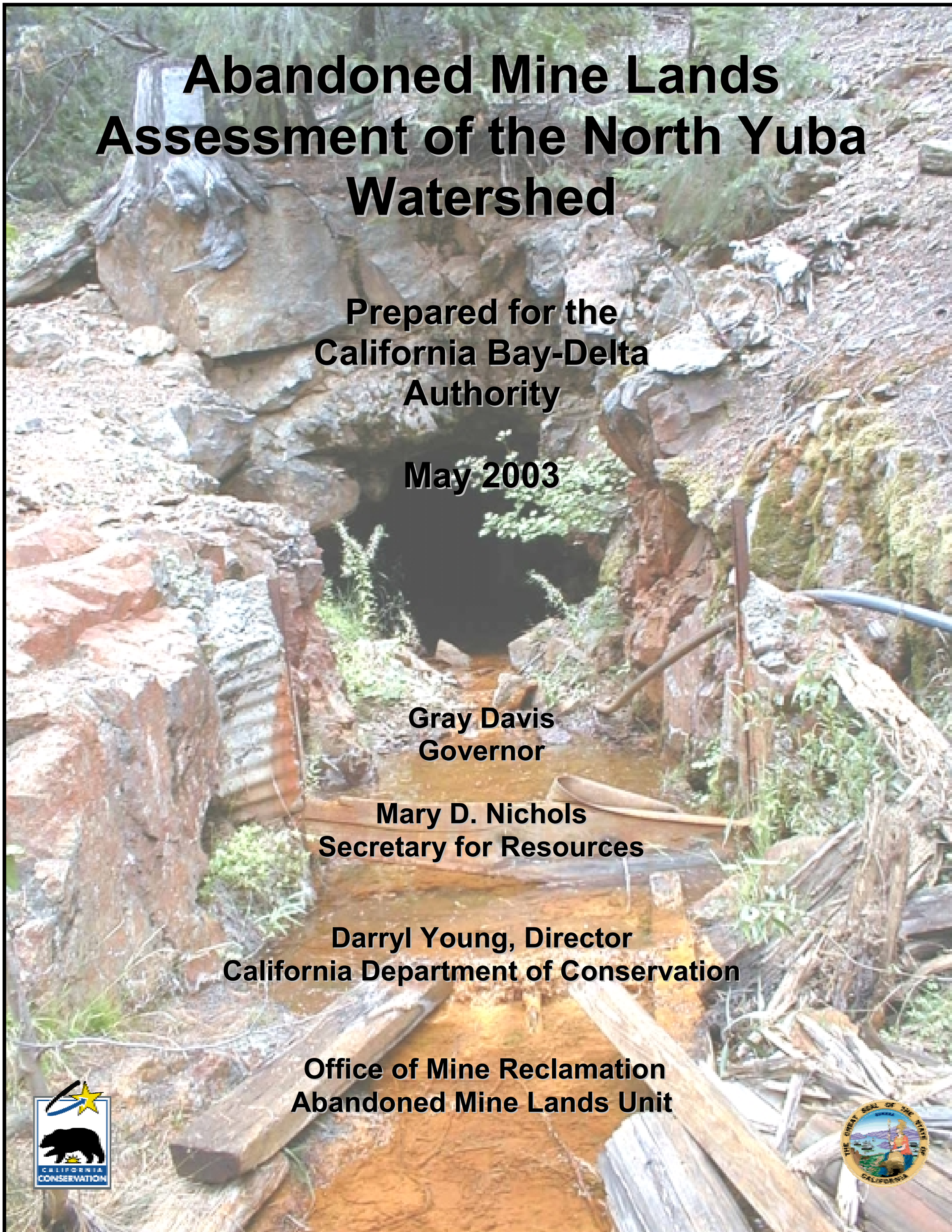

Abandoned Mine Lands Assessment of the North Yuba Watershed

Prepared for the
California Bay-Delta
Authority

May 2003

Gray Davis
Governor

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Table of Contents

Tables

Figures

Photos

Cover: Horizontal opening at the Queen City Mine, Sierra County, California. (September, 2001)

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Acknowledgements

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I. Introduction

A. Purpose and Scope

At the request of the California Bay-Delta Authority, the Department of Conservation, Office of Mine Reclamation, Abandoned Mine Lands Unit (AMLU) conducted an assessment of the extent and nature of abandoned mine lands (AML) within the North Yuba Watershed. The assessment involved approximately 60 days of fieldwork to visit 128 mine sites. The data gathered during fieldwork was combined with historical and modern literature research to form the North Yuba Watershed Database. The mine sites were ranked based on the chemical hazards present and on the results of a limited soil study.

B. Mining History

The North Yuba Watershed was a very important and productive gold mining region, playing a central role in the California Gold Rush of 1849. One of the first gold discovery parties to arrive in this region was lead by William Downie, after whom the town of Downieville was named. Mining districts were quickly organized with fixed claims of "30 feet per man" (Clark 1998). Many rich strikes were made, and the population of the area soared to more than 5,000 by 1851.

Surface placer deposits in this watershed were mined intensively, including in-stream mining of gravel bars in the North Yuba and its tributaries. This was followed by extensive hydraulic operations throughout the watershed, the most notable being Howland Flat, La Porte, Poverty Hill, Port Wine, Morristown, Chip's Flat, Scales and Eureka. These hydraulic mines were worked steadily from the 1850s until WWII. Drift placer mining developed around the same time as hydraulic mining. The Ruby mine was one of the major drift placer mines in the watershed.

