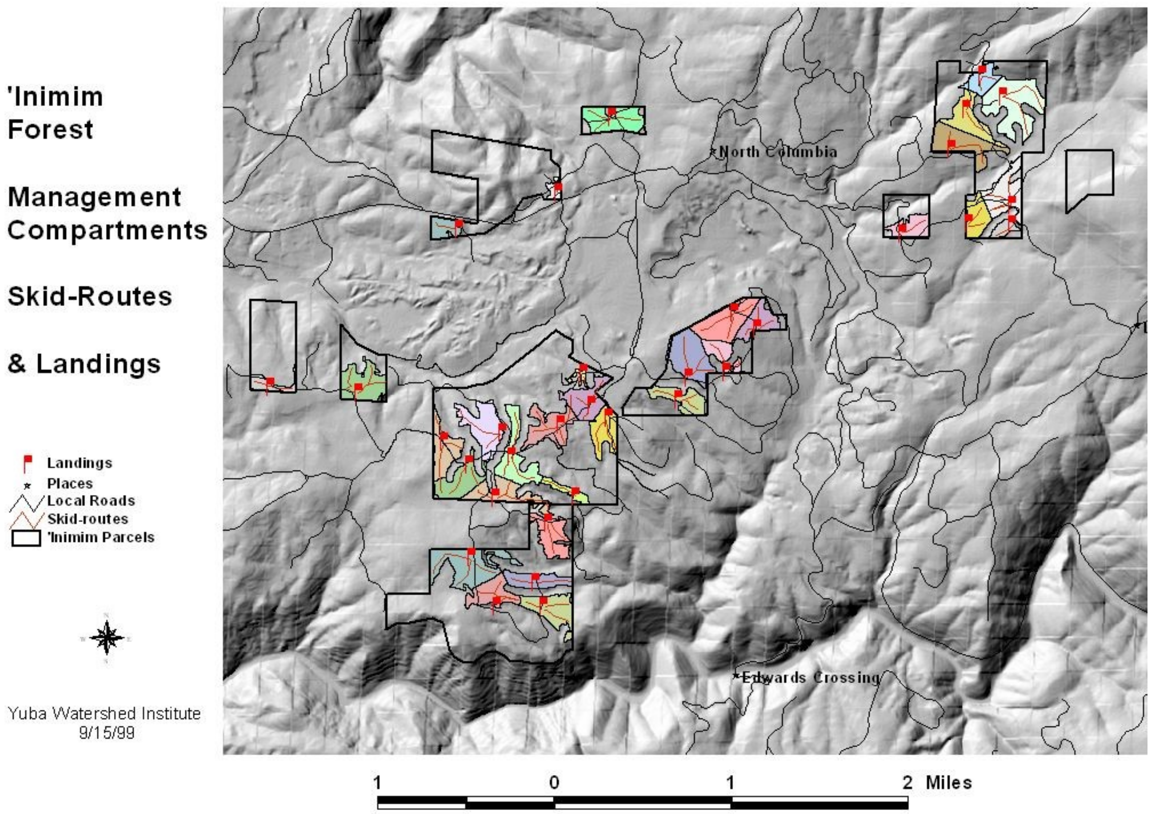


Figure 1-3

All logging (where logging is planned and necessary) will occur once every twenty years in each compartment. Maximum allowable cut statistics have been generated for each compartment based on inventoried timber volume and measured forest growth. Ten percent of this volume and growth will be left in each compartment for snag (dead standing tree) and down log recruitment. These dead trees are essential for wildlife, and maintaining soil productivity. The maximum allowable cut at each entry is the total amount of growth over twenty years for the compartment, minus the 10% necessary for snags and down logs. This yields a mean output of 38,440 board feet per compartment per entry. In between logging cycles, the compartment will rest, with the only management prescribed fire or mastication of brush on the forest floor.

The total volume being managed on the ‘Inimim Forest is 31.1 million board feet. Fourteen point four million of this lies in streamside protection zones, old-growth forests and on steep slope where logging will never occur in this plan. Such volume is not part of sustained yield calculations. Over the 200 year life of the plan, 90% the remaining 16.7 million board feet will be cut, yielding an ecologically sustainable annual output of 67,260 board feet per year. In the first 50 years of the Forest Plan, the ‘Inimim Forest will produce 3.4 million board feet of timber, primarily by thinning from below (removing the smaller trees, leaving the largest to grow).

Chapter 2: Watershed and old-growth forest habitat condition

A. Findings from Watershed Analysis

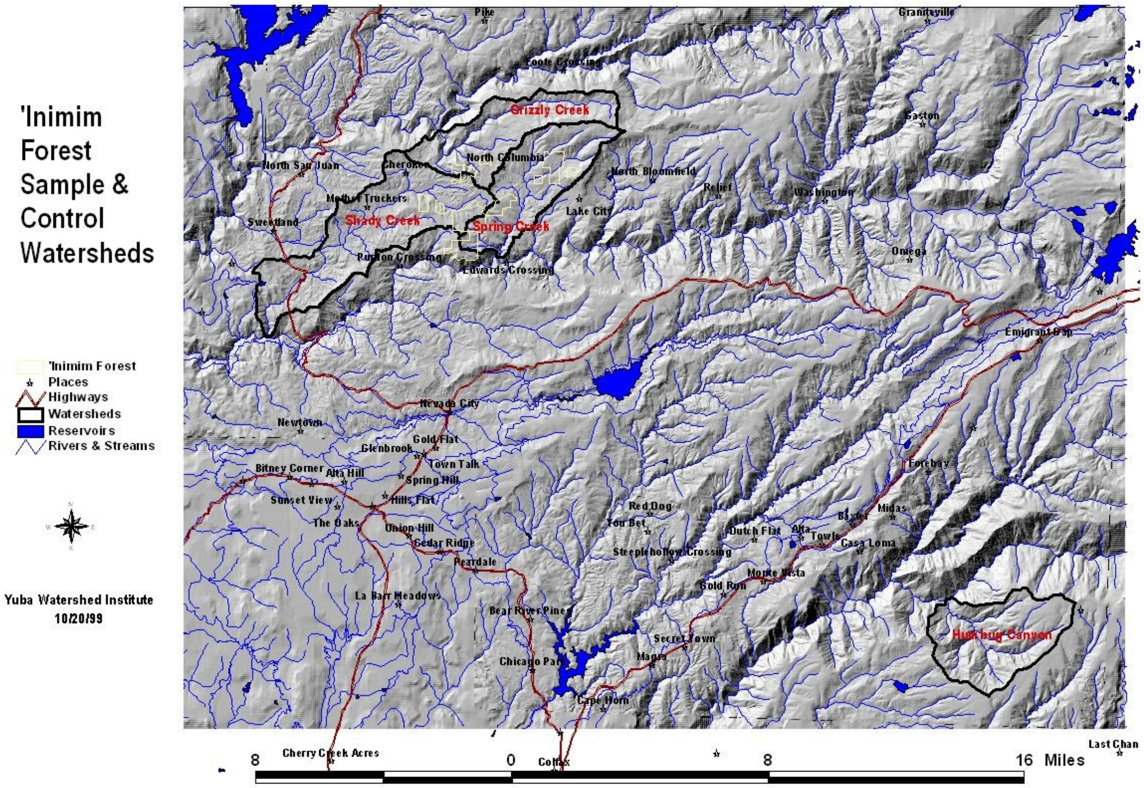


Figure 2-1

I. Methodology

Overall Goals

Before logging, fire and other ground disturbing activities commence on 'Inimim lands, YWI undertook this assessment regarding the current condition of surrounding watersheds and stream systems. One of the principles of ecologically sustainable forest management is that water quality and watersheds are not degraded over time. The 'Inimim Forest parcels occupy only a small percentage of each planning watershed in which they occur (Grizzly, Spring and Shady Creeks, see Figure 2-1). As a result, YWI and the Bureau of Land Mangement (BLM) have only limited control over land-disturbing activities in the `Inimim planning watersheds. Still, watershed assessment was essential to understand the cumulative impacts of 'Inimim forest management when combined with other land disturbance in each watershed. Since private lands (the majority ownership in Shady, Spring and Grizzly Creeks) tend to be subject to intense disturbance that results in steam degradation, `Inimim lands need to be managed even more carefully than otherwise to allow stream systems to support diverse natural aquatic communities, and to recover from a legacy of intense mining and logging over the past 150 years.

YWI's first step in watershed assessment was to measure the physical and biological conditions in the stream channels, and the watersheds as a whole.

Background on previous watershed assessments

The United States Forest Service (USFS) completed stream surveys and cumulative watershed impact studies for the upper reaches of Spring and Grizzly Creeks in 1996. This included locating roads and clearings on all ownerships, and channel surveys that noted amphibians, fish, riparian vegetation, sedimentation, and other physical channel conditions. David Lukas of YWI surveyed Spring and Shady Creeks in 1996 and 1997 for yellow-legged frogs. Eric Larsen and Sarah Yarnell of the University of CA, Davis established 20 long-term geomorphology benchmark plots in Spring and Shady Creeks in 1997-98. These plots measure and describe physical channel condition. As part of this plot work, flow gauging stations were setup in Spring and Shady Creeks in fall 1998. (Eric Larsen also has an extensive library on historic physical and biological conditions in Spring and Shady Creeks.) In his MS Thesis at UC Davis, Paul Randall (1997) established 7 plots in Shady and Spring Creeks. He gathered data on fish, amphibians and benthic macroinvertebrates.

Rationale for selection of assessment methodology

At inception of this study, YWI consulted/met with Ken Roby (Plumas NF hydrologist), Eric Larsen (Geomorphologist, UC Davis), Kai Snyder (Oregon State University), Sandra Coveny (Mary's River Watershed Council), Jim Harrington, Monique Born, John Hiscox, Jeff Finn and others (CA Department of Fish and Game), Tom King (Central Valley Water Quality Control Board), Sandy Frizzell (Gold Mine District State Parks), and Ann Carlson, Rick Weaver and Chris Sexton (stream specialists and hydrologists, Tahoe NF). YWI determined how to complete a watershed assessment process that is scientifically objective and state-of-the-art, while simultaneously building on previous assessment work in the watersheds.

Most of the previous assessment work focused on upland conditions and physical channel condition. The assumption was that the overall ecological health of the stream system watershed could be inferred from these measurements. In this assessment, we built on these physical measurements by measuring stream biota directly. At the recommendation of virtually all consultants, we used the California Stream Bioassessment Procedure (CSBP), a regional adaptation of the EPA "Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish." Jim Harrington and Robert Schroeter at the Water Pollution Control Laboratory of the CA Department of Fish and Game have developed the procedure. Eric Beckwitt of YWI took a three-day intensive training in the procedure from Jim Harrington at Columbia College, Sonora, CA on Sept 19-21, 1998.

The CSBP system uses measurement of the relative abundance and diversity of benthic (bottom dwelling) macroinvertebrates (mostly stoneflies, caddisflies and mayflies) to assess water quality, temperature and pollution, and the overall ecological health/status of the watershed. Many of these organisms are long-lived (1-7 years in-stream), and they are highly sensitive to even short-term pulses of sediment or increased temperature. They can be sampled quickly in the field using standard operating protocol admissible in scientific studies and court. A series of samples taken over the first year establishes baseline data that can be compared with future surveys to detect long-term improvement or degradation in water quality. Baseline measurements in nearby relatively undisturbed watersheds in the same EPA subregion are used to evaluate relative watershed degradation/condition today.

Macroinvertebrate Assessment Protocol

Transect 2, Plot 1 on the Control Watershed Humbug Canyon Creek, Placer County, CA

Following the California Stream Bioassessment Procedure, YWI sampled the bottom of Spring, Shady and Grizzly Creeks at 9 locations each using a 0.5 mm Surber sampler. In addition, YWI placed 8 samples in the control watershed Humbug Canyon Creek, a tributary to the North Fork American River about 25 air-miles southeast of the 'Inimim Forest at the same elevation and in the same plant communities (see Figure 2-1) Humbug Canyon is also the same approximate size watershed as Spring, Shady and Grizzly Creeks. Thirty-six total samples were collected for the assessment, plus an additional 5 for a Sierra College class in Natural History, Environment and Conservation.

Samples were clustered in three transect locations on each stream: near the headwaters, near the confluence, and mid-way down the channel. At each transect site, a riffle cluster was located. From this cluster, one or more riffles were selected at random. Each selected riffle was broken up into potential sample sites using a 300-foot tape measure. A potential sample site was laid out every 3 feet, and 3 sample sites were chosen from all available using a random number table. At each sample site, three 1-foot square sub-samples were collected and mixed, following standard operating protocols, to create the final sample. All sample locations were labeled with their GPS coordinates, and described in detail on the sample datasheets. In addition, YWI qualitatively assessed 9 habitat parameters at each transect location. YWI evaluated relative in-stream cover/epifaunal substrate, cobble embeddedness, channel alteration, sediment deposition, riffle frequency, channel flow, bank vegetation, bank stability, and the quality/width of the riparian zone. All qualitative attributes were ranked on relative scale of 1-20. Finally, YWI measured stream temperature and flow (using a water velocity meter and stream cross-section sample grid), and photographed the transect site. These latter three steps were completed on about half of the 12 transects.

Identification of the collected insect taxa, and derivation of statistics on watershed condition was undertaken in three stages. First, a team of YWI volunteers and US Forest Service Fisheries Biologists worked for several nights at the Biology Laboratory at Nevada Union High School, Grass Valley (thanks to Biology teacher Sig Ostrum for letting YWI use this space). This team evaluated 3 plots (one sample each from Shady, Grizzly and Spring Creeks) over two weeks. One hundred macroinvertebrates were sub-sampled from each sample using standard protocols. Eric Beckwitt, using procedures taught by Jim Harrington, maintained quality assurance and chain of custody. The USFS biologists and Eric Beckwitt undertook identification to family level. Eric Beckwitt derived statistics.

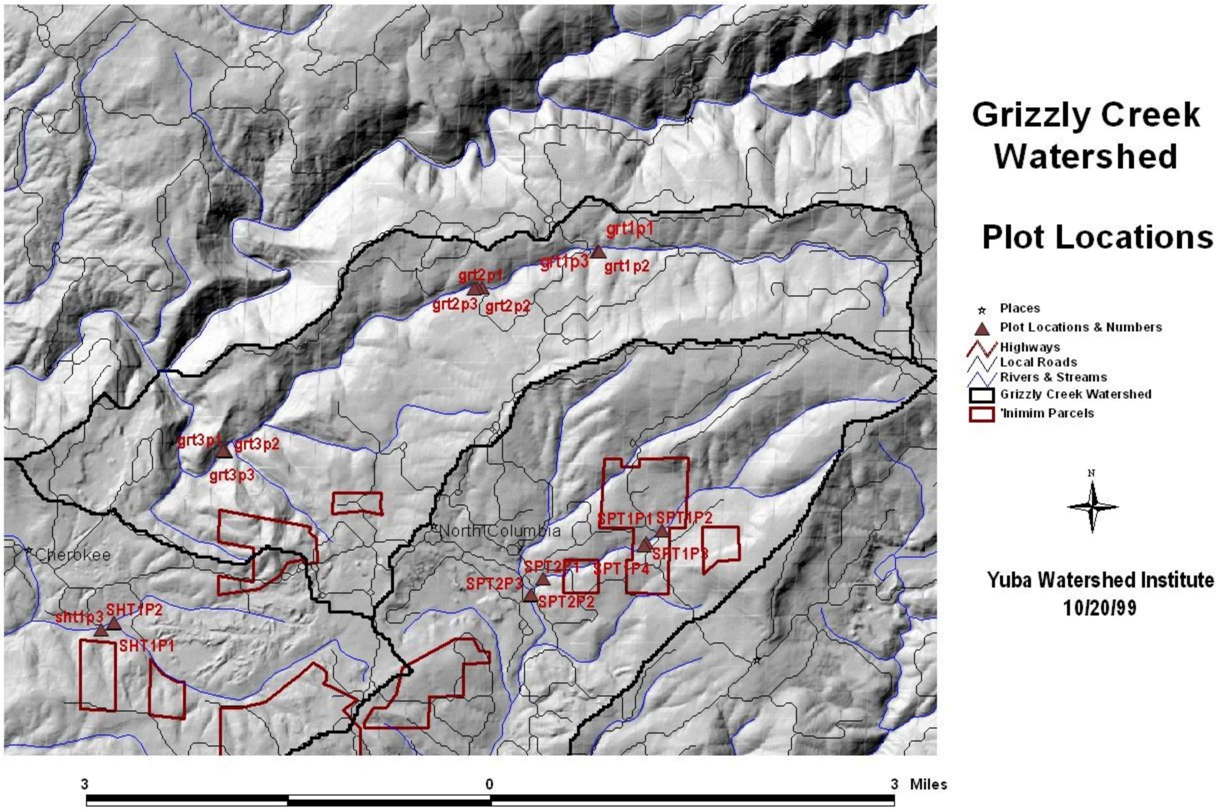
Second, 5 new samples were taken in the field by a Nevada County Campus Sierra College Bio-14 class. With Supervision from Eric Beckwitt and instructor JoAnn Hild, the class picked and sub-sampled 100 macroinvertebrates from each sample, identified the taxa to family level, and derived statistics on watershed condition based on their work. Finally, YWI contracted with Mark Vinson at the National Aquatic Monitoring Center, Department of Wildlife and Fisheries, Utah State University, Logan, to process the remaining 33 samples.

At the Center, individual samples were first placed in a large white enamel pan and large and less-numerous organisms were removed. The sample was then sub-sampled by dispersing it evenly within a No. 60 sieve (250 micron) located in a water filled enamel pan. The sieve was then lifted out of the water and split into two equal parts with a spatula. This procedure was repeated until approximately 300 organisms remained in the sub-sample. Organisms were removed from the sub-sample using a stereoscope with 8-40X magnifications. If less than 300 organisms were found in the sub-sample, additional sub-samples were taken.

Organisms were identified and counted by well-qualified taxonomists. An effort was made to identify organisms to a consistent taxonomic level. Insects were primarily identified to genus, with the exception of Chironomidae, which were identified to subfamily. Non-insect invertebrates were identified to various taxonomic levels depending on the availability of identification keys. Voucher specimens were retained for all unique taxa. Additional information on laboratory procedures can be found in Vinson and Hawkins 1996 (*Journal of the North American Benthological Society*, Volume 15, pages 392-399). The Center completed processing the YWI plots in June 1999. They provided YWI with a voucher collection (labeled set of all organisms identified), and created a report linking the findings of the bioassessment process to stream ecosystem condition. All of these studies were used to develop the findings below.

Sample plot locations

Figures 2-2 through 2-5 display the location of sample sites in the watershed assessment. These maps can be used in association with Tables 2-1 through 2-3 to review ecological conditions at each plot.



Grizzly Creek Watershed
Plot Locations
Places
Plot Locations & Numbers
Highways
Local Roads
Rivers & Streams
Grizzly Creek Watershed
'Inimim Parcels
N
Yuba Watershed Institute
10/20/99
grt1p1
grt1p3
grt1p2
grt2p1
grt2p3
grt2p2
grt3p1
grt3p2
grt3p3
North Columbia
Cherokee
SPT1P1
SPT1P2
SPT1P3
SPT1P4
SPT2P1
SPT2P3
SPT2P2
sht1p3
SHT1P2
SHT1P1
3
0
3 Miles

Figure 2-2

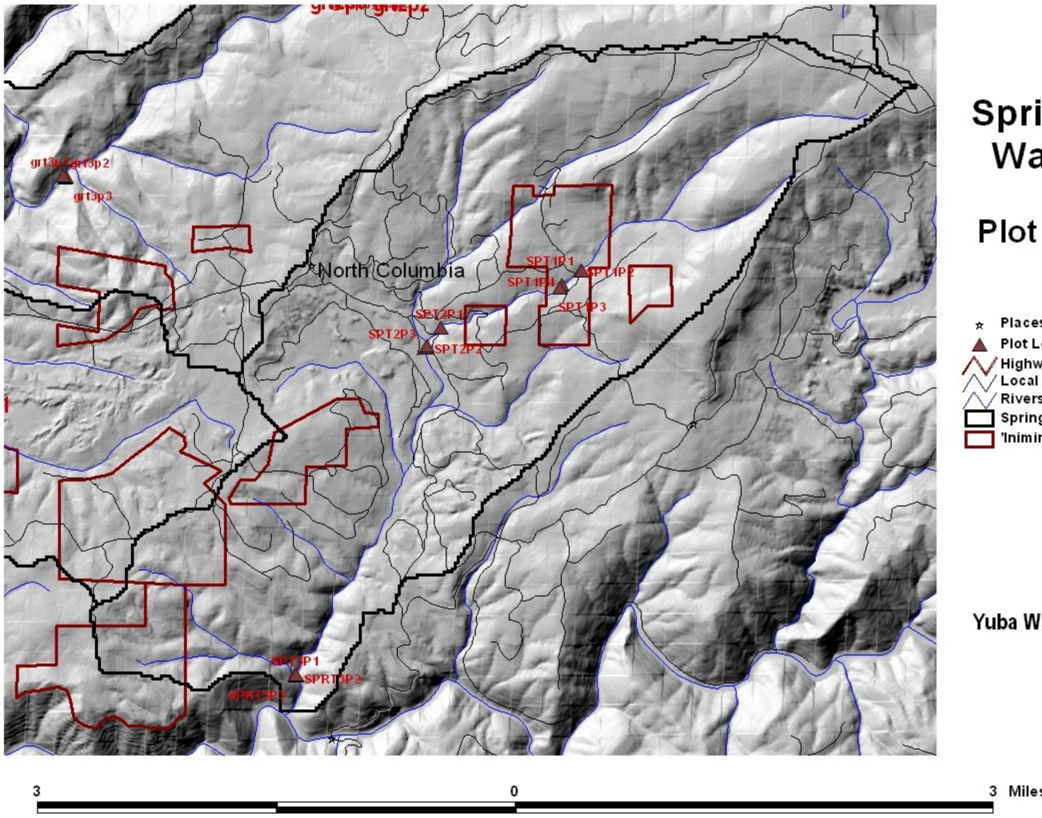

Spring Creek Watershed
Plot Locations
Places
Plot Locations & Numbers
Highways
Local Roads
Rivers & Streams
Spring Creek Watershed
'Inimim Parcels
Yuba Watershed Institute
10/20/99
North Columbia
3
0
3 Miles

Figure 2-3

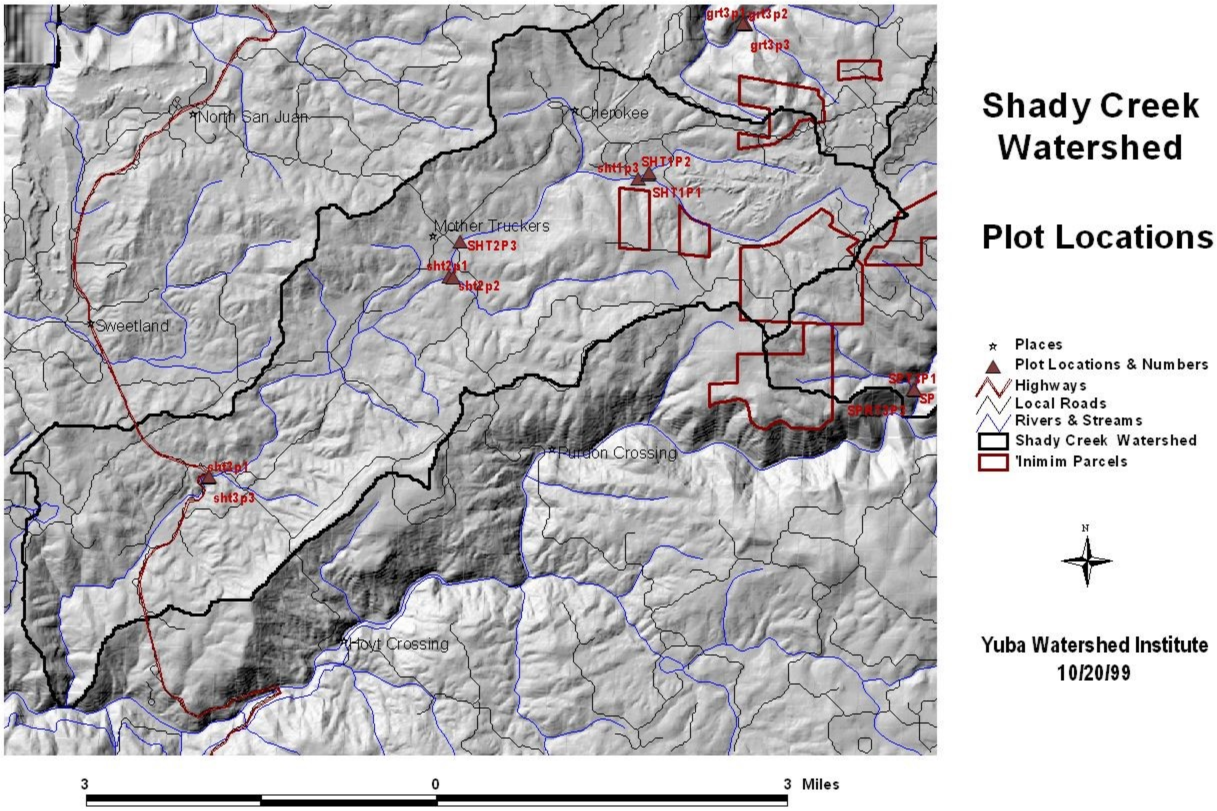

Shady Creek Watershed
Plot Locations
Places
Plot Locations & Numbers
Highways
Local Roads
Rivers & Streams
Shady Creek Watershed
'Inimim Parcels
N
Yuba Watershed Institute
10/20/99
North San Juan
Cherokee
Mother Truckers
Sweetland
Hoyt Crossing
grt3p2
grt3p3
sht1p3
SHT1P2
SHT1P1
SHT2P3
sht2p2
sht3p3
3
0
3 Miles

Figure 2-4

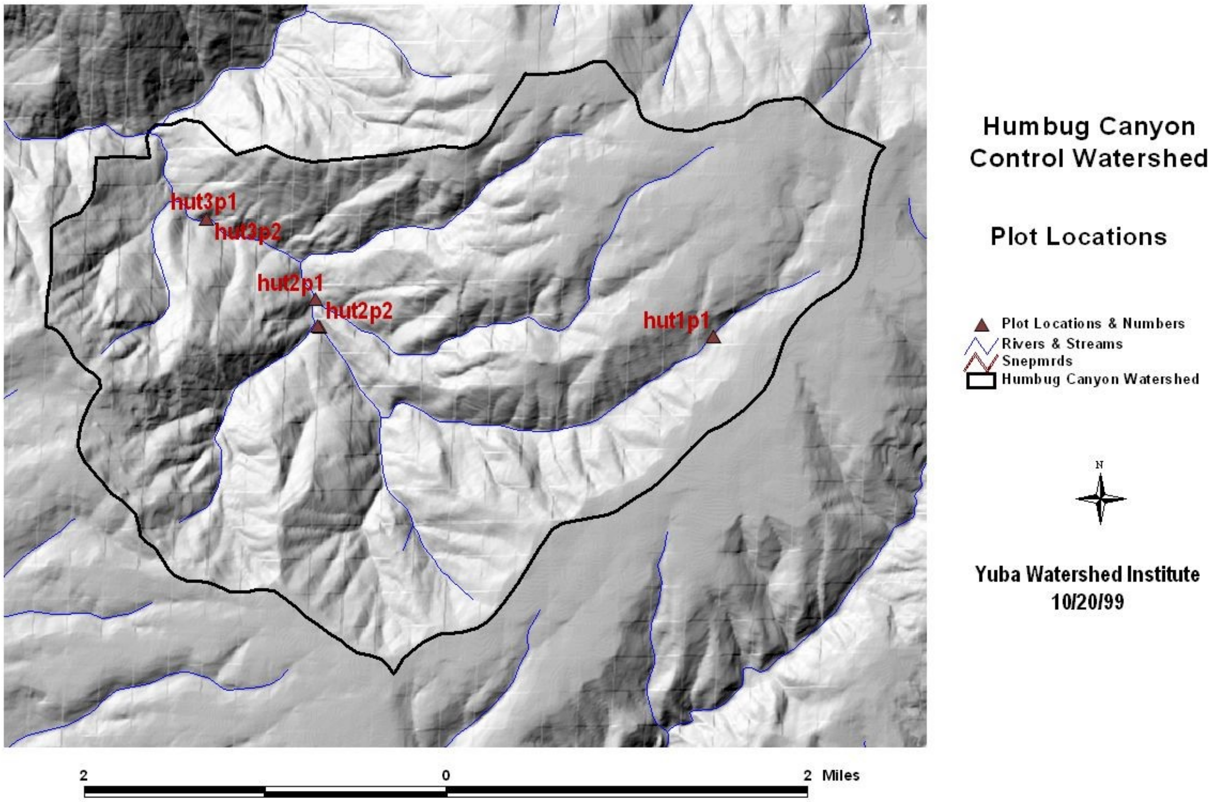

Humbug Canyon
Control Watershed
Plot Locations
Plot Locations & Numbers
Rivers & Streams
Snepmrds
Humbug Canyon Watershed
N
Yuba Watershed Institute
10/20/99
hut3p1
hut3p2
hut2p1
hut2p2
hut1p1
2
0
2 Miles

Figure 2-5

II. Watershed Assessment Findings

Transect 2, Plot 2 on Grizzly Creek, Nevada County, CA

Summary

Overall, Grizzly and Spring Creeks are very similar in health and ecological condition to the Humbug Canyon control watershed. This is a surprising finding, given the extensive road networks, widespread historic and on-going logging, and widespread (although rural), human settlement. This finding may reflect the condition of the relatively undisturbed riparian zone along both of these streams. Although their watersheds are significantly altered, the riparian zones along these streams closely resemble control conditions. The finding may also be influenced by the control watershed: although virtually roadless and unsettled, the control has had some historic logging and mining in two of its tributary first order streams. It is not pristine, but as close to pristine as YWI could find.

Shady Creek is severely damaged. By most measures, it degraded 60-80% percent in comparison to its neighbors and the control. The primary cause of this degradation is the hydraulic mine it flows from. Created over 110 years ago, this gravel pit still sends large volumes of sand and cobble down the stream channel year-round. There is sufficient gravel and sediment to change the channel location every few months in many reaches. In addition, flows are highly variable and large flows short-lived. These factors, combined with low ratings for most of the 9 qualitative streamside habitat descriptors, explain why the stream remains devoid of fish and in terrible ecological condition today.

Recommendations from the Watershed Assessment

Shady Creek is so badly damaged that every effort should be made to restore upland and stream channel health. On the 12% of the watershed (1,133 acres), managed by BLM, no logging should be scheduled for the first 30 years. Prescribed fire should be used sparingly also, until techniques are perfected and hot burns that increase surface runoff and erosion can be consistently avoided. Mastication is the preferred treatment (if any) for BLM lands within the Shady Creek watershed in decades 1 to 3. Afterwards, under-thinning and group selection should proceed as in other watersheds. YWI and the BLM should encourage private landowners to protect streamside forests throughout the watershed. Most importantly, the owners of the historic hydraulic mine in the stream's headwaters should be encouraged to revegetate the site, and otherwise control the influx of gravels and sediments into the stream channel.

Strict no logging buffers should be delineated along both sides of all perennial, intermittent and ephemeral streams in the 'Inimim forest. This zone in the immediate vicinity of the riparian ecosystem provides energy sources (most woody material and leaves), shade and habitat for the aquatic community (Erman et al. 1997). Buffers should follow ephemeral streams up the channel to the first sign of scour. Extending in the stream canyon from above the first sign of scour to the end of concentrated periodic flow (in the stream swale), permanent skid roads should not be established, and old roads not reconstructed.

Sample Watershed Condition Maps

A complete set of watershed condition maps is located at www.oro.net/~ywi/waters.htm). The following samples demonstrate the condition of 'Inimim watershed by comparison to the control using three widely accepted aquatic ecosystem indicator statistics based on benthic macroinvertebrates: total taxonomic groups, taxonomic richness of pollution tolerant groups, and mean abundance of aquatic insects that shred leaves.

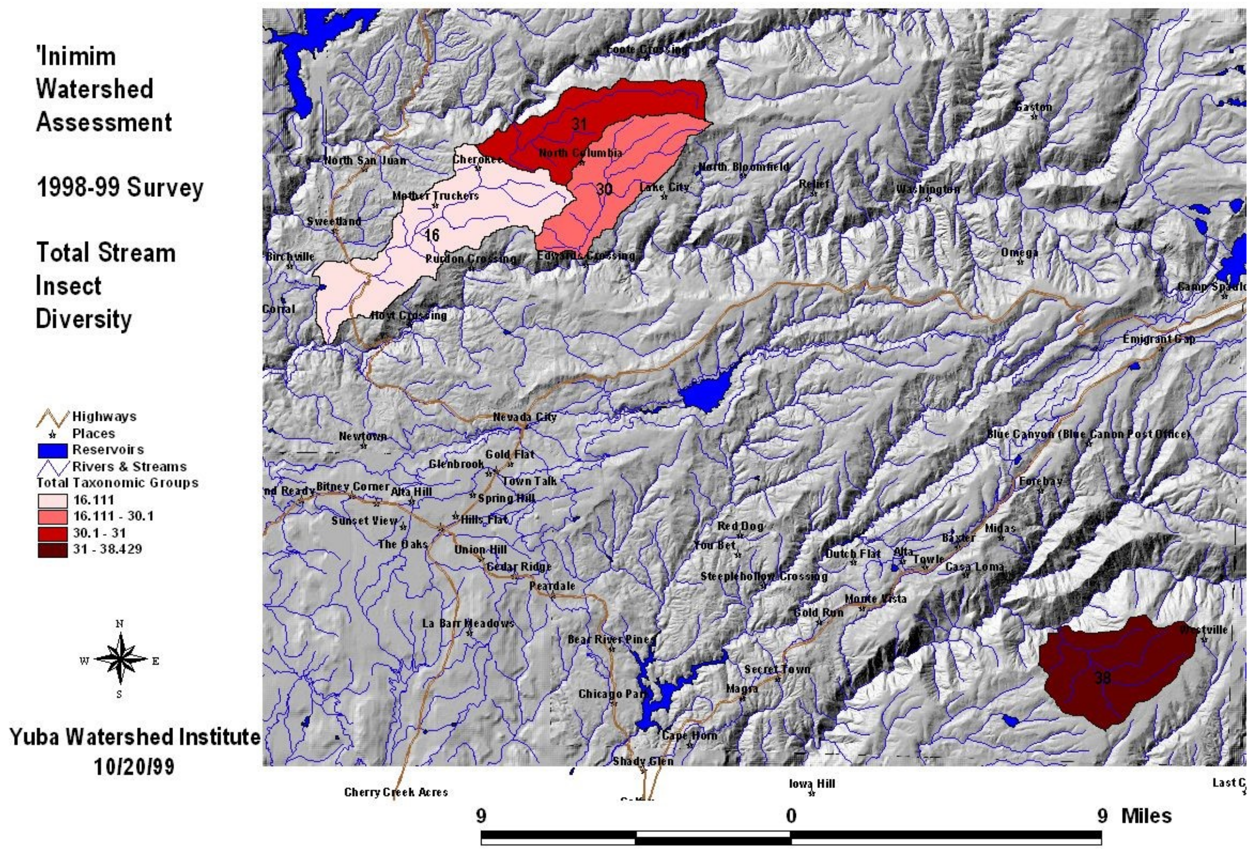

'Inimim
Watershed
Assessment
1998-99 Survey
Total Stream
Insect
Diversity
Highways
Places
Reservoirs
Rivers & Streams
Total Taxonomic Groups
16.111
16.111 - 30.1
30.1 - 31
31 - 38.429
Yuba Watershed Institute
10/20/99
9
0
9 Miles

Figure 2-6

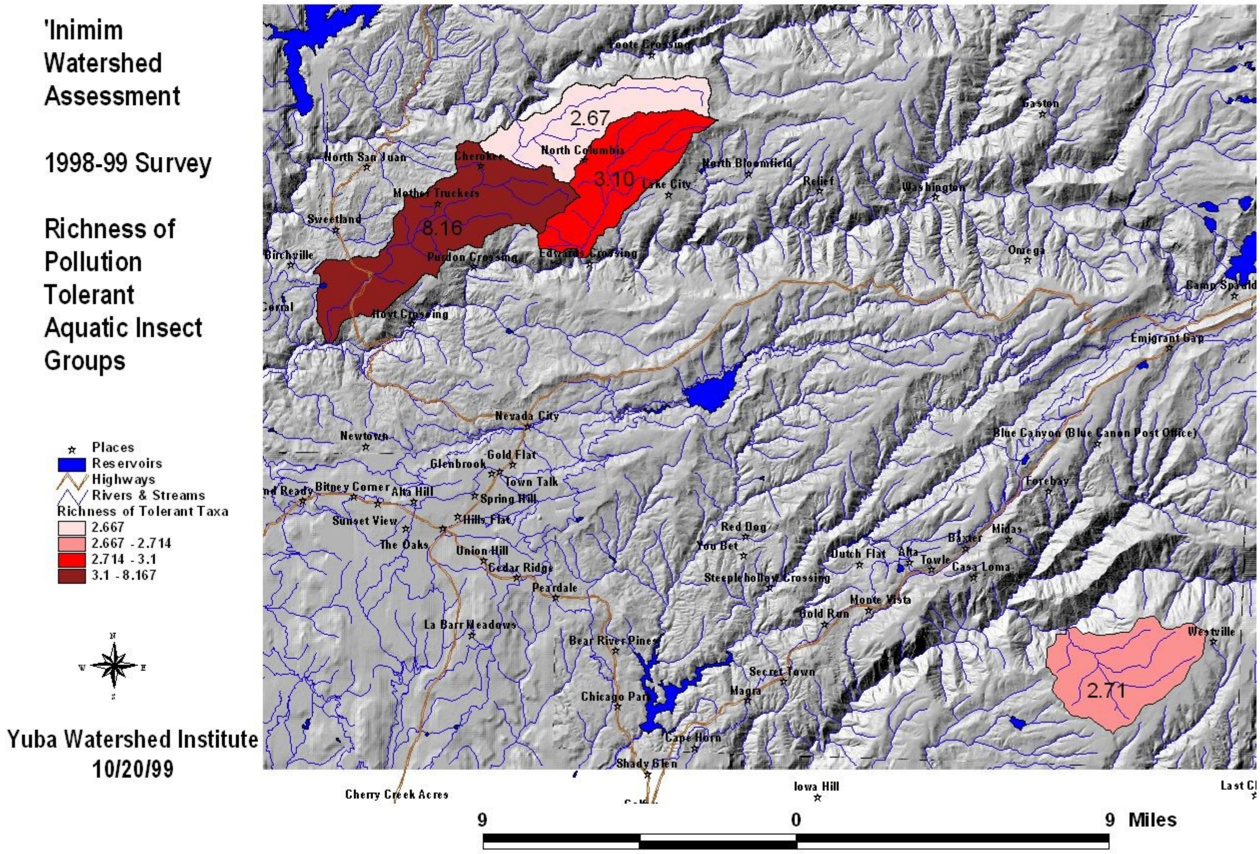

'Inimim Watershed Assessment
1998-99 Survey
Richness of Pollution Tolerant Aquatic Insect Groups
Places
Reservoirs
Highways
Rivers & Streams
Richness of Tolerant Taxa
2.667
2.667 - 2.714
2.714 - 3.1
3.1 - 8.167
Yuba Watershed Institute
10/20/99
2.67
3.10
8.16
2.71
North San Juan
Cherokee
North Columbia
North Bloomfield
Lake City
Mother Truckers
Sweetland
Birchville
Purdon Crossing
Edwards Crossing
Hoyt Crossing
Relief
Washington
Gaston
Omega
Emigrant Gap
Nevada City
Newtown
Glenbrook
Gold Flat
Town Talk
Bitney Corner
Alta Hill
Spring Hill
Sunset View
Hills Flat
The Oaks
Union Hill
Cedar Ridge
Peardale
La Barr Meadows
Bear River Pines
Chicago Park
Cape Horn
Shady Glen
Cherry Creek Acres
Iowa Hill
Red Dog
You Bet
Steephollow Crossing
Dutch Flat
Alta
Towle
Casa Loma
Baxter
Midas
Monte Vista
Gold Run
Secret Town
Magra
Westville
Foresthill
Blue Canyon (Blue Canon Post Office)
Forebay
9
0
9 Miles