Lode gold mining in the watershed began in 1853. The most productive lode gold districts were Downieville and Sierra City. Major lode gold mines included the Sierra Buttes and Brush Creek. Lode gold production in the watershed peaked in 1922, but several lode gold operations continued production of commercial quantities well into the 1960s. In 1942, War Production Board Order L-208 closed most of the mines in the watershed. Some mines resumed operations after the war but at a much smaller scale than before. By the 1950s, there were only 15 lode gold mines still in operation (DMG Vol. 52).

The North Yuba Watershed has 15 distinct mining districts: Brandy City, Camptonville, Clipper Mills, Downieville, Eureka, Furnier, Gibsonville, Gold Valley, Goodyears Bar, Indian Hill, La Porte, Poker Flat, Port Wine, Poverty Hill and Sierra City. The most productive were the La Porte, Sierra City, Downieville and Poker Flat districts (Clark 1998). The La Porte District produced more than $60 million in placer gold, mostly by hydraulic mining, from 1855 to 1871 (dollar values for gold production in this report are historical and based on citations in the Report of the State Mineralogist). Drift and lode gold mining remained commercially profitable and continued there until 1918. The Sierra City District was extremely productive from 1870 to 1914. Estimates of gold output in this district total more than $30 million. The Sierra Buttes Mine was reported to have produced over $17 million in gold alone. The Poker Flat District was heavily mined by hydraulic operations until the 1880s. Howland Flat, one of the largest hydraulic mines in the watershed, is estimated to have produced $14 million. The

Downieville District is famous, not only for being the first mining district established in this watershed, but for the sheer volume and size of gold nuggets recovered from the placer deposits during the early months of the Gold Rush. The Port Wine and Poverty Hill districts were characterized by extensive hydraulic and drift mining.

Only a few mines remain active in the North Yuba Watershed today. These operations include aggregate as well as gold mines.

II. Executive Summary

During the summer and fall of 2001, the Department of Conservation, under contract with the California Bay-Delta Authority, performed an abandoned mine lands assessment of the North Yuba Watershed. This watershed was selected because it ranked highest for potential impacts from historic mining activity within the Bay-Delta Watershed (see Appendix).

The abandoned mine lands assessment involved the collection and analysis of data from 128 mine sites in the North Yuba Watershed. Two-person crews visited each site, gathering accurate location data and noting the physical layout and current conditions of each mine feature. Where appropriate, soil samples were taken and basic water tests performed. Due to time and budget constraints, as well as private property access limitations, not all of the mine sites within the watershed were visited.

Information gathered at the mine sites was combined with laboratory results for soil samples and added to the Department's abandoned mine lands database. Using a Preliminary Appraisal and Ranking (PAR) Model, the Department evaluated the impacts that each site may pose to human health and the environment and assigned individual PAR scores to each mine site.

Two priority lists were then developed, one based on chemical PAR scores and the other based on a combination of chemical PAR scores and soil sample data. The first priority list identified 23 mine sites with high or very high chemical PAR scores. The second priority list, which was limited to sites where soil samples were taken, revealed 10 mine sites with high or very high combined scores. A map showing the location and PAR score ranking of each mine site was prepared for both priority lists.

These priority lists and the data on which they are based may serve as useful starting points for those interested in reclaiming abandoned mine lands in the North Yuba Watershed. Full characterizations of the sites that rank highest on these two lists would help determine the need for, and the most suitable approaches to, their reclamation. Next steps might also include completing the abandoned mine inventory for this watershed and developing a sampling program to determine the extent to which mined material may be affecting water quality.

III. Study

A. Study Area Description

1. General

The North Yuba Watershed is located in the northern Sierra Nevada mountain range. It lies mostly within Sierra County. A sizable portion extends into Yuba County to the west and the northern side pushes into Plumas County. A very small portion of the northwestern side reaches into Butte County (Figure 1). The watershed is approximately 40 miles long and 18 miles wide with a total area of 490 square miles. Elevation varies greatly within the watershed. The New Bullards Bar Dam in the southwest is the lowest point at 1,250 feet and the Sierra Buttes rise to roughly 8,600 feet in the east. Highway 49 provides access in the southern half of the watershed while the main route in the north is the Quincy La Porte Road. Much of the watershed can only be accessed by dirt road. The watershed area is sparsely populated (there are less than 1,000 residents located between Downieville, Sierra City, and La Porte) with the bulk of the population centered along Highway 49 in Downieville and Sierra City.

The watershed drains an area of 127,116 hectares (314,106 acres) from the crest of the Sierra westward to New Bullards Bar Dam. It contains four hydrologic subareas, which are presented below in Table 1 and displayed in Figure 2.