Figure 2-7

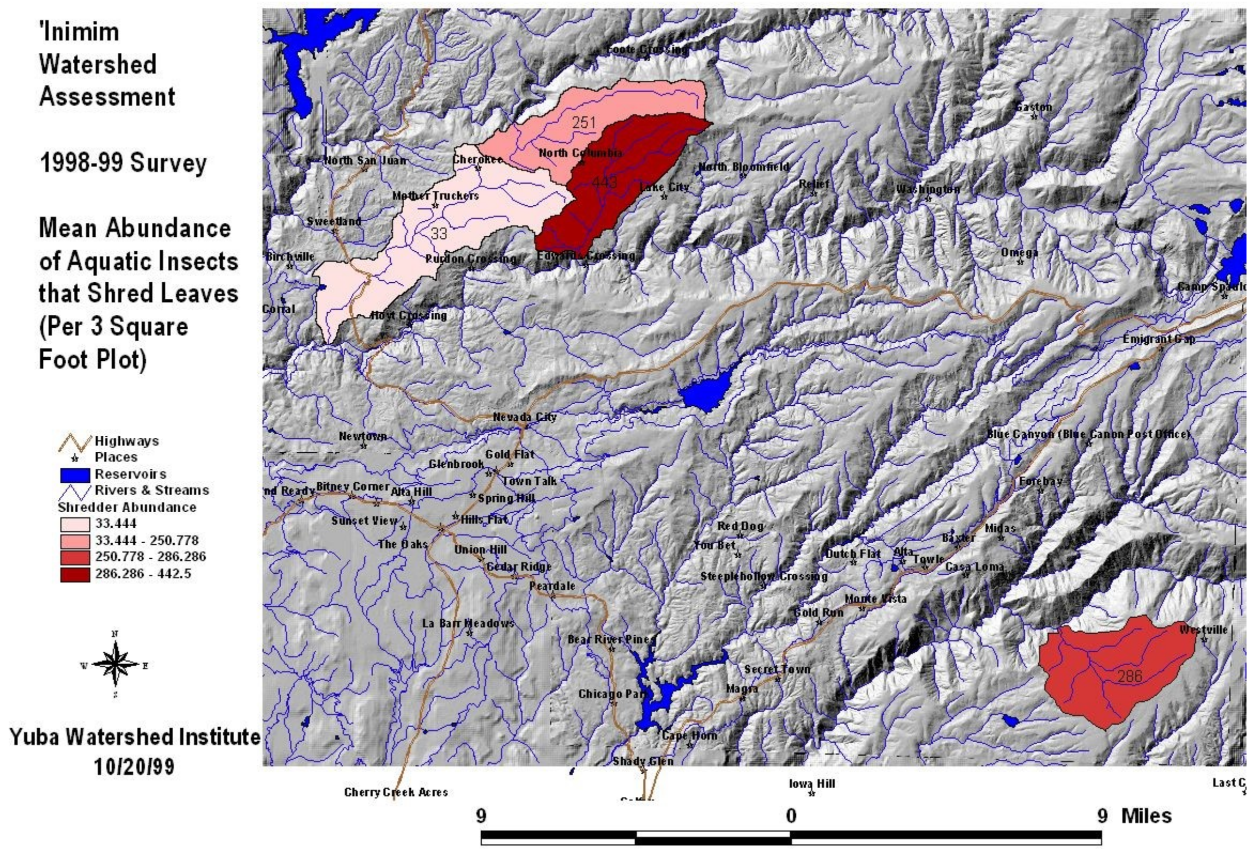


Figure 2-8

Sample Watershed Condition Tables

A complete set of statistical tables describing the health of the 'Inimim sample and control watersheds can be found at www.oro.net/~ywi/waters.htm. The following tables list the taxonomic groups found during the watershed assessment, and the ten most common statistical indicators used to compare aquatic ecosystem health to the stream benthic macroinvertebrate community.

Table 2-1: Crosswalk between Yuba Watershed Institute and Utah State University Plot Numbers

Utah Sample#	Station	Date	Transect, Plot	ID on Map
109932	Y-GR-T1-QN	01/05/99	T1, P1	grt1p1
109933	Y-GR-T1-QN	01/05/99	T1, P3	grt1p3
109934	Y-GR-T2-QN	01/08/99	T2, P1	grt2p1
109935	Y-GR-T2-QN	01/08/99	T2, P2	grt2p2

109936	Y-GR-T2-QN	01/08/99	T2, P3	grt2p3
109937	Y-GR-T3-QN	03/18/99	T3, P1	grt3p1
109939	Y-GR-T3-QN	03/18/99	T3, P2	grt3p2
109938	Y-GR-T3-QN	03/18/99	T3, P3	grt3p3
109964	Y-HU-T1-QN	05/07/99	T1, P1	hut1p1
109963	Y-HU-T1-QN	05/07/99	T1, P2	hut1p2
109962	Y-HU-T1-QN	05/07/99	T1, P3	hut1p3
109957	Y-HU-T2-QN	04/16/99	T2, P2	hut2p2
109960	Y-HU-T2-QN	04/17/99	T2, P1	hut2p3
109959	Y-HU-T2-QN	04/16/99	T2, P3	hut2p3
109958	Y-HU-T3-QN	04/17/99	T3, P1	hut3p1
109961	Y-HU-T3-QN	04/17/99	T3, P2	hut3p2
109949	Y-SH-T1-QN	12/09/98	T1, P1	SHT1P1
109951	Y-SH-T1-QN	03/01/99	T1, P2	SHT1P2
109950	Y-SH-T1-QN	12/09/98	T1, P3	sht1p3
109952	Y-SH-T2-QN	11/13/98	T2, P1	sht2p1
109953	Y-SH-T2-QN	11/16/98	T2, P3	SHT2P3
109955	Y-SH-T3-QN	03/26/99	T3, P1	sht3p1
109956	Y-SH-T3-QN	03/26/99	T3, P2	sht3p2
109954	Y-SH-T3-QN	03/26/99	T3, P3	sht3p3
109940	Y-SPR-T3-QN	12/16/98	T3, P2	SPRT3P2
109941	Y-SPR-T3-QN	12/16/98	T3, P3	SPRT3P3
109943	Y-SPR-T1-QN	11/16/98	T1, P1	SPT1P1
109944	Y-SPR-T1-QN	11/16/98	T1, P3	SPT1P3
109946	Y-SPR-T1-QN	01/12/99	T1, P4	SPT1P4
109945	Y-SPR-T2-QN	11/16/98	T2, P1	SPT2P1
109947	Y-SPR-T2-QN	11/20/98	T2, P2	SPT2P2

109948	Y-SPR-T2-QN	11/20/98	T2, P3	SPT2P3
109942	Y-SPR-T3-QN	12/16/98	T3, P1	SPT3P1

Table 2-2: Ecological, Pollution Tolerance and Distribution Data for Collected Invertebrates

Taxon	Functional	HBI*	USFS TQ	Habitat	Distribution
Agabus	PR	11	72	Lotic-erosional and	Widespread
Agathon	SC	0	2	Lotic-erosional	West mountains
Ameletus	SC	0	72	Lotic-erosional and	Northeast, West and
Amiocentrus	CG	1	24	Lotic-erosional	West
Amphipoda	CG	11	108	various	widespread
Ampumixis	UN	4	104	Lotic-erosional	West
Anagapetus	SC	0	24	Lotic-erosional	Rocky Mountains
Antocha	CG	3	40	Lotic-erosional	WIdespread
Apatania	SC	11	18	Lotic-erosional, lentic-littoral	Widespread(primarily North and higher elevations)
Argia	PR	9	108	Lotic-erosional and	Widespread
Argia vivida	PR	9	72	Lentic-vascular hydrophytes	widespread
Baetis	CG	4	72	Lotic-erosional and	Widespread
Bezzia	PR	6	96	Lentic-littoral, profundal and	Widespread
Blephoricera	SC	0	2	Lotic-erosional	Widespread
Blephariceridae	SC	0	2	Lotic-erosional	widespread
Brachycentridae	CF	1	48	Lotic-erosional	widespread
Caenis	CG	7	72	Lotic-depositional	Widespread
Calineuria	PR	1	21	Lotic-erosional	West
Capniidae	SH	1	32	Lotic-erosional and	widespread
Caudatella	CG	1	24	Lotic-erosional and	West
Caudatella hysterix	CG	1	24	Lotic-erosional and	West
Ceratopogonidae	PR	6	108	Lentic-littoral, lotic-	widespread
Chaetarthria	UN	11	72	Lentic-littoral, lotic-	Widespread
Chelifera	UN	6	95	Lotic-depositional, lentic-	Widespread
Chironomidae	CG	6	108	All types of aquatic habitats	Widespread
Chironominae	CG	8	108	unknown	widespread
Chloroperlidae	PR	1	24	Generally lotic-erosional	widespread

Cinygmula	SC	4	30	Lotic-erosional	West, Northeast, Southeast
Cleptelmis	UN	4	104	Lotic-erosional	West
Clinocera	UN	6	95	Lotic-erosional, lentic-littoral	Widespread
Collembola	CG	11	108	Neuston, moist vegetation,	widespread
Cordulegaster	PR	3	72	Lotic-depositional	East, West
Corydalidae	PR	0	90	Lotic-erosional	widespread
Curculionidae	SH	11	100	Lentic-vascular hydrophytes	widespread
Dicranota	PR	3	36	Lotic-erosioal and	Widespread
Diptera	UN	11	72	various	widespread
Dolophilodes	CF	3	24	Lotic-erosional	Widespread
Doroneuria	UN	1	18	unknown	West
Drunella coloradensis	SC	1	2	unknown	Widespread
Drunella doddsi	SC	1	2	unknown	Widespread
Drunella pelosa	SC	1	2	unknown	widespread
Dysmicohermes disjunctus	PR	0	72	Lotic-erosional, Lotic-	West
Dytiscidae	PR	11	72	Lentic-vascular hydrophytes	widespread
Ecclisomyia	CG	4	24	Lotic-erosional	West
Elmidae	CG	4	104	Generally lotic and lentic-	widespread
Empididae	PR	6	95	Lotic-erosional and	widespread
Epeorus	CG	4	18	Lotic-erosional	Widespread
Ephemerella inermis	CG	1	92	Lotic-erosional and	Widespread
Ephemerellidae	CG	1	48	Lotic-erosional, some	Widespread
Ephemeroptera	UN	11	64	various	widespread
Eubrianix	SC	4	72	Lotic-erosional	West
Gastropoda	SC	11	108	Lotic/lentic, substrate	widespread
Glossosoma	SC	0	24	Lotic-erosional	Widespread
Glossosomatidae	SC	0	32	Lotic-erosional	widespread
Glutops	PR	11	30	Lotic-depositional	Widespread
Gomphidae	PR	1	108	Lotic-depositional, lentic-	widespread
Gumaga	SH	3	72	Lotic-erosional	West
Hemerodromia	PR	6	95	Lotic-erosional and	Widespread
Heptageniidae	SC	4	48	Generally lotic and lentic-	widespread
Hesperoperla	PR	1	30	unknown	West
Hesperoperla hoguei	PR	1	30	unknown	California

Hesperoperla pacifica	PR	1	30	unknown	California, Colorado, New Mexico, Utah
Heterlimnius	UN	4	104	Lotic-erosional	West
Heteroplectron	SH	11	30	Lotic-erosional and	East, West
Hexatoma	PR	3	36	Lotic-erosional and	Widespread
Hydracarina	PR	11	98	Lotic/lentic, benthic,	widespread
Hydraena	UN	11	108	Lotic-erosional, lentic-littoral	Widespread
Hydrophilidae	PR	11	72	Lentic vascular hydrophytes	widespread
Hydropsyche	CF	4	108	Lotic-erosional	Widespread
Hydropsychidae	CF	4	108	Lotic-erosional, some lentic-	widespread
Hydroptila	PH	4	108	Lotic-erosional and	Widespread
Hydroptilidae	PH	4	108	Lotic and lentic-erosional,	widespread
Ironodes	SC	4	30	Lotic-erosional	West
Isoperla	PR	2	48	Lotic-erosional and	Widespread
Juga	SC	11	108	unknown	widespread
Kathroperla	CG	1	24	unknown	West
Lacobius	UN	11	72	unknown	Widespread
Lara	SH	4	104	Lotic-erosional	West
Lepidostoma	SH	11	24	Lotic-erosional and	Widespread
Leptophlebiidae	CG	2	36	Generally lotic-erosional	widespread
Leuctridae	SH	0	18	Generally lotic-erosional and	widespread
Limnephilidae	SH	4	108	Lotic and lentic	widespread
Lumbriculidae	CG	11	90	various	widespread
Malenka	UN	2	36	unknown	West
Marilia	SH	0	48	Lotic	Southwest, Ontario
Maruina	SC	11	36	Lotic-erosional	West
Micrasema	SH	1	24	Lotic-erosional	Widespread
Moselia	UN	0	18	unknown	Pacific Northwest
Narpus	UN	4	104	Lotic-erosional	West
Nematoda	UN	11	108	various	widespread
Nemouridae	SH	2	36	Lotic-erosional and	Widespread
Neophylax	SC	11	24	Lotic-erosional	East, West
Neothremma	SC	11	24	Lotic-erosional	West
Odonata	PR	11	108	Lentic/lotic, climbers,	widespread
Oligochaeta	CG	11	108	Benthic	widespread
Optioservus	SC	4	104	Lotic-erosional and	Widespread

Ordobrevia	UN	4	104	Lotic-erosional	West
Oreogeton	PR	6	95	Lotic-erosional	West
Orohermes crepusculus	PR	0	72	unknown	widespread
Orthocladiinae	CG	6	108	unknown	widespread
Paraleptophlebia	CG	2	30	Lotic-erosional	Widespread
Parapsyche	CF	4	10	Lotic-erosional	Widespread
Perlidae	PR	1	24	Generally lotic and lentic-	widespread
Perlodidae	PR	2	48	Generally lotic and lentic-	widespread
Philopotamidae	CF	3	24	Lotic-erosional	widespread
Physella	CG	11	108	unknown	widespread
Pisidium	CF	11	108	unknown	widespread
Plecoptera	UN	11	108	various	widespread
Plumiperla	UN	1	24	unknown	West
Polycentropus	PR	6	72	Lotic-erosional, lentic-littoral	Widespread
Probezzia	PR	6	90	Lentic-littoral and limnetic	Widespread
Prosimulium	CF	6	108	Lotic-erosional	Widespread
Psephenidae	SC	4	72	Lotic and lentic-erosional	widespread
Pteronarcys	SH	11	30	Lotic-erosional and	Widespread
Pteronaricidae	SH	11	30	Lotic-erosional and	widespread
Rhithrogena	CG	4	21	Lotic-erosional	Widespread
Rhyacophila	PR	0	30	Lotic-erosional	Widespread (except Great Plains)
Sierraperla	UN	11	36	unknown	West (Nevada, California)
Simuliidae	CF	6	108	Lotic-erosional	widespread
Simulium	CF	6	108	Lotic and lentic erosional	Widespread
Stenocolus	SH	11	72	Lotic-erosional and	CA
Sweltsa	PR	1	24	unknown	East, West
Tabanus	PR	6	108	Lentic-littoral, lotic-erosional,	Widespread
Taeniopterygidae	SH	2	48	Lotic-erosional and	
Tanypodinae	PR	6	108	unknown	widespread
Tipula	SH	3	80	Lotic erosional and	Widespread
Tipulidae	SH	3	72	Lentic-littoral, lotic-erosional &	Widespread
Trichoptera	UN	11	72	various	widespread
Tubificidae	CG	11	108	various	widespread
Turbellaria	CG	11	108	various	widespread
Visoka	UN	2	30	unknown	West

Yoraperla	SH	11	36	unknown	West(mountain, int-mt)
Zaitzevia	UN	4	104	Lotic-erosional	West
Zapada	SH	2	16	Lotic-erosional	West, East
*HBI - Hilsenhoff Biotic Index (Hilsenhoff 1987)					
USFS TQ - Pollution tolerance quotient (Mangum 1979)					
Functional feeding groups:					
CG - collector gatherers					
CF - collector filterers					
SC - scrapers					
SH - shredder					
PA - parasites					
PR - predators					
UN - unknown or highly variable					
XY - xylophages (wood eaters)					

Table 2-3: Ten metrics thought to be most responsive to human-induced disturbance

Date	Sample ID	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	Long-lived Taxa	Intolerant Taxa	Percent Tolerants	Clinger Taxa	Percent Contribution Dominant Taxon	Percent Predators
99/01/05	109932	33	10	6	5	6	12	12	19	12.6	6.4
99/01/05	109933	27	6	4	5	4	9	16.7	12	19.3	8.3
99/01/08	109934	30	7	6	6	6	12	24.4	16	25.8	3
99/01/08	109935	29	6	4	7	7	9	21.2	16	22.5	3.4
99/01/08	109936	34	9	7	5	7	14	32.5	15	32.5	3.2
99/03/18	109937	34	12	4	10	4	14	1.5	20	19.9	9.2
99/03/18	109938	37	11	4	8	9	13	8	22	15.9	13.5
99/03/18	109939	43	13	6	8	9	15	0.9	25	14.2	11.1
99/05/07	109962	41	10	11	9	6	15	25.5	21	25.5	10.9
99/05/07	109963	36	8	8	6	3	14	12.6	11	18.3	11.9

99/05/07	109964	42	9	13	3	8	18	12.6	13	18.8	14.9
99/04/16	109957	39	10	8	8	6	17	5.6	20	20.3	9.4
99/04/16	109959	40	9	9	7	6	16	7.1	18	11.8	14.4
99/04/17	109958	37	13	7	7	5	17	9.4	18	13.4	4.9
99/04/17	109960	34	11	9	3	3	15	3.4	13	20.5	5.5
99/04/17	109961	40	11	10	5	7	18	9	17	15.8	13.1
98/12/09	109949	23	4	3	2	4	6	9.3	7	49.7	4.6
98/12/09	109950	17	4	2	2	2	4	2.7	3	40.7	15.2
99/03/01	109951	2	0	0	1	0	0	0	0	70	0
98/12/09	109949	23	4	3	2	4	6	9.3	7	49.7	4.6
98/12/09	109950	17	4	2	2	2	4	2.7	3	40.7	15.2
99/03/01	109951	2	0	0	1	0	0	0	0	70	0
98/11/13	109952	29	3	1	6	7	3	8.8	8	39.2	21.1
98/11/16	109953	7	1	1	1	1	1	2.4	2	40.7	2.4
99/03/26	109954	27	4	4	3	10	6	6.3	11	29.7	10.1
99/03/26	109955	13	2	1	3	2	4	3.9	6	16.9	16.9
99/03/26	109956	13	3	0	1	4	1	0	6	30.8	15.9
98/11/16	109943	42	8	6	8	11	11	1.9	19	25.4	8.9
98/11/16	109944	32	8	4	9	5	10	6.1	14	17.7	4.8
99/01/12	109946	31	8	3	6	5	10	3	13	25.7	4.3
98/11/16	109945	30	10	6	5	5	9	2.5	15	29.5	8.2
98/11/20	109947	29	7	7	3	4	9	1.1	11	33.3	7.8
98/11/20	109948	32	7	8	5	4	10	2.4	15	45.6	7.9
98/11/16	109945	30	10	6	5	5	9	2.5	15	29.5	8.2
98/11/20	109947	29	7	7	3	4	9	1.1	11	33.3	7.8
98/11/20	109948	32	7	8	5	4	10	2.4	15	45.6	7.9
98/11/16	109945	30	10	6	5	5	9	2.5	15	29.5	8.2

98/11/20	109947	29	7	7	3	4	9	1.1	11	33.3	7.8
98/11/20	109948	32	7	8	5	4	10	2.4	15	45.6	7.9
98/12/16	109940	30	7	2	4	9	8	2.4	20	27.7	6.1
98/12/16	109941	33	7	4	6	7	9	2.5	17	26.7	9.9
98/12/16	109942	28	9	4	3	5	10	0.7	18	28.2	8.5

Data analysis and Interpretation

This section is provided as an introduction to interpreting the aquatic macroinvertebrate sample results displayed in the statistical tables above. Additional information can be found in the resources cited at the end of this section. A variety of data measures have been developed to assess the stream health using aquatic macroinvertebrates. Those most commonly used are described below and have been calculated for the YWI samples.