Table 1: Summary Statistics for Hydrologic Areas in the North Yuba Watershed

Hydrologic Region	Hydrologic Unit	Hydrologic Area	Hydrologic Subarea	Acres	Hectares
Sacramento River	Yuba River	North Yuba	Slate Creek	39,354	15,926.2
Sacramento River	Yuba River	North Yuba	Goodyears Bar	131,998	53,418.3
Sacramento River	Yuba River	North Yuba	Sierra City	90,479	36,615.9
Sacramento River	Yuba River	North Yuba	Bullards Bar	52,275	21,155.2
			Totals:	**314,106**	**127,116**

Land ownership is summarized in Table 2, below. More than 76% of the watershed is owned by two federal agencies: the United States Forest Service (USFS) and the Bureau of Land Management (BLM). The Tahoe National Forest comprises 78% and Plumas National Forest comprises 22% of the USFS lands. About 23% of the watershed is privately held land. Less than 1% of the total area in this watershed is owned by state agencies, mainly the Department of Parks and Recreation and the State Lands Commission (Figure 1).

Table 2: Land Ownership Summary for the North Yuba Watershed

Ownership	Government Agency	Acres	Percent
Federal	US Forest Service	241,114	76.76
	Bureau of Land Management	18	0.01
	Subtotal	**241,132**	**76.77**
State	Parks and Recreation	46	0.01
	State Lands Commission	17	0.01
	Subtotal	**63**	**0.02**
Private		72,911	23.21
	Grand Total	**314,106**	**100.00**

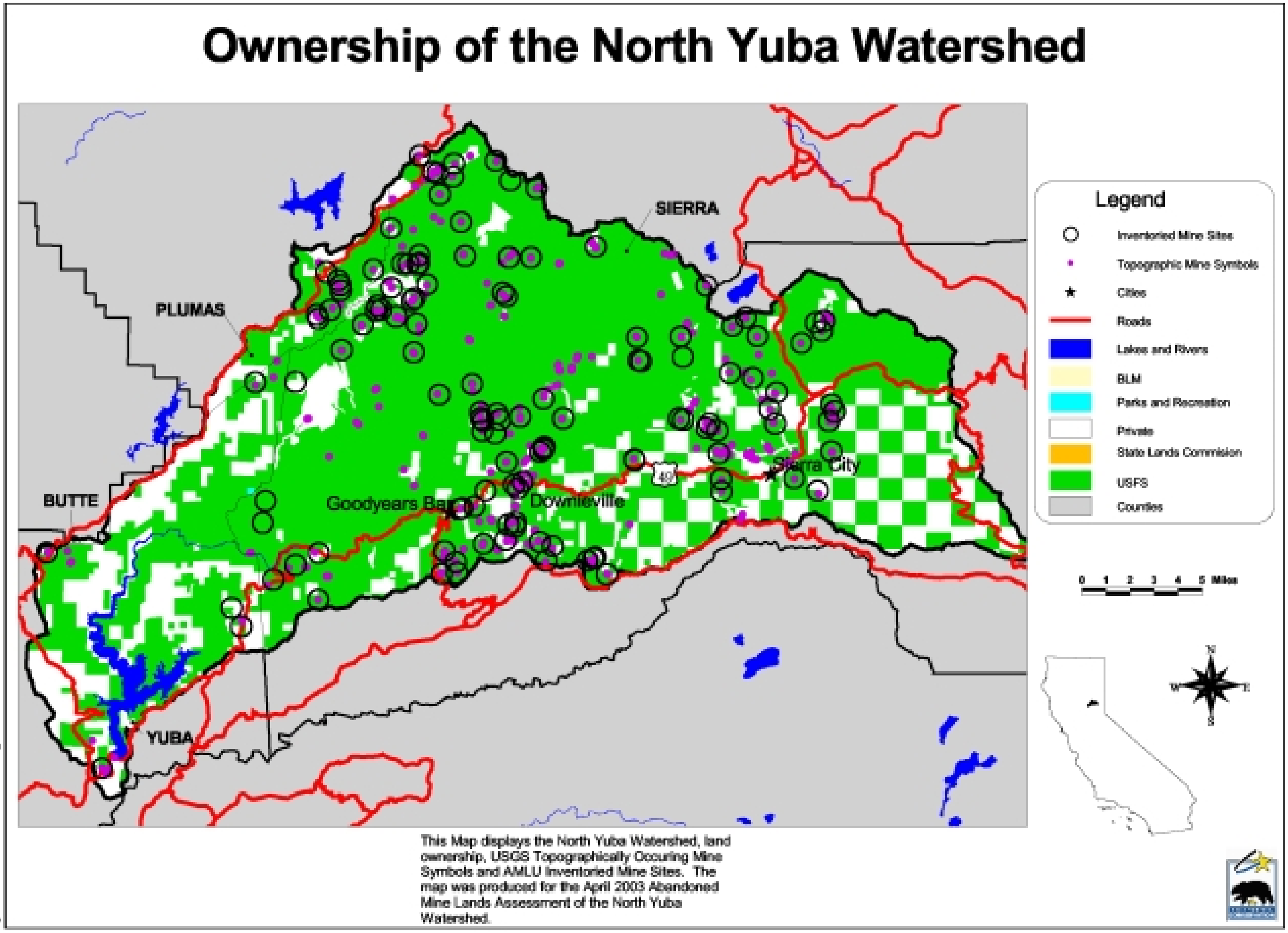


Figure 1: Ownership of the North Yuba Watershed

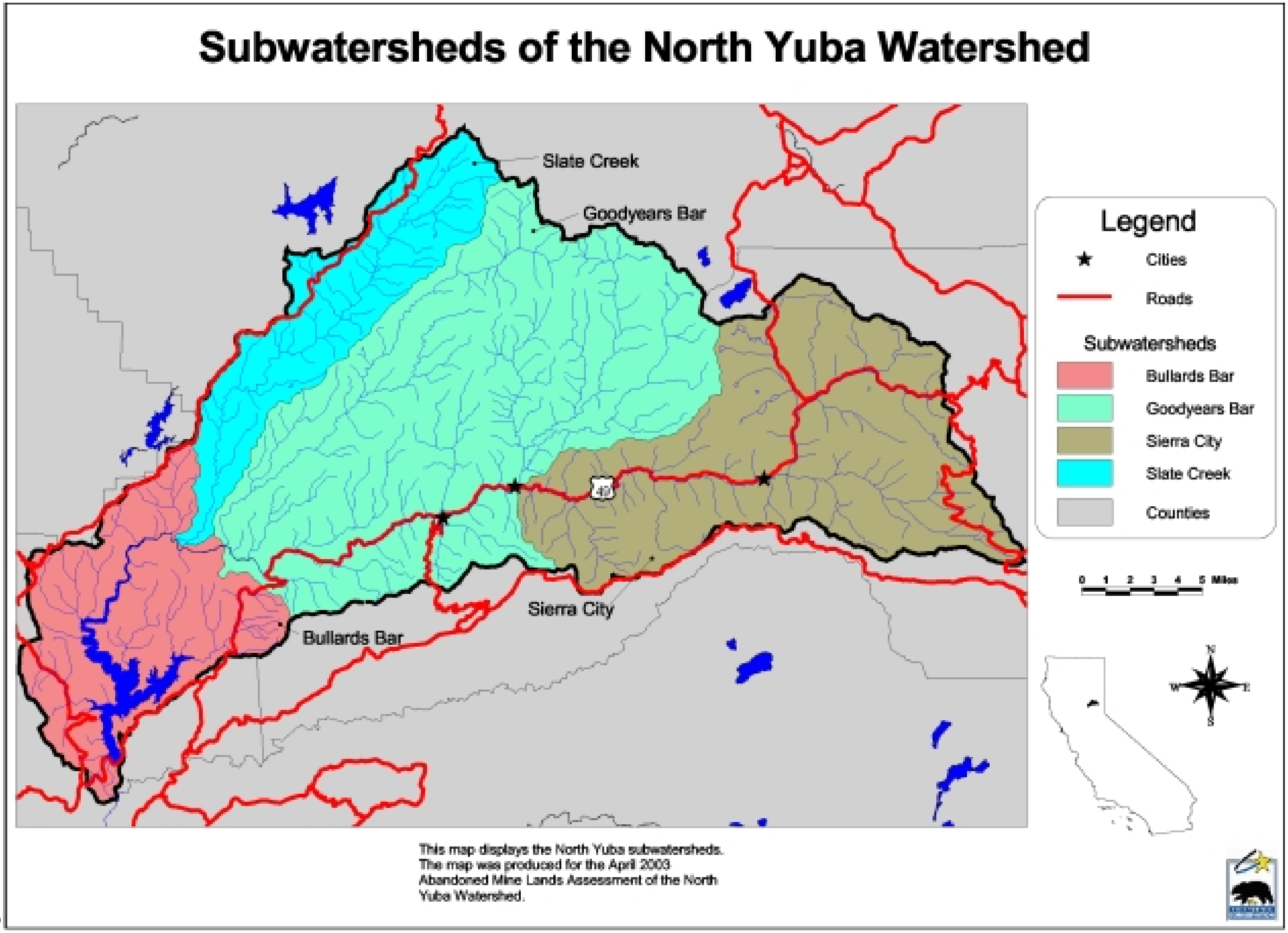


Figure 2: Subwatersheds of the North Yuba Watershed

2. *Climate and Vegetation*

The North Yuba watershed is characterized by cool, wet winters and hot, dry summers with occasional high elevation thundershowers. Annual precipitation ranges from 25 to 85 inches, increasing with elevation due to orographic lift. Precipitation is mostly in the form of rain below 3,500 feet while the snow line generally falls around 5,000 feet, with accumulations of ten to twenty feet not uncommon. Many areas at this elevation are inaccessible between November and May due to the heavy snow pack.

The watershed is part of the Northern Sierra Nevada Mountain Range Ecoregion (Hickman 1993) and includes several plant communities. With a lack of protected areas, such as parks or preserves, most of this watershed has been heavily affected by logging and is either second or third growth forest, with very little old growth left.

In the lowest elevations is the Foothill Woodland zone, unique to California and dominated by Blue Oak, Interior Live Oak, and Gray (Foothill) Pine, with Canyon Live Oak, California Buckeye and Pacific Madrone more prevalent on canyon slopes. These are species adapted to the long, dry summers typical of the foothills of the Sierra. The vegetation found in the canyons at these elevations is largely determined by slope aspect, with south facing slopes dominated by live oak and scrub, while north facing slopes include more conifers, even Douglas Fir in the shadier spots. Riparian vegetation consists of Cottonwood, White Alder and Bigleaf Maple, with an understory of Blackberry and Oregon Grape most common.