Benthic macroinvertebrates are important elements of water quality evaluations and watershed assessments because they (1) live in, on, or near streambed sediments; (2) have relatively long life cycles; and (3) are relatively sessile compared with larger organisms, such as fish. This combination of characteristics ensures that benthic invertebrates (1) respond to natural and anthropogenic environmental conditions that physical or chemically alter streambed sediments; (2) integrate effects over a year; and (3) characterize effects over a relatively small spatial scale (in contrast with fish, which may travel long distances). These factors make benthic invertebrates well suited for use in assessing site-specific water quality and comparing spatial patterns of water quality at multiple sites, and for integrating effects up to a year after a pollution or disturbance event.

The distribution of benthic invertebrates in a stream is a response to natural and anthropogenic influences. Rivers naturally change as they flow downstream. Riparian vegetation conditions, light, temperature, hydraulics, and substrate composition all change. In response to these environmental changes, benthic invertebrate communities change. Thus, each location in a river has a range of environmental conditions that dictate which invertebrate species are found there.

Taxa richness - Richness is a component and estimate of community structure and stream health based on the number of distinct taxa. Taxa richness normally decreases with decreasing water quality. In some situations organic enrichment can cause an increase in the number of pollution tolerant taxa.

Abundance - The abundance, density, or number of aquatic macroinvertebrates per unit area is an indicator of habitat availability and fish food abundance. Abundance may be reduced or increased depending on the type of impact or pollutant. Increased organic enrichment typically causes large increases in abundance of pollution tolerant taxa. High flows, increases in fine sediment, or the presence of toxic substances normally cause a decrease in invertebrate abundance.

EPT - A summary of the taxa richness and abundance among the insect Orders Ephemeroptera, Plecoptera, and Trichoptera. These orders are commonly considered sensitive to pollution.

Number of families - All families are separated and counted. The number of families normally decreases with decreasing water quality.

Percent taxon or family dominance - A community dominated by a single taxon or several taxa from the same family suggests environmental stress.

Shannon Diversity Index - Ecological diversity is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances. The Shannon index has been the most widely used in community ecology.

Simpson's Index of diversity - Simpson's index gives little weight to the tare taxa and more weight to the common taxa. It ranges in value from 0 (low diversity) to a maximum of (1 - 1/S), where S is the number of taxa.

Evenness - Evenness is a measure of the distribution of taxa within a community.

Biotic Indices - Biotic indices use the indicator taxa concept. Taxa are assigned water quality tolerance values based on their specific tolerances to pollution. Scores are typically weighted by taxa relative abundance. In the United States the most common biotic indices in use are the modified Hilsenhoff Biotic Index and the USFS Biotic Condition Index that has been principally used by the Bureau of Land Management and the United States Forest Service.

Hilsenhoff Biotic Index - The Hilsenhoff Biotic Index (HBI) summarizes the overall pollution tolerances of the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. It is best at detecting organic pollution. Families were assigned an index value from 0- taxa normally found only in high quality unpolluted water, to 10- taxa found only in severely polluted waters. Index values came from Hilsenhoff (1987, 1988). Samples with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted.

USFS Community tolerant quotient biotic condition index - This index has been widely used by the USFS and BLM throughout the western United States. Taxa are assigned a tolerant quotient (TQ) from 2 (taxa found only in high quality unpolluted water) to 108 (taxa found in severely polluted waters). TQ values were developed by Winget and Mangum (1979).

Functional feeding group measures - A useful classification scheme for aquatic macroinvertebrates is to categorize them by feeding acquisition mechanisms. Categories are based on food particle size and food location, e.g., suspended in the water column, deposited in sediments, leaf lifter, or live prey. This classification system reflects the major source of the resource, either within the stream itself or from riparian or upland areas and the primary location, either erosional or depositional habitats. The character of a stream can be determined by evaluating the relative proportions of functional groups.

Shredders - Shredders use both living vascular hydrophytes and decomposing vascular plant tissue - coarse particulate organic matter (CROM). Shredders are sensitive to changes in riparian vegetation. Shredders can be good indicators of toxicants that adhere to organic matter.

Scrapers - Scrapers feed on periphyton: attached algae and associated material. Scraper populations increase with increasing abundance of diatoms and can decrease as filamentous algae, mosses, and vascular plants increase. Scrapers decrease in relative abundance in response to sedimentation and organic pollution.

Collector-filterers - Collector-filterers feed on suspended fine particulate organic matter (FPOM). Collector-gatherers are sensitive to toxicants in the water column and deposited in sediments.

Collector-gatherers - Collector-gatherers feed on deposited fine particulate organic matter. Collector-gatherers are sensitive to deposited toxicants.

Predators - Predators feed on living animal tissue.

Unknown feeding group - This category includes taxa that are highly variable, parasites, and those that for which the primary feeding mode is currently unknown.

Other measures - The number of long-lived taxa and the number of "clinger"' taxa have been found by Karr and Chu (1998) to respond negatively to human disturbance.

Clingers - Clinger taxa were determined using information in Merritt and Cummins (1996). These taxa typically cling to the tops of rocks and are may be reduced by sedimentation or abundant algal growths.

Long-lived Taxa - Long-lived taxa are those taxa that typically have 2-3 year life cycles. Disturbances and water quality and habitat impairment typically reduces the number of long-lived taxa

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B. Findings from Old-Growth Forest Mapping

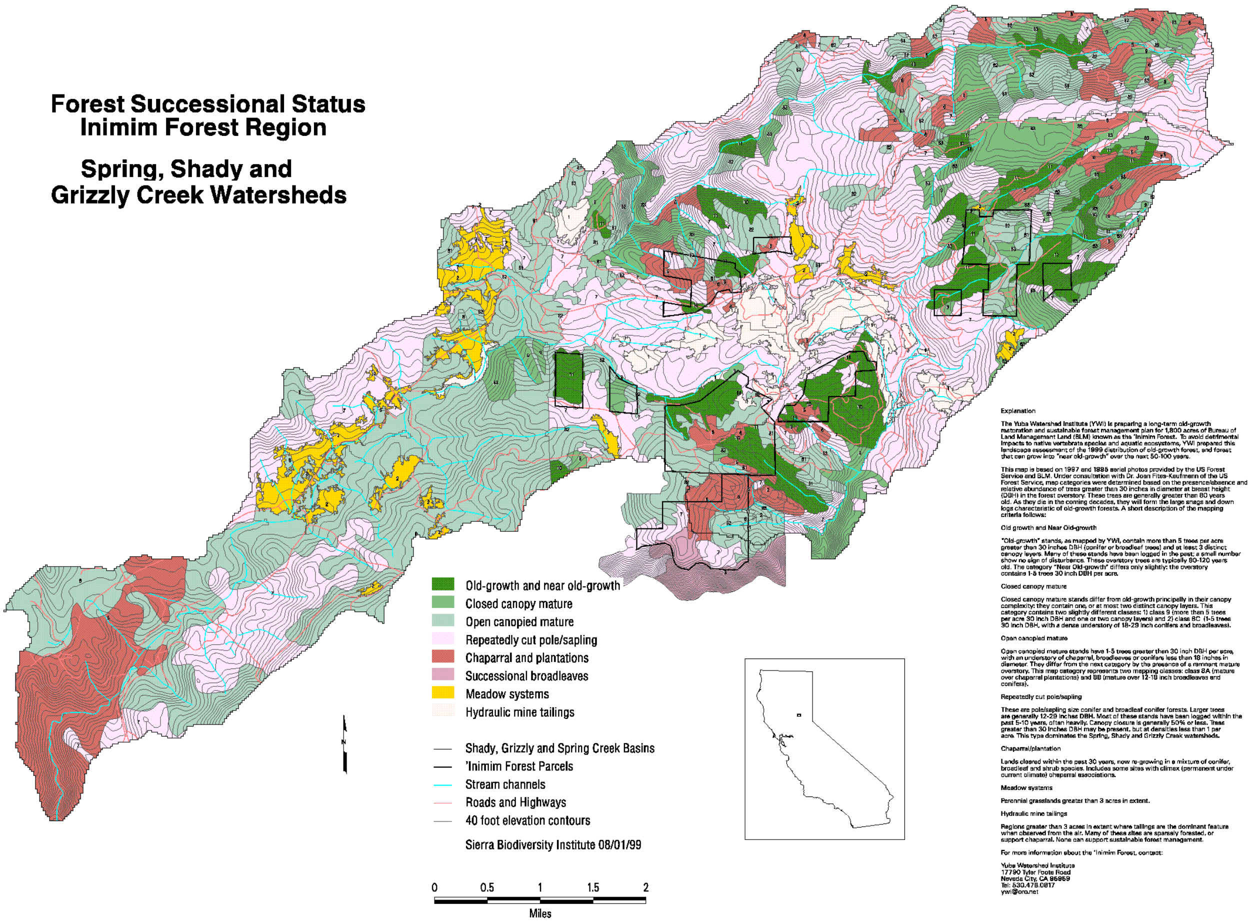


Figure 2-9

I. Methodology

Overview

The purpose of late-successional/old-growth (LSOG) forest mapping was to determine the overall distribution of old-growth forest, and stands that will grow into old-growth forest during the next few decades. Our study area was the Shady, Spring and Grizzly Creek watersheds, plus parts of South Yuba Canyon in the Bald Mountain region. Old-growth mapping was suggested by United States Forest Service (USFS) biologist Michael Chapel as the best way todetermine the significance of old-growth stands on the 'Inimim, and plan for the use of these stands in a regional conservation strategy for vertebrates like the spotted owl, fisher and pileated woodpecker.

At inception of the study, YWI consulted with Dr. JoAnn Fites-Kaufmann, ecologist and old-growth forest specialist with the USFS. Dr. Fites-Kaufmann suggested we use density of large diameter trees as the basis for delineating old-growth and near old-growth stands. She suggested we map the entire landscape, not just old-growth or mature stands. The spatial context of each stand, i.e., what kind of vegetation surrounds it, and how far is it from other mature or old-growth stands, can be as important as qualities intrinsic to the stand, such as relative disturbance or patch size. Following Dr. Fites-Kaufmann's advice, we mapped entire watersheds. This comprehensive work supports our overall goals for watershed assessment/old-growth mapping: we needed to know the current extent and condition of broad classes of vegetation throughout the watershed, especially successional vegetation recovering from disturbance during the past 30 years.

Data Sources

The USFS provided YWI with digital timber type maps for about 40% of Grizzly Creek and 25% of the Spring Creek watershed. This data is based on 1978 aerial photo interpretation, but has been repeatedly updated and is current to the mid-1990s. The USFS also gave us 1997 aerial photos at the 1:12,000 scale for the entire Grizzly Creek watershed and most of Spring Creek. Lower Spring Creek is completely covered by 1995 1:6,000 scale photos provide by the Bureau of Land Management (BLM). The USFS and BLM photos cover the upper 30% of Shady Creek, and 1995 1:6,000 scale photos provided by the Empire Mine State Parks District cover Shady Creek's confluence with the South Yuba. All these photos (except two from State Parks) were scanned and rectified to a standard projection. The USFS also provided YWI with a 5-meter resolution 1997 black and white satellite image. This image covers the entire San Juan Ridge region from near Graniteville west to near Ponderosa Pond on Shady Creek.

Assessment Process

The 'Inimim Old-growth Assessment was based on 1997 and 1995 color aerial photos provided to YWI by the Tahoe National Forest and the BLM. These photos were scanned at 300 dpi resolution and transformed into the California Albers map projection using the 5 meter cell size panchromatic satellite image of 'Inimim region as a source of coordinates of visible geographic features, such as stream confluences.

A series of field maps were made using the processed digital photos. Overlaid over the photos on these maps were areas greater than 5 acres that shared a common aspect, i.e., north, or southwest. Forest types commonly differ on north and south facing slopes. We exploited this difference to draw initial forest type boundaries. Each unique area on the field map, called a polygon, was labeled with its predominant aspect. Where previous mapping had labeled the polygon by forest type, size and canopy closure (on and near national forest lands) such label was printed in the polygon. The field maps also included streams and roads printed over the photos to aid location of polygons in the field. Each polygon was labeled with a unique identifying number. This number was also printed on a field data entry form. The mapping process involved reviewing the vegetation inside each polygon, and filling in the field forms describing each place.

To facilitate rapid characterization of vegetation types and forest size classes in the field, a dichotomous key was developed. This key was subject to review by specialists in old-growth forest mapping before use. In addition to the class number from this key, YWI mappers were required to label each polygon with its canopy closure class (based on the USFS system), and

Wildlife Habitat Relationships (WHR) vegetation type code. Additional information, such as dominant species in the overstory (the top of the forest as seen from above) was not required but frequently noted.

Field mapping work was broken up by watershed. A team of YWI staff and volunteers went into the field and transected several polygons in a given region. They compared the vegetation as seen from the ground with the same sites as seen on the photos. When they surveyed a sufficient number of polygons, it became possible to begin labeling all similar polygons in that region. When a new type was observed on the photo that mappers could not label with certainty, the team moved to a location that contained the new type and made at least one transect through it. By transecting 6-8 sites per watershed, YWI field workers were able to map with confidence the entire 20,000 acre 'Inimim planning watershed region.

Because the aspect-based initial polygons were small (typically 5-40 acres), most mapping required only labeling them. Boundary corrections were required on 10-20% of the polygons. Typically, staff would draw a new line separating two distinct types that occurred within a single polygon. Such lines were drawn in the field on the printed photos. Later, these corrections were incorporated into the final digital map and database (GIS) for each watershed in the computer by hand editing the aspect polygons using the aerial photos on-screen as basis for new polygon delineation.

Accuracy Assessment

Old-growth Sierra Nevada Mixed Conifer Forest, Humbug Canyon Control Watershed, Placer County, CA

Mapping accuracy was assessed using 1/10th acre plots arranged on a transect that bisected size class 10 and 11 stands. YWI volunteers randomly selected 7 of these stands. In the field, volunteers located the edge of the stand and selected an azimuth (compass bearing) that would transect the stand along its long axis. Plots were established along the transect 200 in from the stand edge, and every 300 feet thereafter. Each plot was a 37.2-foot radius circle. At plot center a global positioning system was used to record latitude, longitude and elevation. Volunteers also recorded aspect, slope and basal area. Within each plot, all trees greater than 30 inches in diameter at breast height were tallied. The diameter and species of each such tree was noted, plus height and age where time permitted. The presence or absence of visible historic logging was also noted, both in the plot and along the transect.

II. Findings

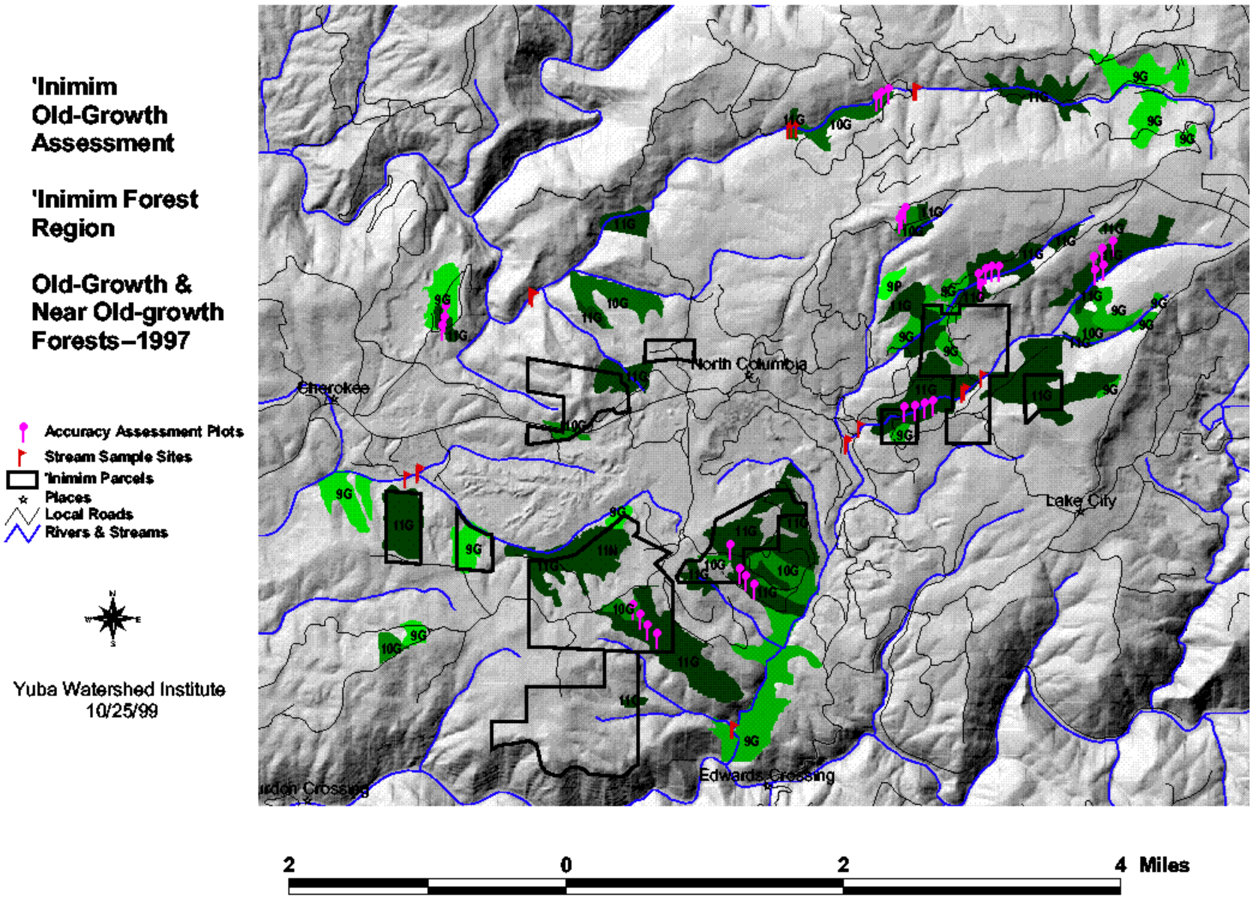


Figure 2-10

Landscape distribution

Old-growth and near old-growth forests (stands that can grow most old-growth structures within a few decades) currently occupy 11% of the 20,864 acre, three watershed study area. In all, these forests cover 2,287 acres. Spring Creek has the greatest extent of these forests (1,429 acres or 25% of the watershed), followed by Grizzly Creek (447 acres or 9%), and Shady Creek (381 acres, 4% of the watershed area). In terms of ownership, 45% of this forest grows on private lands. 'Inimim Forest/BLM encompasses 31%, US Forest Service 23%, and State Parks, 2%. These results are surprising, especially the extent of old-growth and near old-growth on private lands. As a result of these findings, YWI's old-growth policy will include active outreach to local private landowners, and coordinated conservation of old-growth and near old-growth forests across all ownerships. Where these rare forests grow on 'Inimim lands, they will be managed only with prescribed fire and some brush mastication. Commercial logging will not be planned in the 'Inimim's remnant old-growth, but rather in the younger stands that surround these forests.