Above elevations of 2,000 and 3,000 is the Mixed Conifer Forest, a collective term for stands with varying mixes of Ponderosa Pine, Sugar Pine, Incense-cedar, Douglas Fir, and, at the higher elevations of this zone, White Fir. Due to decades of fire suppression, much of the vegetation found at these elevations is unnaturally thick, with many small, shade-tolerant species crowding together. Other trees found in this zone include Pacific Madrone, Black Oak and Pacific Dogwood. At elevations below 4,000 feet, Poison Oak is a prevalent component of the understory. At lower elevations, these forests may form a mosaic with species associated with the foothill woodlands and chaparrals, while at the higher elevations a mosaic may occur with forests of the Lodgepole Pine and Red Fir series.

3. *Geology*

The North Yuba Watershed is contained within the Northern Sierra Nevada geologic province. This watershed is comprised mainly of metamorphic rocks of the Western Sierra Nevada Metamorphic Belt, with smaller amounts of volcanic and granitic rocks (Figure 3). The Western Sierra Nevada Metamorphic Belt is comprised of four smaller belts, each trending roughly north-south and separated from each other by steeply dipping faults. These smaller belts are the Western, Central, Feather River, and Eastern Belts.

The western half of the watershed lies in the Western and Central Belts and is primarily volcanic and metavolcanic rocks of Paleozoic and Mesozoic age. The Feather River Belt traverses the center of the watershed. This is a narrow zone of ultramafic Cenozoic rocks, chiefly serpentinite with lesser amounts of peridotite and gabbro. The majority of the eastern half of the watershed is marine sedimentary rocks of the Eastern Belt. Significant amounts of volcanic and metavolcanic rocks of Mesozoic to Paleozoic age are also present near the eastern edge of the watershed, and there are some glacial deposits in the higher elevations near the Sierra Buttes. Significant amounts of Mesozoic granitic rocks and Tertiary volcanic rocks (mainly mudflow and pyroclastic deposits) are present throughout the watershed. These Tertiary volcanic rocks buried portions of the ancestral Yuba River channel, preserving the auriferous gravels until they were mined hydraulically in the late 1800s.

B. Data Collection

1. Watershed Selection

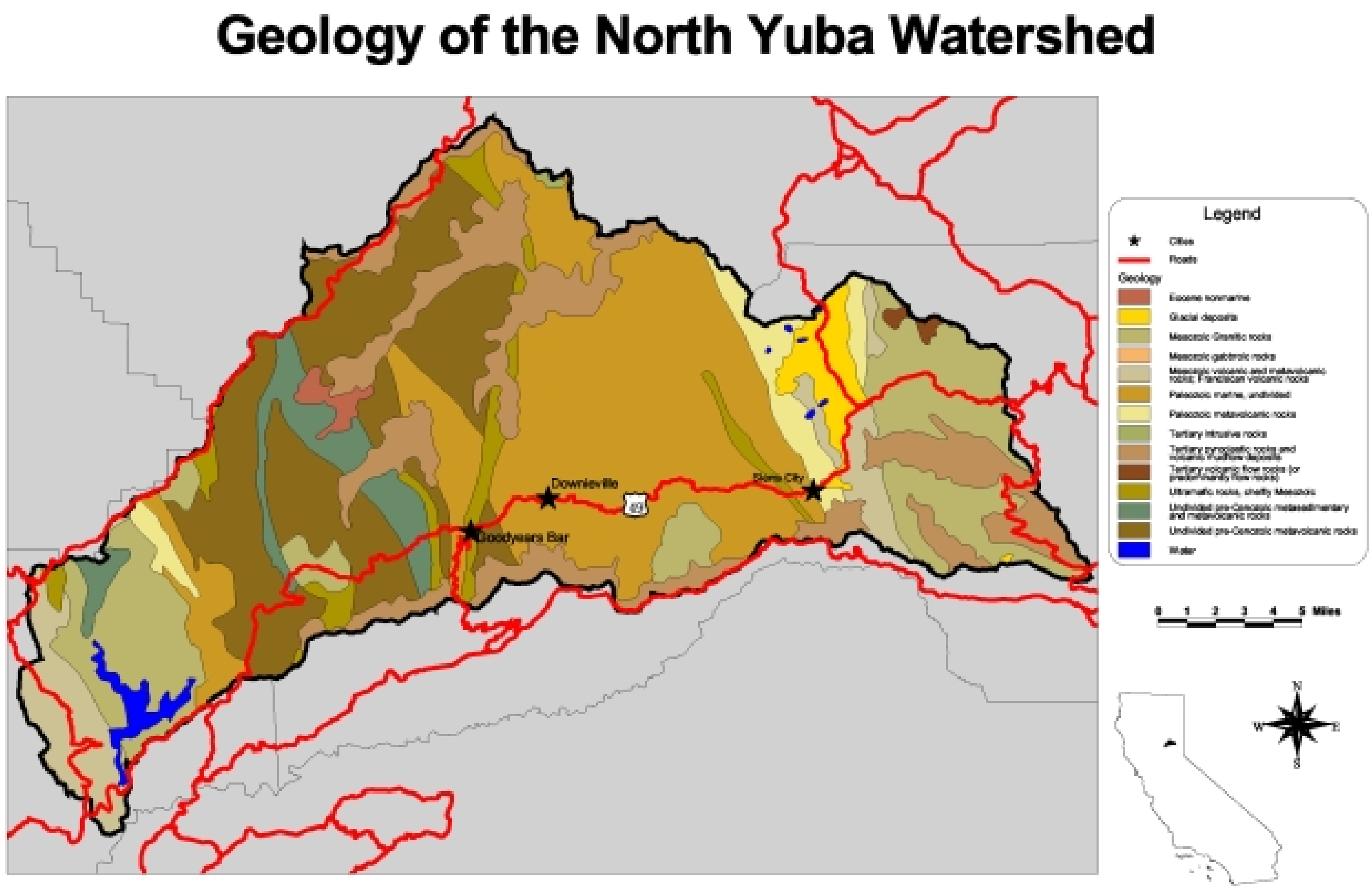
The North Yuba Watershed was selected as a priority watershed based on the results of the watershed-ranking model described in the appendix to this report.