Table 2-3: Old-Growth and Near Old-Growth Forest Distribution by Watershed*

Ownership	Watershed	Acres: Old-Growth & Near Old-Growth	Acres: All Lands	Percent of Old-Growth in Ownership Category	Percent of Watershed in Ownership
Private	Grizzly Creek	176	3366	5%	62%
BLM	Grizzly Creek	49	413	12%	8%
USFS	Grizzly Creek	252	1683	15%	31%
All	**Grizzly Creek**	**477**	**5461**	**9%**	**100%**
Private	Shady Creek	133	8442	2%	88%
BLM	Shady Creek	248	1133	22%	12%
All	**Shady Creek**	**381**	**9575**	**4%**	**100%**
Private	Spring Creek	714	3759	19%	65%
State Park	Spring Creek	45	74	61%	1%
BLM	Spring Creek	406	987	41%	17%
USFS	Spring Creek	264	1007	26%	17%
All	**Spring Creek**	**1429**	**5828**	**25%**	**100%**

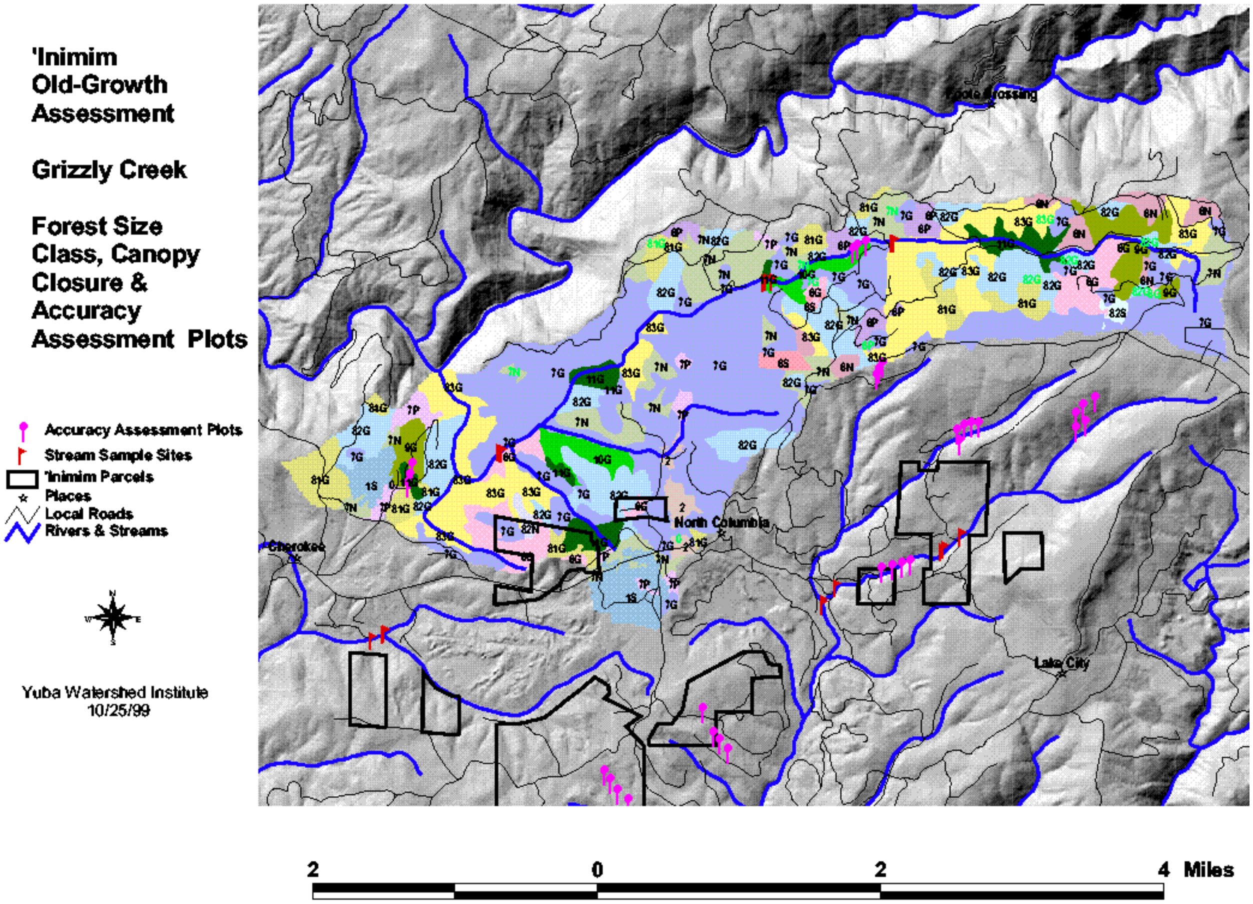
Total	**All**	**2287**	**20864**	**11%**	**100%**
*Size class 9, 10 and 11, all canopy closure classes.					

Mapping Accuracy

In terms of mapping accuracy, the results of random transects in 7 stands reveal an overall mean density of 10.8 trees per acre greater than 30 inches in diameter at breast height (standard deviation (SD) for the transects: 5.0). (Following YWI mapping protocol, old-growth stands have 5 or more 30-inch trees per acre.) Total stand basal area was consistently high (mean: 192, SD: 15.7). Mean diameter of the overstory trees was 38.4 inches (SD: 3.38). Just over half of these trees are Douglas Fir, followed by Ponderosa Pine, Incense Cedar, and Sugar Pine. Mean overstory height (based on measurement of 6 trees) is 135 feet (SD: 29.93). Mean age of four sampled trees was quite young: 120 years (SD: 10.1). This reflects the recovering nature of many of these stands. Structurally, in terms of large trees, snags and down logs, these stands are functioning, or just beginning to function, as old-growth. Many characteristics of old-growth are present in these stands, even though they are not as old as classic old-growth Sierran mixed conifer forest (greater than 180 years).

Recommendations

All old-growth and near old-growth stands mapped during this survey should be protected. No activity that reduces canopy closure, canopy layering or species composition of the overstory should be permitted. All stands with riparian corridors (those stands transected by streams) should be protected permanently as old-growth reserves. Some of the upland stands can be available for logging following the above guidelines, but cutting in such stands should be delayed until the last decades of the 'Inimim plan. In the first three decades, logging should focus on under-thinning stands outside the old-growth network.



'Inimim
Old-Growth
Assessment
Grizzly Creek
Forest Size
Class, Canopy
Closure &
Accuracy
Assessment Plots
Accuracy Assessment Plots
Stream Sample Sites
'Inimim Parcels
Places
Local Roads
Rivers & Streams
Yuba Watershed Institute
10/25/99
North Columbia
Cherokee
Lake City
2
0
2
4 Miles

Figure 2-11

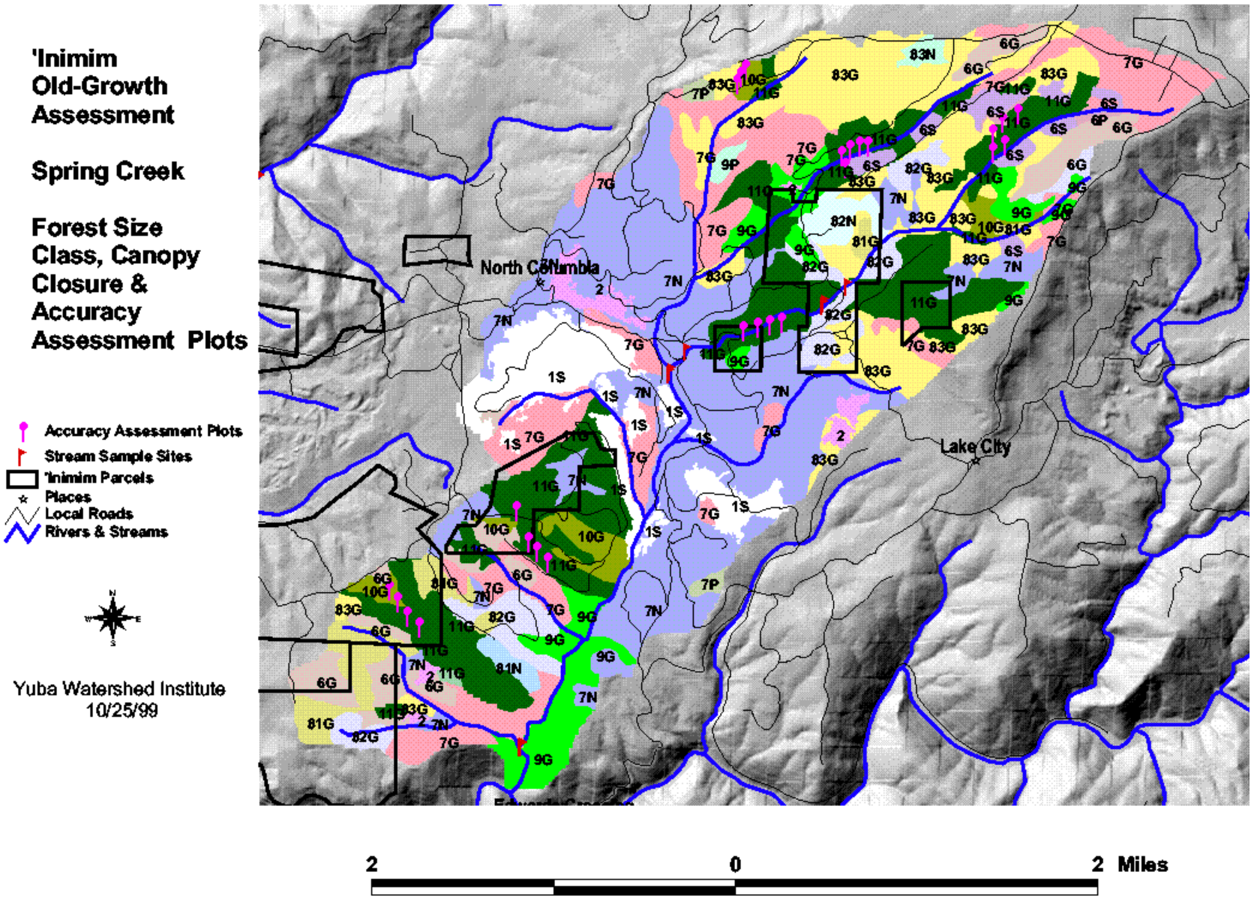

'Inimim
Old-Growth
Assessment
Spring Creek
Forest Size
Class, Canopy
Closure &
Accuracy
Assessment Plots
Accuracy Assessment Plots
Stream Sample Sites
'Inimim Parcels
Places
Local Roads
Rivers & Streams
Yuba Watershed Institute
10/25/99
North Columbia
Lake City
2
0
2 Miles

Figure 2-12

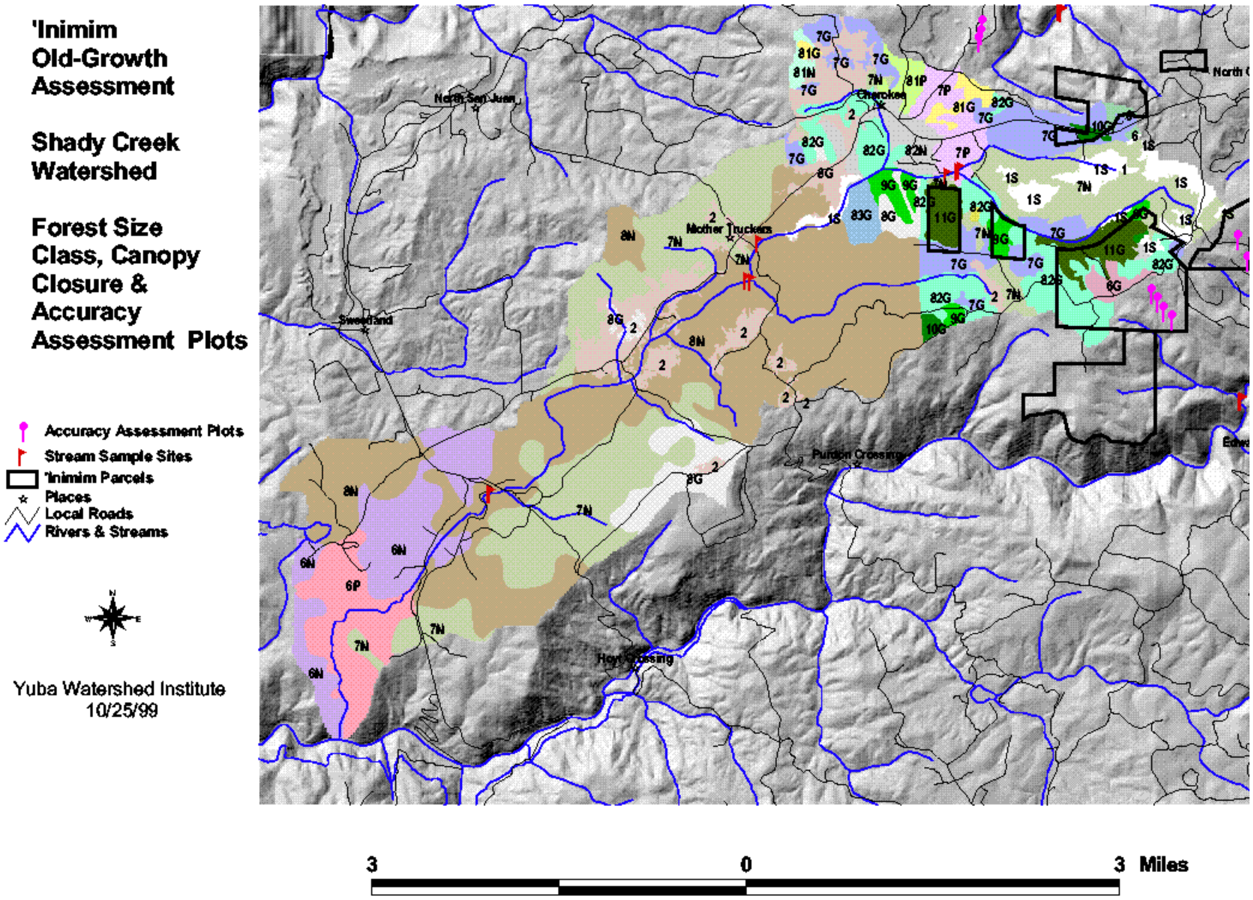

'Inimim Old-Growth Assessment
Shady Creek Watershed
Forest Size Class, Canopy Closure & Accuracy Assessment Plots
Accuracy Assessment Plots
Stream Sample Sites
'Inimim Parcels
Places
Local Roads
Rivers & Streams
Yuba Watershed Institute
10/25/99
North San Juan
Sweetland
Mother Truckers
Cherokee
Purdon Crossing
Hoyt Crossing
3
0
3 Miles

Figure 2-13

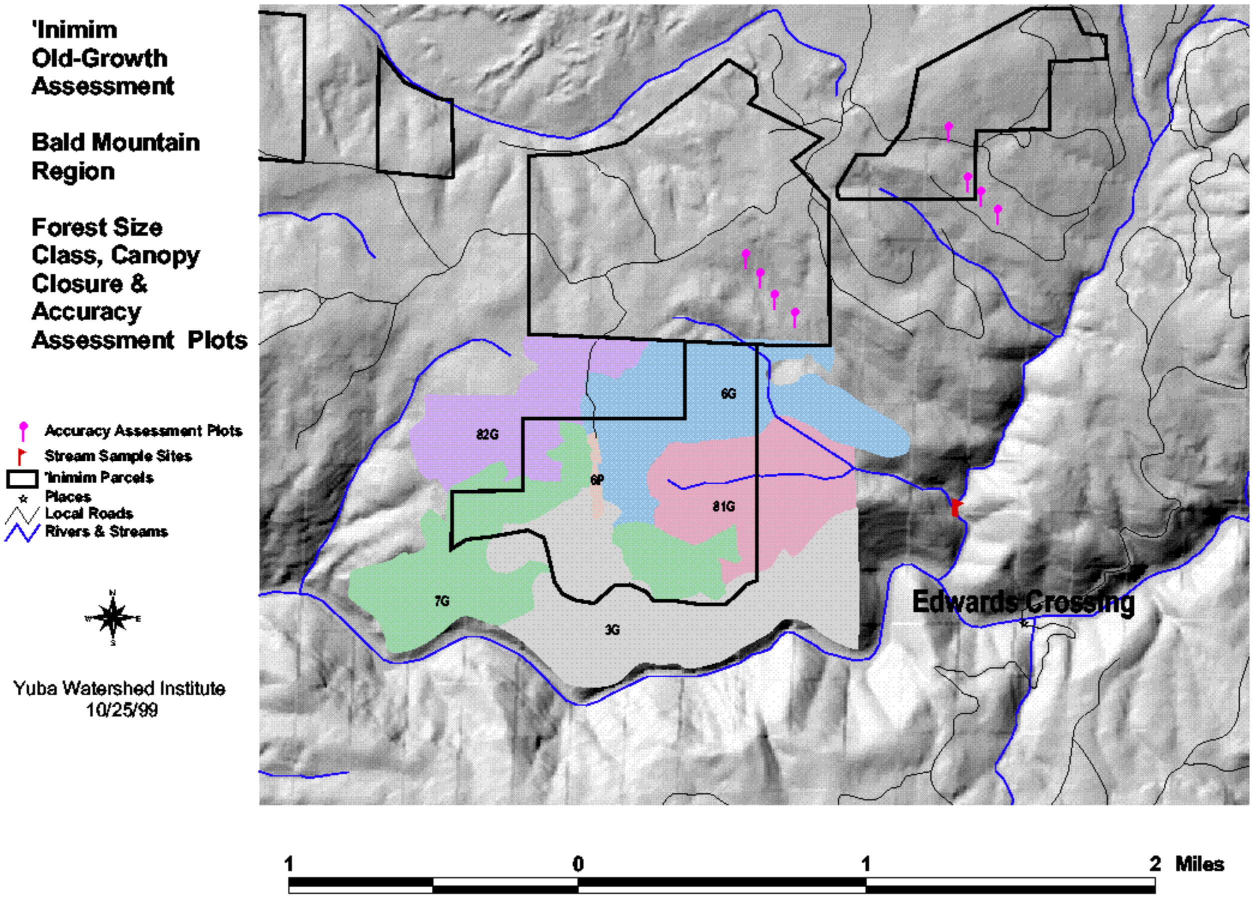

'Inimim Old-Growth Assessment
Bald Mountain Region
Forest Size Class, Canopy Closure & Accuracy Assessment Plots
Accuracy Assessment Plots
Stream Sample Sites
'Inimim Parcels
Places
Local Roads
Rivers & Streams
Yuba Watershed Institute
10/25/99
82G
6G
6P
81G
7G
3G
Edwards Crossing
1
0
1
2 Miles

Figure 2-14

Chapter 3: 'Inimim vegetation condition and management goals

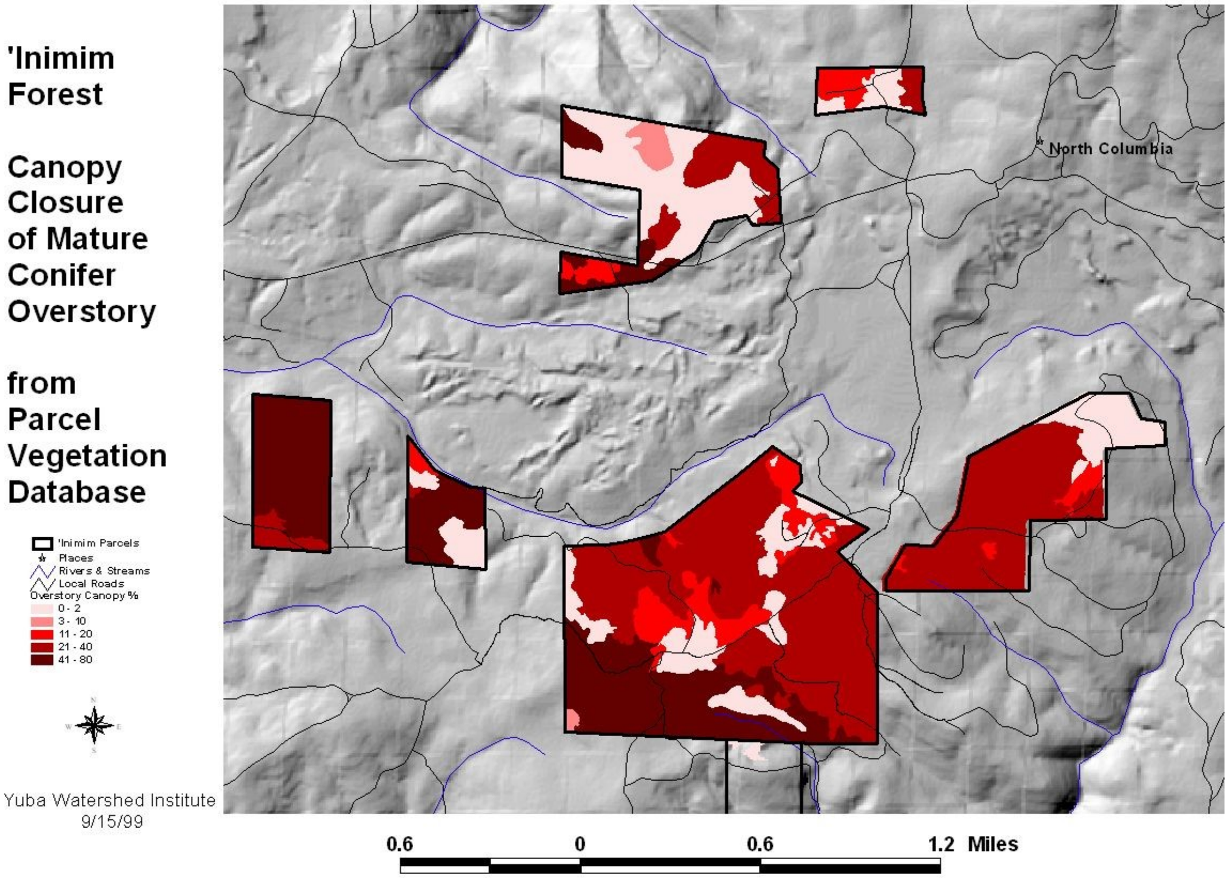


Figure 3-1

A. Vegetation condition maps

A primary foundation for the 'Inimim plan is the parcel vegetation database. This mapping exercise, based on 1997 and 1995 aerial photos supplied by the US Forest Service and Bureau of Land Management, respectively, provides the information all proposed logging is based on. To map vegetation, YWI developed and used the following protocol.

B. Parcel Vegetation Mapping Protocol

The parcel vegetation mapping procedure was designed to stratify 'Inimim lands based on the level of departure from old-growth conditions. The mapping described each stand based on the following old-growth attributes that YWI seeks to restore:

I. Overstory.

For the purposes of mapping, YWI defined the overstory as trees greater than 24 inches in diameter at breast height (DBH). Presence of these trees is essential for snag and down log recruitment. They are also the most resistant to destruction by catastrophic fire. Out 50-100 years in the future, YWI wants all coniferous forest sites in 'Inimim to support an overstory. The density of this overstory will vary based on aspect and local site conditions, but it will be present everywhere. It is not present everywhere today.

For each stand, YWI noted if an overstory is currently present. Where it was, YWI recorded species makeup of the first and second most abundant species that comprise it, and their combined total contribution to canopy closure in the stand. Canopy closure was estimated using the aerial photos to the nearest 20% increment, i.e., 0, 20, 40, 60, 80 or 100%. (YWI used canopy closure estimates instead of number of trees per acre because YWI can more accurately estimate canopy closure in the field. Data on trees per acre was gathered via circular plots. See Chapter 5, Part B.)

II. Midstory

The midstory are those trees in the stand that will grow into the overstory over the first few decades of the 'Inimim plan. These are trees currently 18-24 inches DBH. YWI needed to know the density and species makeup of the midstory to predict the rate of recovery of the overstory where it is currently lacking or at lower than desired densities. YWI recorded the first and second most abundant species in the midstory. Like the overstory, YWI also recorded the canopy closure of the midstory, using 20% increments.

III. Seedlings/Saplings

The species composition of seedlings and saplings on the forest floor informs us of the future makeup of the 'Inimim forest especially out 100-200 years. Many stands will be almost pure madrone or black oak in the overstory and midstory, but will have pine, cedar and Douglas fir at high densities in the seedling layer. YWI wanted to separate these successional mixed broadleaf conifer stands from pure broadleaf stands that YWI will not subject to logging, and may propose different fire regimes in.

Seedlings/saplings were measured using two 100 foot belt transects per polygon. The first two most abundant species were noted, and density recorded in number per acre.

IV. Vegetation Type

Each vegetation polygon was labeled with vegetation type based on the Holland system as adapted for the California GAP Vegetation study. Vegetation type labeling is import for separation of blue oak, white oak and serpentine chaparral types from the coniferous forest majority. YWI used the Holland system because it is more precise and descriptive that the Wildlife Habitat Relationships (WHR) system YWI used in the old-growth/landscape condition mapping.

V. Basal Area

Two or three basal area samples were placed at random while transecting each stand. This basal area data provided YWI with an index of the overall volume and canopy area of each stand.

VI. Canopy layers

The number of distinct canopy layers was noted. Canopy layering and spatial variability increase over time in westside conifer forests. Our goal in restoration of old-growth conditions will include adding spatial heterogeneity (variability) to younger, single canopy layer stands.

C. Findings of Vegetation Mapping

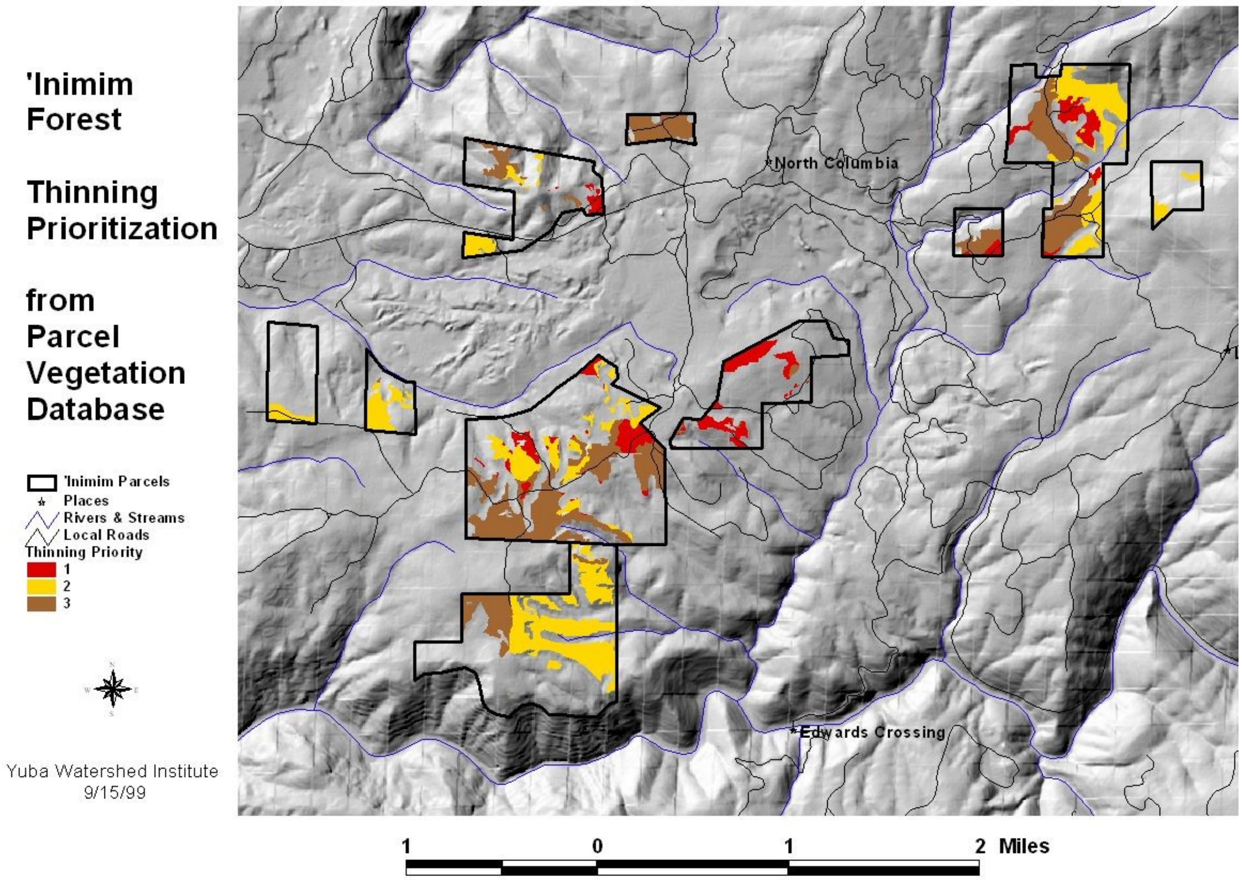


Figure 3-2

Based on species composition (the most abundant species only) and density of the over- and mid-stories, there are 48 vegetation type/structural classes of forest on 'Inimim. Table 3-1 lists each of these types, plus its extent in acres, assigned management group, and understory thinning priority. This table was used to make thinning prioritization plan (Figure 3-2).

Table 3-1: 'Inimim Vegetation Types/Structural Classes and Assigned Management

Holland Type	Overstory	Overstory Canopy	Midstory	Midstory Canopy	Saplings	Acres	Group*	Underthinning Priority
Black Oak Forest	CADE	2	QUKE	80	CADE	10.3	1	0
Black Oak Forest	PIPO	10	QUKE	10	PIPO	2.0	1	0
Black Oak Forest	QUKE	80	CADE	0	CADE	8.6	1	0
Black Oak Woodland		0	QUKE	60	PIPO	12.0	1	0
Black Oak Woodland	PIPO	2	QUKE	60	PSME	31.9	1	0
Blue Oak Woodland	PIPO	20	QUDE	20	PIPO	6.3	3	0
Mid-elevation Conifer Plantation	NA	0	PIPO	2	PIPO	6.3	1	3
Mid-elevation Conifer Plantation	NA	0	PIPO	60	PIPO	6.0	1	3
Mid-elevation Conifer Plantation	PIPO	2	PIPO	60	PIPO	17.4	1	3
Mid-elevation Conifer Plantation	PIPO	20	PIPO	2	PIPO	2.6	1	3
Montane Manzanita Chaparral		0		0	PIPO	39.9	3	0

Montane Manzanita Chaparral	NA	0	PIPO	20	PIPO	7.3	1	3
Montane Manzanita Chaparral	PIPO	2	PIPO	2	PIPO	1.4	3	3
Permanently-flooded Lacustrine Habitat		0		0		2.8	3	0
Sierran Mixed Coniferous Forest	PIPO	20	CADE	20	CADE	12.5	1	3
Sierran Mixed Coniferous Forest	PIPO	20	PSME	20	PSME	6.3	1	3
Sierran Mixed Coniferous Forest	PIPO	40	CADE	20	PILA	6.7	1	3
Sierran Mixed Coniferous Forest	PIPO	40	CADE	20	PSME	60.5	1	3
Sierran Mixed Coniferous Forest	PIPO	40	CADE	40	PSME	85.8	1	1
Sierran Mixed Coniferous Forest	PIPO	40	PIPO	40	CADE	87.2	1	1
Sierran Mixed Coniferous Forest	PIPO	40	PSME	20	CADE	1.9	1	2
Sierran Mixed Coniferous Forest	PIPO	40	PSME	20	PSME	33.8	1	2
Sierran Mixed Coniferous Forest	PIPO	40	PSME	40	CADE	71.5	1	1
Sierran Mixed Coniferous Forest	PIPO	40	PSME	40	PSME	13.9	1	1
Sierran Mixed Coniferous Forest	PIPO	60	PIPO	40	PSME	9.4	1	2
Sierran Mixed Coniferous Forest	PIPO	60	PSME	20	CADE	0.8	1	2
Sierran Mixed Coniferous Forest	PIPO	60	PSME	20	PSME	116.5	1	2
Sierran Mixed Coniferous Forest	PSME	40	PSME	40	PSME	1.4	1	1
Sierran Mixed Coniferous Forest	PSME	40	PSME	60	PSME	10.8	1	2
Sierran Mixed Coniferous Forest	PSME	60	PSME	40	PSME	20.6	1	2
Strip Mines, Quarries and Gravel Pits	PIPO	2	PIPO	2	PIPO	16.0	3	0
Urban or Built-up Land		0		0		0.7	2	0
Westside Ponderosa Pine Forest		0		0	PIPO	2.4	1	3
Westside Ponderosa Pine Forest		0	PIPO	2	PIPO	25.0	1	3
Westside Ponderosa Pine Forest	PIPO	2	PIPO	20	PIPO	22.6	1	2
Westside Ponderosa Pine Forest	PIPO	2	QUKE	2	PIPO	9.9	1	3
Westside Ponderosa Pine Forest	PIPO	2	QUKE	2	PSME	3.3	1	3
Westside Ponderosa Pine Forest	PIPO	10	PIPO	2	PIPO	10.7	1	3
Westside Ponderosa Pine Forest	PIPO	20	PIPO	20	PIPO	25.1	1	2
Westside Ponderosa Pine Forest	PIPO	20	PSME	40	PSME	1.6	1	1
Westside Ponderosa Pine Forest	PIPO	20	QUKE	20	PIPO	26.0	1	2
Westside Ponderosa Pine Forest	PIPO	40	CADE	20	PSME	1.4	1	2
Westside Ponderosa Pine Forest	PIPO	40	CADE	40	PSME	1.3	1	1
Westside Ponderosa Pine Forest	PIPO	40	PIPO	20	PIPO	2.1	1	2
Westside Ponderosa Pine Forest	PIPO	40	PSME	2	PIPO	5.8	1	3
Westside Ponderosa Pine Forest	PIPO	40	PSME	40	PSME	61.1	1	1
Westside Ponderosa Pine Forest	PIPO	40	QUKE	2	PSME	1.0	1	3
Westside Ponderosa Pine Forest	PIPO	60	QUKE	20	PSME	97.5	1	3

Table 3-2: Soil/Plant Association Management Groups*

The soil/plant associations in the 'Inimim can be classified into three groups based on the kind, and intensity of human interaction proposed in this plan. Management practices will be applied to 'Inimim lands based on these three groups.

Group 1: These are commercial conifer forests growing on deep productive, resilient soils.

Practice 2: Restoration/working with succession.
Practice 4: Thinning from below
Practice 5: Small group selection logging.

Practice 6: Use only existing roads and skid trails.
Practice 7: Maintain soil cover.
Practice 8: Maintain soil organic matter.
Practice 9: Inventory and Monitoring
Practice 10: Contract sizing to benefit small, community companies.
Practice 11: Growth and maintenance of late-succession forest conditions.
Practice 12: Protection of riparian zones.
Practice 13: Educational example for private land management.
Practice 14: Study Area
Practice 15: Fuel load reduction

Group 2: assemblages that support commercial conifer and broadleaf species but are marginally productive, dry, shallow soils.

Practice 2: Restoration/working with succession.
Practice 3: Transplantation, natural seeding and reforestation
Practice 12: Protection of riparian zones
Practice 13: Educational example for private land management.
Practice 14: Study Area
Practice 15: Fuel load reduction

Group 3: Chaparral/scrubland, wetland, and non-commercial associations.

Practice 1: Natural processes and cycles.
Practice 12: Protection of riparian zones
Practice 13: Educational example for private land management.
Practice 14: Study Area
Practice 15: Fuel load reduction

* See www.oro.net/~ywi/plan.htm for complete description

D. Protected and Logging Zones

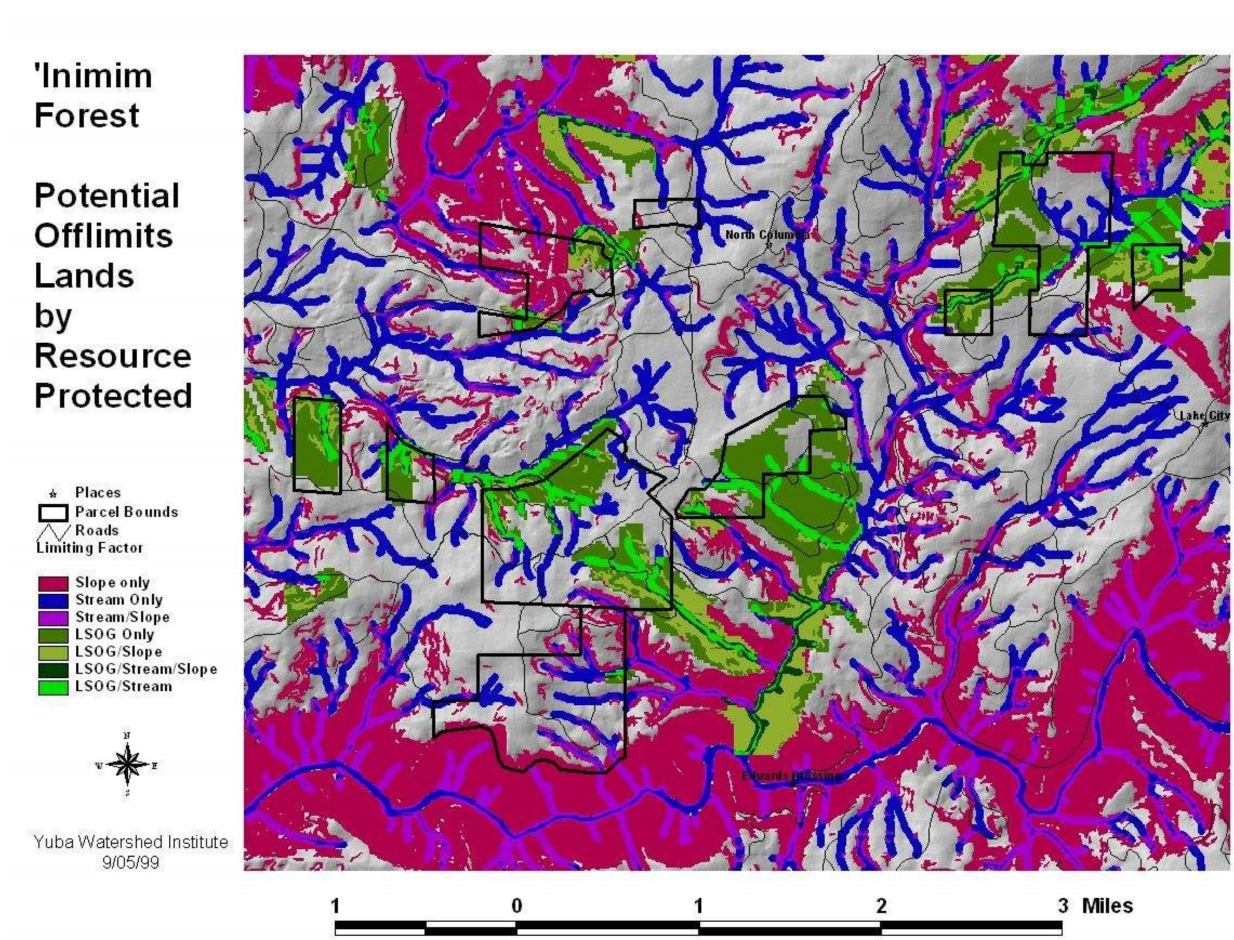


Figure 3-3

Data from parcel vegetation mapping, the old-growth inventory, and the watershed assessment were used in combination with digital slope maps and stream buffers to separate the 'Inimim forest into two zones. In the first, logging is permissible; in the second logging is prohibited to protect streamside habitats, steeply sloping soils, and selected late-succession/old-growth (LSOG) forest reserves. To delineate the second zone, YWI mapped: 1) all lands within 100 feet of perennial, intermittent and ephemeral streams, 2) sites where slope is greater than 30%, and 3) old-growth and near old-growth forests as defined in YWI's old-growth landscape assessment (see Chapter 2).