2. Sample Design

This assessment of the North Yuba Watershed is based on the attempted visitation of at least 100 mine sites in the watershed. This minimum number was stipulated in the contract between the California Bay-Delta Authority and the Department of Conservation. One hundred twenty eight mine sites were visited for this contract.

Mine symbols from 7.5 minute USGS topographical maps were used as the population to be sampled. Previous work in other watersheds has shown that this data most accurately represents the actual mine sites and locations that are present in a given geographic area (DOC 2000). Initially, an effort was made to visit sites that correlated with Principle Areas Of Mine Pollution (PAMP) sites, but private property access issues made this approach impracticable.

There are 400 mine symbols present on the USGS topographical maps for this watershed. Twenty of these symbols (5%) were not cataloged because they appeared to be on or near active mine sites. Visits to twenty-one of these symbols (5%) were attempted but no significant features were found. Sites corresponding to two hundred twenty-one of these symbols (55%) were visited and cataloged. Visits to one hundred thirty-eight of these symbols (35%) were not completed due to lack of access and time. The steep and heavily vegetated terrain, as well as the lack of roads or trails, rendered some sites inaccessible.



This map displays the geologic units of the North Yuba Watershed. The map was produced for the April 2003 Abandoned Mine Lands Assessment of the North Yuba Watershed.

Figure 3: Geology of the North Yuba Watershed

3. <u>Data Acquisition</u>

Prior to the start of fieldwork, sites to be visited were compared to historic mine literature. Such documents provide useful information regarding the commodity mined, extent of workings, processing methods, and other data that aids in the interpretation of the sites as they exist today. During field investigations, data were collected on the location, character, and condition of mine features. Basic screening parameters of pH, electrical conductivity, oxidation-reduction potential, and temperature were collected at on-site water sources. The location of each mine feature and sampling locality was recorded with a global positioning system (GPS) to an accuracy of 10 meters or less.

For underground mines, grab soil samples were taken from all tailings dumps and fine-grained waste rock dumps. Dumps with varied physical characteristics required samples from each discrete unit of the dump material. For hydraulic operations, all fine-grained tailings were sampled along with sediments in the bottom of watercourses down gradient of probable sluice locations.

All soil samples were collected using the same methodology. The top one to two inches of soil material was discarded and only the material deeper than one inch was bagged in "Whirl-Pack" bags to be tested. The bags were filled one-half to three-quarters full (when possible), then sealed and placed inside a second identical bag. A GPS device was used to record the precise location of each sample taken. The unique file name generated by the GPS device was used to identify and track the samples during shipping and processing.

C. Data Analysis

1. <u>Soil Sample Analysis Methodology</u>

Soil samples collected in the field were shipped to CLS Labs in Rancho Cordova, California, for processing. The samples were air dried and sieved to a particle size of 1.0 millimeter (mm). The prepared samples were analyzed for arsenic, lead and mercury using the EPA 60-10 (ICP) and EPA 74-71 (cold vapor test) methods. CLS Labs generated a report with the results of the chemical analysis. The results are shown below in Table 3.

Table 3: Summary of Soil Sample Analysis Results

OMR_ID	GIS_ID	Mine Name	Arsenic (ppm)	Mercury (ppm)	Lead (ppm)
322012	S080818B2001SPC1	Barnard Diggings	5.8	nd	17
462044	R071718F2001MFT1	Big Bolder	1.8	nd	7.3
462044	R071719C2001MFT1	Big Bolder	1.6	nd	12
462190	R072420Z2001MFT1	Brandy City Diggings	3.3	nd	6.5
462248	J091916A2001SER1	California	1.4	0.9	15
462248	J091917A2001SER1	California	4	0.58	11
322015	A105261A2002AML1	Claybank	4.7	0.29	29
462057	A105249A2002AML1	Clippership	nd	nd	10
462059	R071817D2001MFT1	Columbo	53	nd	22
462234	A105266A2002AML1	Davis Motor	36	0.14	38