Using the management group system developed in the 'Inimim Forest Plan (see www.oro.net/~ywi/plan.htm), in combination with the geographic information system-based zoning system described above, YWI classified all 'Inimim lands into three groups (see Table 3-2 for details). Using this zoning system, 44% of the 'Inimim Forest (Group 1 and 2 lands) remain open to some form of silviculture. The other 66% (Group 3) are protected. This group includes all of the non-commercial shrub and broadleaf plant communities, plus those potentially commercial forests (streamside zones, old-growth).

Special attention was given, during the creation of the management group map, to the careful delineation of riparian zones using field reconnaissance and a global positioning system for spatial accuracy. Complete protection for the riparian or streamside zone in the 'Inimim is among the most important acts YWI can take to protect biodiversity and aquatic ecosystems. Using a buffer of 100 feet on each side of the stream (based on the approximate height of standing conifers nearby the stream; all trees that can fall into the stream should be allowed too), the 'Inimim streamside protection zone encompasses 364 acres. In the modeling process by which this zone was delineated, YWI created new stream traces based on 10 meter digital elevation models. This new stream "model" more closely resembles the real- world distribution of perennial, intermittent and ephemeral streams than the approximate stream traces on the 1:24,000 scale topographic maps. Still, these stream traces required 100% field verification. While gathering plot data on each parcel, YWI staff walked the course of each new stream channel identified on the field maps. The stream was traced from where the first sign of wash occurs (leaf movement, bedrock or cobble exposure) all the way to its intersection with previously mapped major perennial streams, or the edge of the 'Inimim parcel.

E. Distribution and Extent of Management Groups

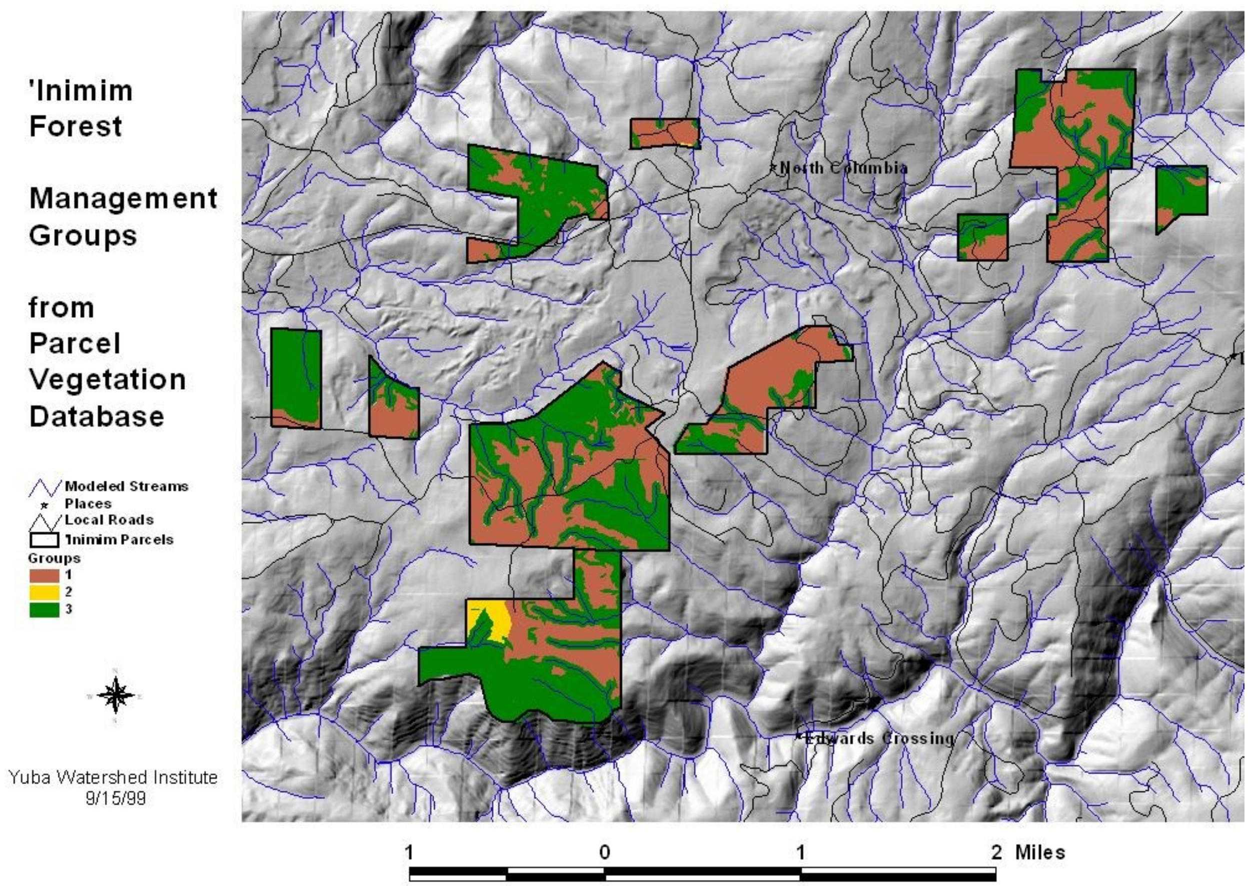


Figure 3-4

Figure 3-4 displays the distribution and extent of 'Inimim Management Groups. Group 1 encompasses 742.1acres; group 2, 23.2; and group 3, 992.2. From a soils and topographic perspective, group 1 is gently sloping highly productive upland soils near the road system. Group is steeper, shallower soils dominated by broadleaf trees. Group three comprises the steep, remote, streamside, non-commercial and old growth forest- and scrublands.

Chapter 4: Management compartments and logging plan

A. Management Compartments

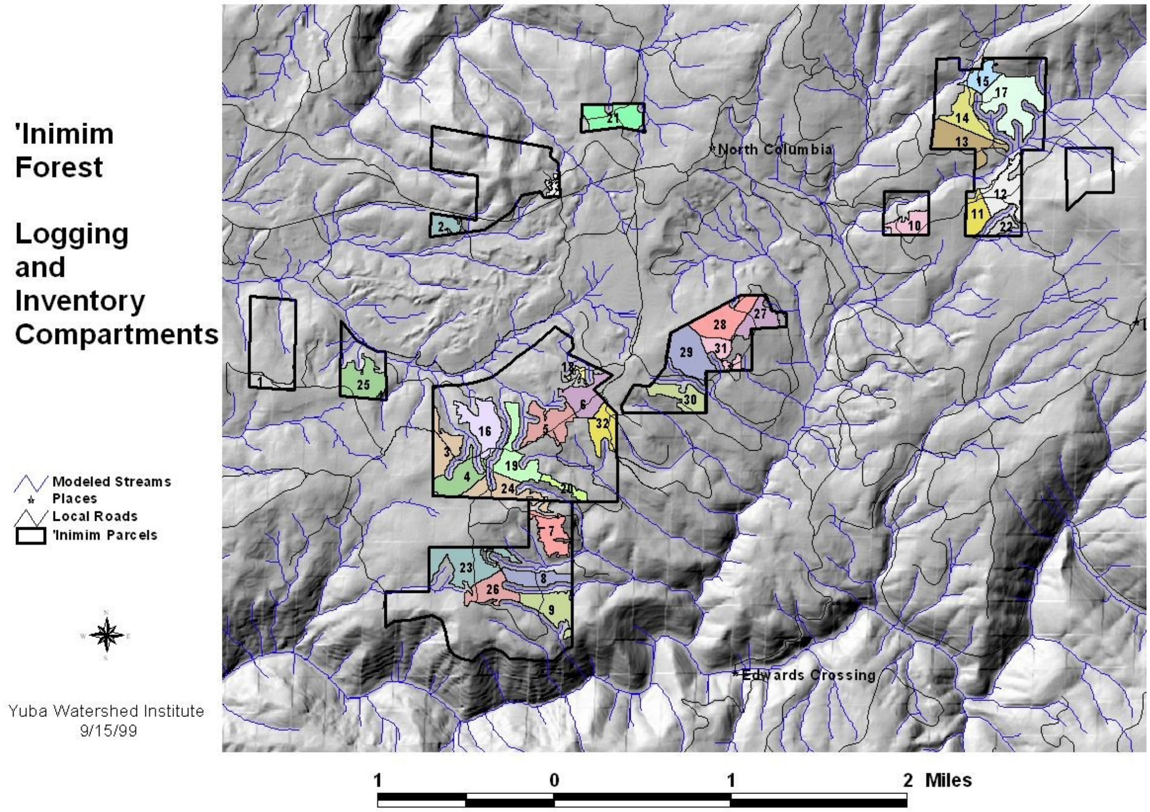


Figure 4-1

Management or logging and inventory compartments are necessary to minimize the impact of each logging entry. The focal point of each compartment is the landing. The landing is where logs are loaded onto trucks or processed. The compartment is designed as a tributary region around the landing. It represents all of those places where logs can be removed to a central point with minimal impact to soils and streams. Landings and compartments must have road access. Because the 'Inimim plan will build no new roads, compartments were placed only adjacent to the existing road system.

Figure 4-1 displays the thirty-three 'Inimim management compartments. Table 5-3 (Chapter 5) shows current volume, maximum allowable cut per year, and growth by compartment. Although management for the entire 'Inimim forest is ecologically sustainable, sustained yield is practiced by compartment. YWI will not concentrate all logging for the whole 'Inimim for the whole twenty year period on one or more compartments. Although this would be sustainable over the entire 'Inimim forest, it would involve unsustainably over-cutting the compartment. Instead, YWI will use the maximum allowable logging values per compartment (Table 5-3) when planning timber sales. Each compartment will be reviewed on a twenty year cycle. All logging (if any) planned within the compartment will completed at that time, with the compartment resting in between cutting cycles.

On going inventory and monitoring will also be conducted by compartment, starting with the baseline data gathered during implementation plan development.

B. Haul Road System

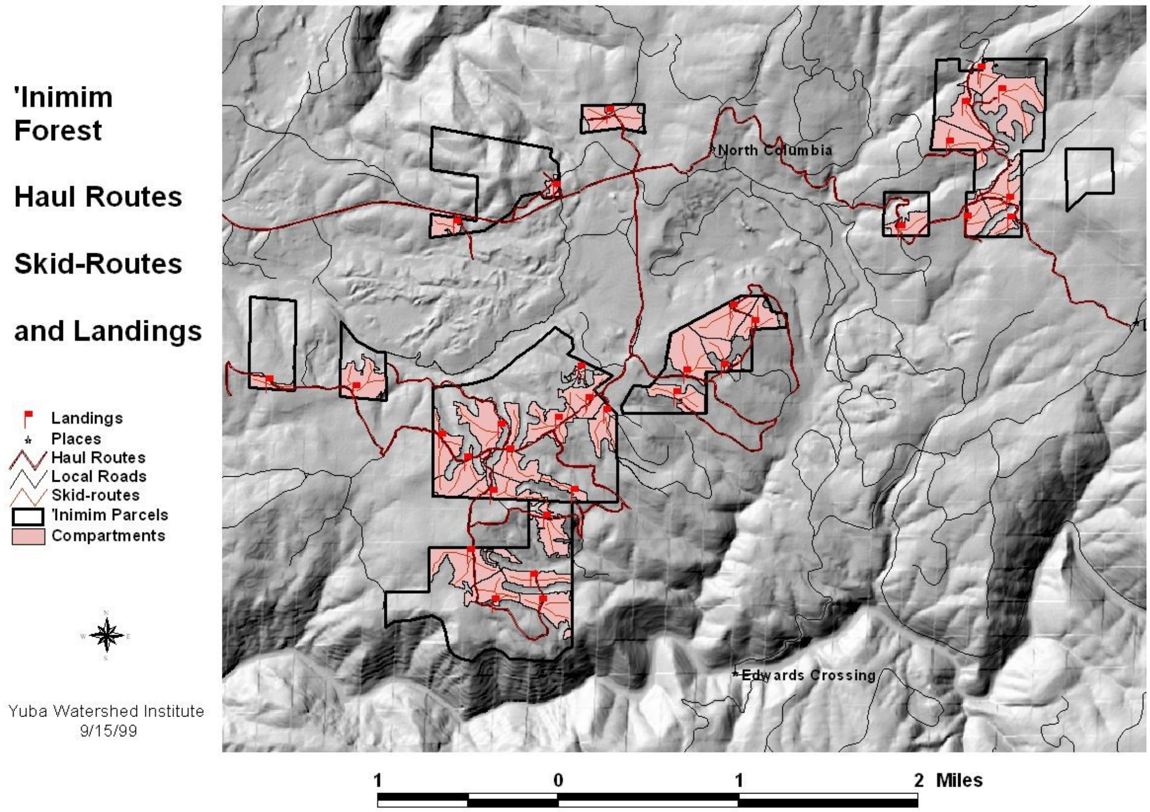


Figure 4-2

For haul roads, the 'Inimim plan will use existing county and privately maintained roads. Where necessary YWI will request that the BLM request permission from private landowners to use existing rights of way and roads that pass through their properties. The complete set of all roads that the 'Inimim plan will use over the next 50 years is shown in Figure 4-2.

C. Designated Landings and Skid-trails

Both landings and skid-trails (routes along which logs are dragged) were permanently designated in the field by experienced logging technicians. The use of permanent landings and skid routes is essential to minimize soil compaction and erosion, and the incremental loss of productive forestland over multiple logging entries. By determining, in advance, where landings and skid roads can be placed within the environmental guidelines established in the 'Inimim plan, YWI avoided the possible inclusion of inaccessible forest land in the sustained yield plan.

D. Planned Logging by Decade

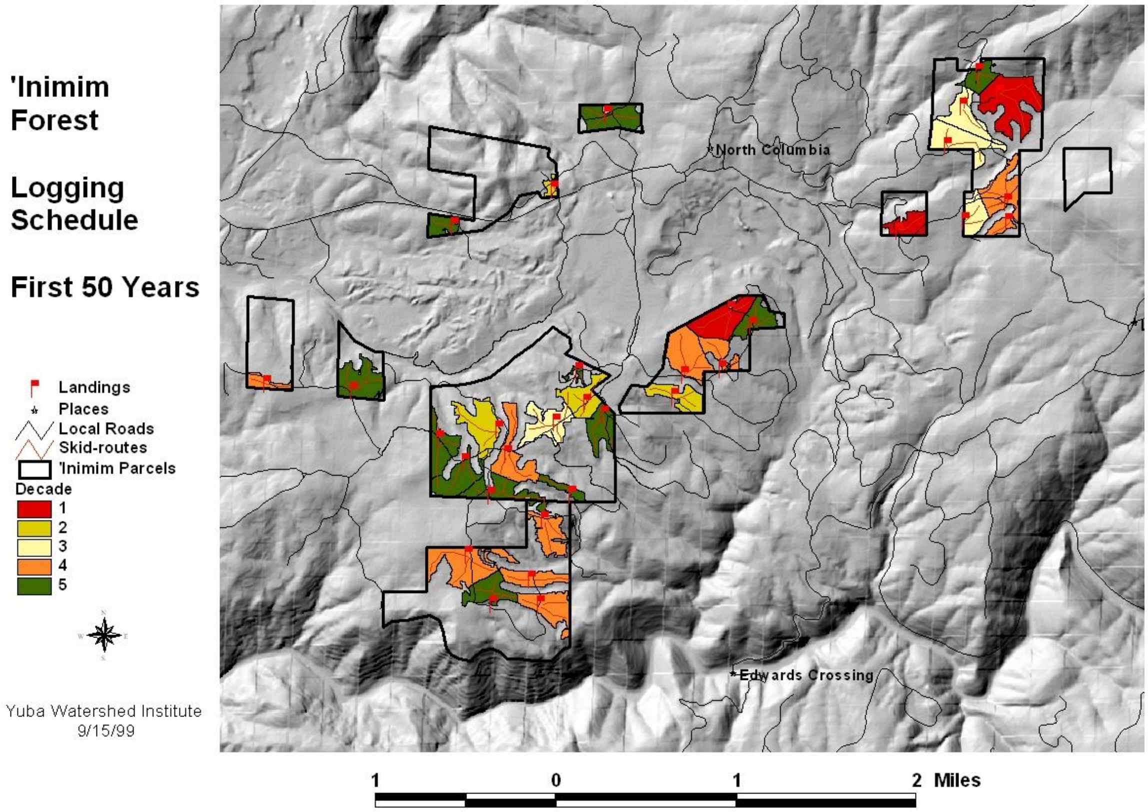


Figure 4-3

Figure 3-5 displays the logging schedule for the first five decades of the 'Inimim Plan. Note that this map displays *compartments,* not actual stands that will be logged. Within each compartment, mapped stands that meet the current goal will be subject to logging.

The goals of logging vary by decade. For the first 30 years, the 'Inimim focuses on under-thinning stands with poorly developed overstories. Stunted trees in the understory of selected stands will be cut, allowing soil moisture and nutrients to be used for rapid growth of those trees with canopies open to the sky. This will increase the speed at which a fire-resistant overstory forms in these stands, and remove "fire ladder" fuels, which would increase the probability of the overstory burning during wildfire. For details on this technique, see "Practice 4: Thinning from below" in the 'Inimim Forest Plan (www.oro.net/~ywi/plan.htm).

In decades 4 and 5, overstory thinning and small group selection will begin. Here the logging will be designed to produce an ecologically sustainable supply of old growth and near old-growth timber. See "Practice 5: Small group selection logging" in the 'Inimim Plan for details.

Chapter 5: Sustained yield capacity of the 'Inimim Forest

A. Calculation of Sustained Yield

Determining the ecological sustained yield capacity of the 'Inimim Forest was the heart of the implementation plan. To do so, YWI first ruled out all of the lands where logging will not occur (see Chapter 3, Part C). These include stream ecosystem energy/ community zones, steeply sloping fragile soils, and representative old-growth and near old-growth forests. Although these regions contain millions of board feet of standing conifer forest, YWI did not include this volume in any of our calculations. Because timber will never be cut in these regions, for sustained yield calculations it is as if these stands do not exist.

After determining which lands would be available for logging, YWI designed a sampling system to measure existing timber volume and growth on these lands.