OMR_ID	GIS_ID	Mine Name	Arsenic (ppm)	Mercury (ppm)	Lead (ppm)
462234	S081017D2001SPC1	Davis Motor	5.6	0.31	1,000
462234	S081018D2001SPC1	Davis Motor	1.4	0.11	16
462036	A105256A2002AML1	Hilda	5.2	nd	15
462036	A105257A2002AML1	Hilda	8.3	nd	12
462036	A105258A2002AML1	Hilda	1.6	nd	11
462036	A105259A2002AML1	Hilda	2.6	nd	9.2
462036	A105260A2002AML1	Hilda	15	nd	15
462206	R062920C2001JXM1	Indian Hill	4.2	5	20
462116	R062520E2001JXM1	Ironsides	130	47	590
462062	R071623C2001MFT1	Keystone	80	0.34	42
462269	R072700Z2001MFT1	Lower Brush Creek	670	nd	30
462250	A105252A2002AML1	Lucky Hill	3.2	0.38	21
462250	A105253A2002AML1	Lucky Hill	6.5	0.68	26
462067	R071820G2001MFT1	Monarch	310	0.13	23
462239	A105250A2002AML1	Mountain Boy	2.7	Nd	12
462239	J091720B2001SER1	Mountain Boy	2.5	0.19	13
462239	J091720C2001SER1	Mountain Boy	4.9	nd	14
462050	R071722A2001MFT1	Oakland Pond	9.5	0.46	32
322009	S080716A2001SPC1	Onion Valley	nd	0.15	11
462237	J091816B2001SER1	Pacific	6.8	0.31	140
322011	A105267A2002AML1	Secret Diggings	1.5	nd	9.5
322011	S080717F2001SPC1	Secret Diggings	nd	nd	10
322011	S080717G2001SPC1	Secret Diggings	1.2	nd	20
322011	S080719A2001SPC1	Secret Diggings	1.4	nd	80
322011	S080719E2001SPC1	Secret Diggings	2.8	0.3	9.2
322011	S080721B2001SPC1	Secret Diggings	2.9	0.53	11
322014	A105263A2002AML1	Spanish Flat	5	0.66	13
322014	A105264A2002AML1	Spanish Flat	1.5	nd	14
322014	A105265A2002AML1	Spanish Flat	7.5	0.21	15
462241	A105269A2002AML1	Union-Keystone	600	0.63	130
462183	R062718A2001MFT1	Unknown	10	0.33	24
462183	R062718B2001MFT1	Unknown	2.4	0.2	14
462227	J073123B2001JXM1	Unknown	12	0.6	25
462227	J073123D2001JXM1	Unknown	5	0.1	14
322017	A105262A2002AML1	Upper Dutch Diggings	4.4	nd	12

nd=not detected

2. ***Summary of Key Data***

Field and categorical (literature search) data were evaluated using the AMLU-developed Preliminary Appraisal and Ranking (PAR) model. The PAR model evaluates the potential impacts that each site poses to human health and the environment. It assigns values to ranges of numerical and categorical data and then evaluates a mine site via a series of matrices. In addition, it separately evaluates exposure potential, chemical hazards, and physical hazards. The sum of these evaluations generate an overall PAR score for a mine site. Table 4 below summarizes the key data for the 128 localities that were cataloged.

Table 4: Summary of Key Data for Inventoried Mine Sites

Mine Name	Comm-odity	Operation type	Physical PAR Score	Chemical PAR Score	Total PAR Score	Number of Openings	Tailings (Cubic Yards)	Waste (Cubic Yards)
1001	Gold	Dredge, Underground,Hydraulic	1,114	328	1,442	1	0 - 50	500 - 1,000
Alpha	Gold	Placer, Processing Plant/Mill, Underground	1,724	33	1,757	2	0 - 50	0 – 50
Argus Placer	Gold	Pit/Quarry, Placer, Processing Plant/Mill, Underground	544	4,648	5,192	1	1,000 - 10,000	1,000 - 10,000
Arizona	Gold	Placer, Underground	1,354	475	1,829	3	0 - 50	1,000 - 10,000
Australia	Gold	Underground	846	46	892	2	0 - 50	0 – 50
Barnard Diggins	Gold	Hydraulic	584	587	1,171	0	50 - 250	500 - 1,000
Bellevue	Gold	Pit/Quarry	694	478	1,172	0	0 - 50	1,000 - 10,000
Big Boulder	Gold	Placer, Underground,Processing Plant/Mill	1,024	6,033	7,057	2	10,000 - 100,000	0 – 50
Borrow Pit	Sand and Gravel	Pit/Quarry	284	40	324	0	0 - 50	0 – 50
Brandy City Diggings	Gold	Hydraulic, Underground	3,554	10,052	13,606	1	>100,000	>100,000
Buffalo	Gold	Underground	34	41	75	0	0 - 50	0 – 50
Bunker Hill	Gold	Underground	324	5,729	6,053	3	250 - 500	250 - 500
Caledonia	Gold	Hydraulic	606	653	1,259	0	0 - 50	1,000 - 10,000
California	Gold	Hydraulic, Underground	1,504	3,062	4,566	1	0 - 50	10,000 - 100,000
City of Six	Gold	Pit/Quarry, Placer, Underground	974	456	1,430	1	0 - 50	1,000 - 10,000
Claybank	Gold	Hydraulic	354	178	532	0	0 - 50	250 - 500
Clippership	Gold	Hydraulic	384	2,650	3,034	0	0 - 50	1,000 - 10,000
Columbo	Gold	Processing Plant/Mill	664	6,339	7,003	2	10,000 - 100,000	500 - 1,000
Comet	Gold	Underground	1,244	10,051	11,295	3	>100,000	>100,000
Cometose	Gold	Underground	544	104	648	1	0 - 50	50 – 250
Craigs Flat	Gold	Hydraulic	894	4,652	5,546	0	1,000 - 10,000	1,000 - 10,000
Davis Motor	Gold	Hydraulic, Underground	514	108	622	2	0 - 50	50 – 250