B. Sampled polygons and plot locations

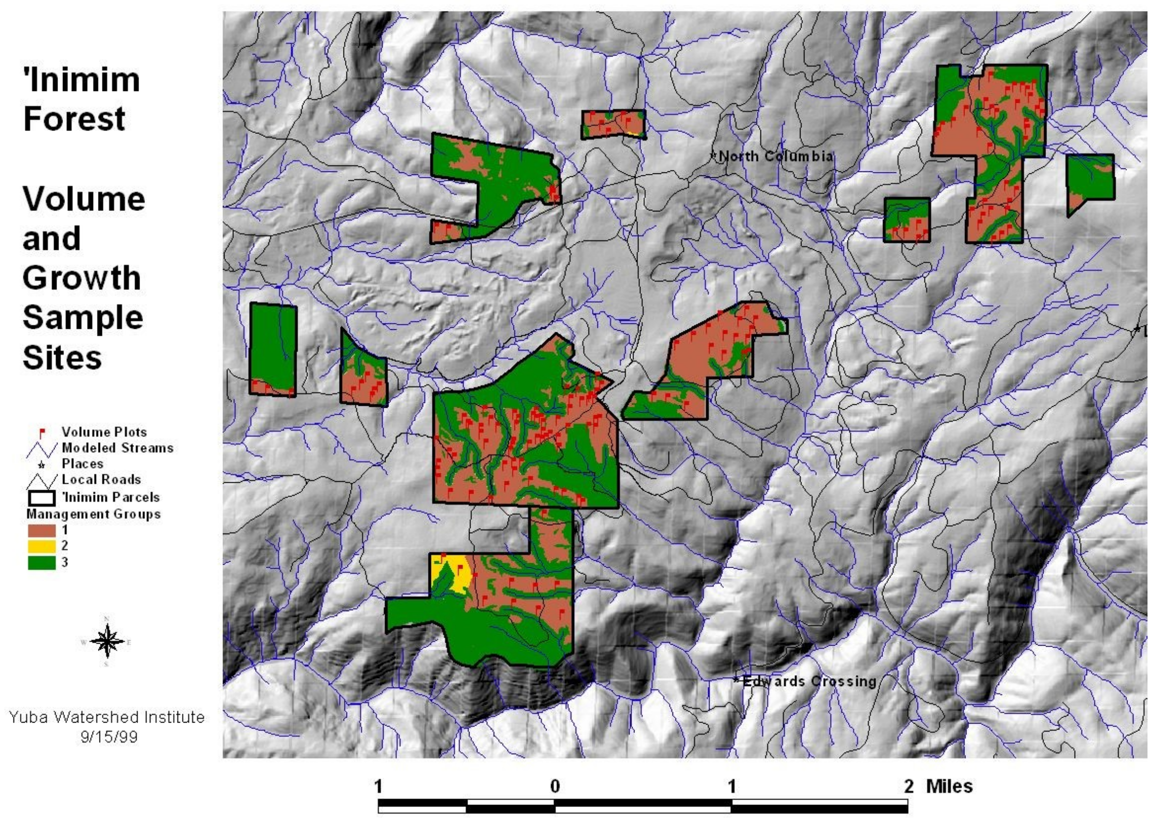


Figure 5-1

Within the logging zone (management groups 1 and 2, see Figure 5-1), YWI placed one hundred and fifty three circular inventory plots. YWI placed three plots in each polygon greater than 1 hectare (2.47 acres). The plots were located at 100 or 300 feet intervals (depending on polygon size) along a compass bearing that transected the polygon along its long axis. A random number table was use to offset the transect from the original location of the field person to avoid sampling error.

On the Big Parcel (see Figure 1-1 for map of parcels), data was gathered at the site of the long-term monitoring plot locations wherever possible.

Each plot consisted of three nested subplots: a 1/10th acre (37.2 feet radius) overstory plot, in which the species, diameter and height of all trees greater than 11.6 inches DBH was noted; a 1/100th acre (11.8 feet radius) mid-story plot, in which all above data was recorded for trees 5 to 11.6 inches DBH; and a site tree plot, in which age, height and DBH of a single free growing conifer was determined to assess soil productivity or site class (see Part E, below).

Results of plot data gathering for a selected subset of plots are displayed in Table 5-1, below.

Table 5-1: Sample Volume Data from 1/10th Acre Inventory Plots

Plot Number	Elevation (meters)	Volume per Acre (Board Feet)			
		Cedar	Yellow Pine	Douglas Fir	Total Conifer
9912061	899.996	1,080	10,600	5,240	16,920
9912062	898.775	3,370	25,600	0	28,970
9912063	898.092	4,960	0	0	4,960
9912064	975.360	0	45,800	0	45,800
9912065	897.296	0	115,000	0	115,000
9912066	899.142	0	19,900	0	19,900
9912081	1072.622	0	18,900	0	18,900
9912082	878.548	0	0	0	0
9912083	877.288	1,820	41,800	0	43,620
9911182	854.245	0	26,800	0	26,800
9911182	846.760	0	26,800	0	26,800
9911183	854.130	0	19,050	3,410	22,460
9911184	876.319	0	1,800	0	1,800
9911181	888.982	0	0	1,180	1,180
9912022	876.310	0	0	0	0
9912023	877.366	0	0	0	0
9912024	876.795	0	79,000	0	79,000
9912025	888.356	0	11,800	0	11,800
9912026	890.533	0	63,100	0	63,100

C. Available volume in the logging zone

Based on the inventory plots, the mean volume in the logging zone is 23,234 board feet per acre (standard deviation: 26,913). Given the 708 acres in the zone, the total available conifer volume (>11.6 inches DBH only) is 16,749,806 board feet.

D. Allowance for snags and coarse woody debris

Not all trees in the logging zone will be cut over the 200-year growth cycle. Some of the timber volume will be left on-site as snags, which will fall to the forest floor as coarse woody debris. For the purposes of sustained yield calculations, YWI assumed that 10% of the total volume would never be removed. Instead this wood would remain on-site to fulfill essential habitat, water storage and energy source services provided by dead and decaying logs.

E. Site Class and Anticipated Growth

Each location differs in its ability to grow trees over time. Soil, slope, rainfall and aspect all contribute to growth potential. Foresters have developed statistical tables (site class tables) for predicting future growth based on measured growth of free-grown young coniferous trees. "Free grown" means these trees were in full sunlight and experienced minimal competition from brush and other trees throughout their life to date.

Based on 153 sample points, the mean site class for the 'Inimim logging zone is 52.6 (standard deviation: 14.4). Based on yield tables for ponderosa pine (Arvola, 1978), the most abundant tree species in 'Inimim, 19,000 board feet of pine will grow on every acre over the 200 year life of the Forest Plan. When evaluated by management compartment, this anticipated growth yields an annual allowable cut 10% smaller than that derived by volume estimates. See Table 5-3 for detailed statistics by compartment.

Table 5-2: Site Index Data for Selected Inventory Plots

Plot	Species	DBH	Height	Age	Site Index
9911221	PSME	9.2	42	28	70
9911222	CADE	5.2	22	19	50
9911223	PSME	5.9	33	41	40
9911181	CADE	5.1	22	24	40
9911182	PSME	2.8	16	17	40
9911183	PSME	6.4	38	27	60
9911184	PSME	1	7	12	40
9911185	PIPO	10	43	37	50
9911186	PSME	15.7	72	77	50
9911241	PIPO	10.3	42	69	30
9911242	PIPO	12	60	64	50
9911244	PIPO	6.5	30	34	50
9911245	PIPO	7.9	53	51	50
9911246	PIPO	7.1	60	45	70
9912021	PIPO	7	39	44	50
9912022	PIPO	6.4	31	35	40
9912024	CADE	8.6	37	42	50
9912025	PIPO	9.5	47	27	90
9912026	PIPO	4.5	29	19	80
9912061	PSME	3.9	24	31	40
9912062	PSME	4.9	29	30	50
9912063	PSME	3.6	31	24	60
9912064	PSME	4	27	25	60

9912065	PSME	7.4	39	34	60
9912066	PIPO	4.9	28	27	50
9912081	PIPO	5.7	24	33	40
9912082	PIPO	4.5	17	31	30
9912083	CADE	5.9	26	37	30
Mean		**6.639286**	**34.57143**	**35.14286**	**52.59259**
Standard Deviation		**3.034534**	**14.4848**	**15.27698**	**14.38326**

Species Code	**Full Name**
PSME	Douglas Fir
PIPO	Ponderosa Pine
CADE	Incense Cedar

F. Sustained yield capacity by compartment

Table 5-3 displays the maximum allowable logging by compartment. These statistics are based on existing volume, and growth over time. For each compartment, the most conservative statistic will be used to ensure sustained yield. Based on a twenty –year return interval for logging, not more than 20 years growth or 20 year's worth of volume will be removed at any time. Under this system, not only will the 'Inimim Forest be managed sustainably, but *each compartment* will function as a sustained yield unit.

Table 5-3: Compartment Sustained Yield Statistics

Compartment	Harvest Decade	Acres	Board Feet						Growth over 200 Years	
			Total Conifer Volume	Volume for Snag/Log Replacement	Available Conifer Volume	Allowable Annual Cut	Decade Allowable Cut	Twenty Year Allowable Cut	Total	Annual Increment
1	4	9	209,646	20,965	188,681	943	9,430	18,860	171,000	855
2	5	11	256,234	25,623	230,611	1,153	11,530	23,060	209,000	1,045
3	5	22	512,468	51,247	461,221	2,306	23,060	46,120	418,000	2,090
4	5	23	535,762	53,576	482,186	2,410	24,100	48,200	437,000	2,185
5	3	26	605,644	60,564	545,080	2,725	27,250	54,500	494,000	2,470
6	2	23	535,762	53,576	482,186	2,410	24,100	48,200	437,000	2,185
7	4	21	489,174	48,917	440,257	2,201	22,010	44,020	399,000	1,995
8	4	17	395,998	39,600	356,398	1,781	17,810	35,620	323,000	1,615
9	4	25	582,350	58,235	524,115	2,620	26,200	52,400	475,000	2,375
10	1	16	372,704	37,270	335,434	1,677	16,770	33,540	304,000	1,520
11	3	16	372,704	37,270	335,434	1,677	16,770	33,540	304,000	1,520
12	4	28	652,232	65,223	587,009	2,935	29,350	58,700	532,000	2,660
13	3	31	722,114	72,211	649,903	3,249	32,490	64,980	589,000	2,945
14	3	24	559,056	55,906	503,150	2,515	25,150	50,300	456,000	2,280
15	5	13	302,822	30,282	272,540	1,362	13,620	27,240	247,000	1,235
16	2	31	722,114	72,211	649,903	3,249	32,490	64,980	589,000	2,945
17	1	49	1,141,406	114,141	1,027,265	5,136	51,360	102,720	931,000	4,655

18	5	2	46,588	4,659	41,929	209	2,090	4,180	38,000	190
19	4	28	652,232	65,223	587,009	2,935	29,350	58,700	532,000	2,660
20	5	7	163,058	16,306	146,752	733	7,330	14,660	133,000	665
21	5	27	628,938	62,894	566,044	2,830	28,300	56,600	513,000	2,565
22	4	6	139,764	13,976	125,788	628	6,280	12,560	114,000	570
23	4	42	978,348	97,835	880,513	4,402	44,020	88,040	798,000	3,990
24	5	24	559,056	55,906	503,150	2,515	25,150	50,300	456,000	2,280
25	5	28	652,232	65,223	587,009	2,935	29,350	58,700	532,000	2,660
26	5	20	465,880	46,588	419,292	2,096	20,960	41,920	380,000	1,900
27	5	17	395,998	39,600	356,398	1,781	17,810	35,620	323,000	1,615
28	1	31	722,114	72,211	649,903	3,249	32,490	64,980	589,000	2,945
29	4	35	815,290	81,529	733,761	3,668	36,680	73,360	665,000	3,325
30	2	19	442,586	44,259	398,327	1,991	19,910	39,820	361,000	1,805
31	4	10	232,940	23,294	209,646	1,048	10,480	20,960	190,000	950
31	4	3	69,882	6,988	62,894	314	3,140	6,280	57,000	285
32	5	20	465,880	46,588	419,292	2,096	20,960	41,920	380,000	1,900
33	2	4	93,176	9,318	83,858	419	4,190	8,380	76,000	380
All		**708**	**16,492,152**	**1,649,215**	**14,842,937**	**74,198**	**741,980**	**1,483,960**	**13,452,000**	**67,260**

G. References

Arvola, T.F. 1978. *California Forestry Handbook* (State of California, The Resources Agency, Department of Forestry and Fire Protection)

Chapter 6: Prescribed fire/fuels reduction plan

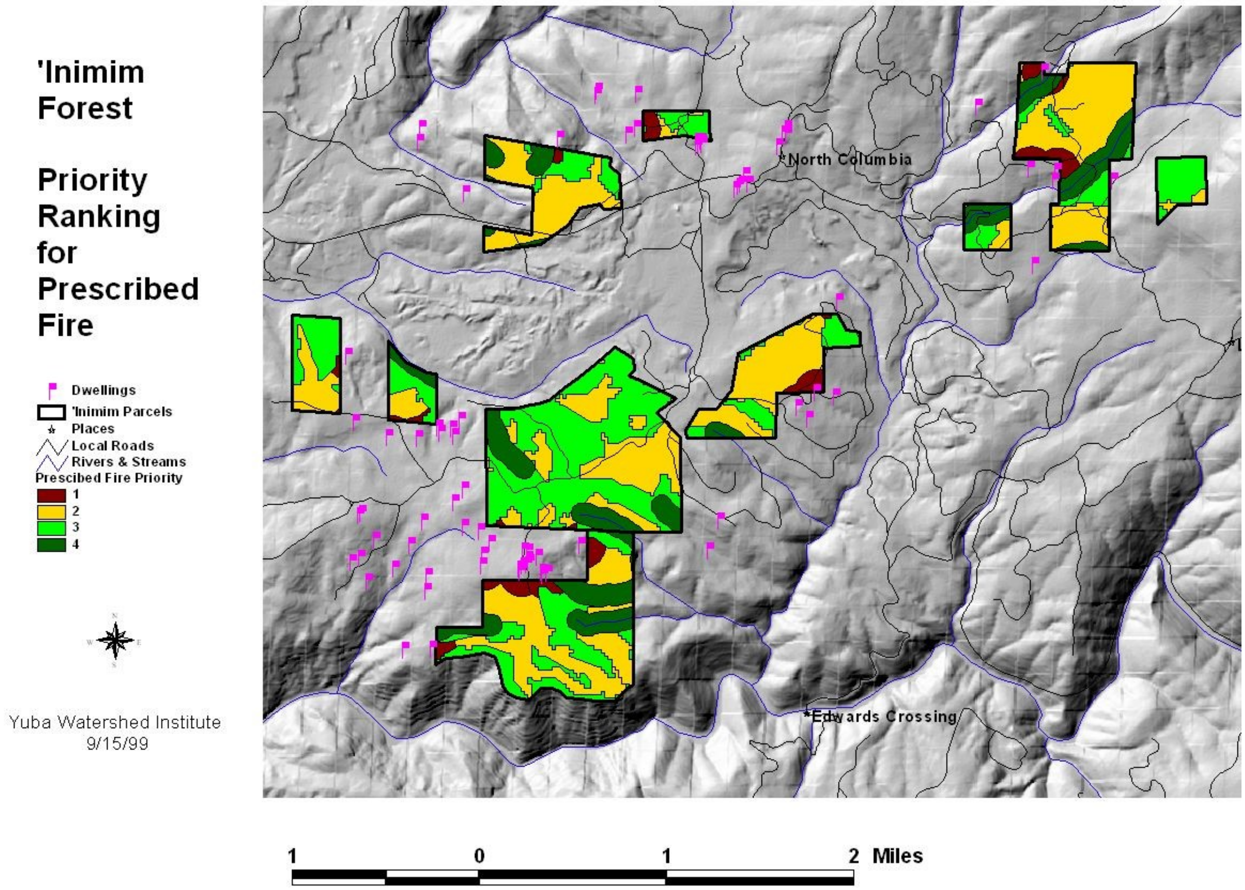


Figure 6-1

A. Prioritization process

The ‘Inimim fuels reduction plan is strategic. It focuses activities on the most flammable vegetation types first. Within these types, stands within 200 meters of human habitation receive the highest priority.

To prioritize for fuels reduction, YWI considered proximity to perennial streams, slope, aspect, topographic position (relative placement of each site in relation to ridge tops and stream bottoms), potential natural vegetation, location of old growth and near old-growth stands, and proximity to dwellings and improvements. The zone within 300 feet on either side of perennial streams is the lowest priority (rank 4) for fuels reduction. Closed canopy (>80% total canopy) old-growth and near old-growth forests on north and east facing sloping slopes are also rank 4. Rank 4 forests are the most likely to survive catastrophic fire without any treatment. Rank 3 forests, the second lowest priority, grow on north facing and highly productive soils where Douglas Fir will dominate the overstory over time. These stands naturally burned less frequently and are at lower risk of fire ignition in most circumstances. Rank 2 forests are south and west facing slopes and less productive soils where ponderosa pine will dominate the overstory over time. Most of these stands have a highly flammable forest floor of kitkitdizee (*Chamaebatia foliosa*), manzanita (*Arctostaphylos viscida*), and ponderosa pine needles. Rank 1 forests are the same, but within 200 meters of human habitation or structures.

B. Coordination with logging and mastication

Fuels reduction is the primary goal of the prescribed fire plan. Accordingly, wherever practical, mastication will be used in lieu of fire. Mastication will be scheduled using the same strategic fuels reduction plan. The only exception from the plan will be logging. Depending on fuels loading in the forests scheduled for logging, the annual fuels efforts may be wholly or partially shifted to these lands. However, such exceptions will only occur once every 5 or 10 years, as only then will logging take place on the 'Inimim (See chapter 5 for details.) Fuels reduction through prescribed fire and mastication will be performed every year.

C. Fifty year prescribed fire/mastication plan

Figure 6-1 displays the fuels reduction prioritization for the 'Inimim Forest. Each zone will be subject to fuels treatment, but at greatly differing initial treatment and fire or mastication return times. All priority 1 lands will be treated in the first decade, and then once per decade for the life of the plan. Priority two lands will all be treated by the end of decade two. Afterwards, treatment will return to these lands once per 15 to 20 years. Priority 3 lands will be treated by decade three, and only once in the life of the plan. Priority 4 lands require special treatment before burning, such as hand removal of built-up fuels at the base of old-growth coniferous trees. These lands will only be treated as funds and community volunteer time allow.

Table 6-A: Spatial Extent of Fuels Reduction Priority Classes

Priority	Acres
1	79
2	781
3	630
4	265
All	1756

Chapter 7: Community outreach

Instructor JoAnn Hild and Sierra College Class Bio-14 students volunteer on the 'Inimim watershed assessment

A. Community Involvement in Developing Implementation Plan

Over 45 local people, staff of state and federal agencies, college students, independent scientists, instructors with Sierra Community College and the researchers at the University of California, Davis, donated their time to the implementation plan project. Many agency staff helped repeatedly, providing supplies, consultation, field time and office/laboratory support. The campuses and staff at the Sierra Community College Nevada County Campus, and Nevada Union High School provided access to laboratories, supplies, and equipment. Staff from the Nevada County Resources Conservation District, CA Department of Fish and Game, CA Department of Parks and Recreation, USDA Forest Service and Bureau of Land Management provided repeated assistance to the project. They worked tirelessly in the field, loaned equipment, and provided professional consultation to YWI staff.

B. Public Meeting

A public meeting was held to solicit public input on the draft implementation plan. The meeting occurred at the North Columbia Schoolhouse Cultural Center on March 14, 2000. This provided local residents with an opportunity to review all maps and detailed planning assumptions.

On Saturday, September 4, 1999, YWI held a field day. YWI assembled a group of interested residents at the San Juan Ridge Volunteer Fire District Station #3. Staff took the group into three regions of the 'Inimim to discuss how different forest types and management groups would be treated. As a result of these meetings, some minor adjustments were made in the implementation plan (some compartments were eliminated, and the logging schedule altered in some decades, but the plan remains largely unchanged.