Mine Name	Comm-odity	Operation type	Physical PAR Score	Chemical PAR Score	Total PAR Score	Number of Openings	Tailings (Cubic Yards)	Waste (Cubic Yards)
Mine								
Depot Hill	Gold	Hydraulic	2,084	4,640	6,724	4	1,000 - 10,000	1,000 - 10,000
Empire	Gold	Processing Plant/Mill, Underground	2,204	1,631	3,835	5	250 - 500	50 – 250
Eureka Diggings	Gold	Placer	1,664	2,336	4,000		500 - 1,000	500 - 1,000
Excelsior	Gold	Hydraulic	144	4,640	4,784	0	1,000 - 10,000	1,000 - 10,000
Garabaldi	Gold	Underground	419	25	444	1		
Gold Point	Gold	Processing Plant/Mill, Underground	664	1,748	2,412	1	250 - 500	250 - 500
Golden Hub	Unknown	Underground	1,254	1,591	2,845	2	0 - 50	250 - 500
Golden Scepter	Gold	Underground, Mineral Location/Prospect	494	5,633	6,127	1	0 - 50	0 – 50
Hilda	Gold	Placer, Underground	1,514	235	1,749	2	0 - 50	250 - 500
Holly Peak	Gold	Hydraulic	484	2,350	2,834	0	500 - 1,000	500 - 1,000
Independence	Gold	Hydraulic	206	108	314	0	0 - 50	50 – 250
Indian Hill	Gold	Hydraulic, Placer, Processing Plant/Mill	5,684	7,054	12,738	3	10,000 - 100,000	10,000 - 100,000
Ironsides	Gold	Processing Plant/Mill, Underground	1,004	41	1,045	2	0 - 50	0 – 50
Isabel Placer	Gold	Pit/Quarry, Underground	634	44	678	1	0 - 50	0 – 50
Keystone	Gold	Processing Plant/Mill, Underground	486	10,044	10,530	1	>100,000	>100,000
Lower Brush Creek	Gold	Underground, Processing Plant/Mill	614	2,356	2,970	1	500 - 1,000	500 - 1,000
Lower Carson	Gold	Underground	334	642	976	3	50 - 250	50 - 250
Lucky Boy	Gold	Processing Plant/Mill, Underground	2,064	2,341	4,405	5	500 - 1,000	500 - 1,000
Lucky Hill	Gold	Pit/Quarry, Processing Plant/Mill, Underground	334	1,149	1,483	1	50 - 250	1,000 – 10,000
Monarch	Gold	Placer, Processing Plant/Mill, Underground	596	2,349	2,945	1	500 - 1,000	500 - 1,000
Monte Cristo	Gold	Placer	954	41	995	3	0 - 50	0 - 50
Monumental	Gold	Underground	784	32	816	2	0 - 50	0 - 50
Mountain Boy	Gold	Hydraulic, Underground	3,314	663	3,977	3	0 - 50	1,000 – 10,000
Mountain Mine	Gold	Processing Plant/Mill, Underground	1,301	141	1,442	3	0 - 50	250 - 500
New Century	Gold	Hydraulic	474	483	957	0	0 - 50	1,000 – 10,000
New Kirk	Gold	Placer, Underground	484	333	817	1	0 - 50	500 -

Mine Name	Comm-odity	Operation type	Physical PAR Score	Chemical PAR Score	Total PAR Score	Number of Openings	Tailings (Cubic Yards)	Waste (Cubic Yards)
								1,000
Oakland Pond	Gold	Underground	264	2,031	2,295	0	1,000 - 10,000	0 - 50
Old Colony	Gold	Unknown	34	41	75	0	0 - 50	0 - 50
Orient	Gold	Underground	504	39	543	1	0 - 50	0 - 50
Pacific	Gold	Processing Plant/Mill, Underground	284	138	422	1	0 - 50	50 - 250
Peck	Gold	Underground	924	177	1,101	2	0 - 50	250 - 500
Pliocene	Gold	Mineral Location/Prospect	34	244	278	0	0 - 50	500 - 1,000
Potosi Site	Gold	Underground	224	115	339	1	0 - 50	50 - 250
Poverty Hill	Gold	Hydraulic	1,534	1,850	3,384	3	250 - 500	500 - 1,000
Pride	Copper, Gold	Pit/Quarry, Underground	794	42	836	2	0 - 50	0 - 50
Pride Hydraulic	Gold	Hydraulic	734	643	1,377	0	0 - 50	1,000 - 10,000
Queen City	Gold	Processing Plant/Mill, Underground	554	8,041	8,595	1	0 - 50	0 - 50
Sailor Boy Diggings	Gold	Hydraulic	3,594	10,066	13,660	0	>100,000	>100,000
Secret Diggings	Gold	Hydraulic	1,074	226	1,300	2	0 - 50	250 - 500
Shasta	Gold	Underground, Mineral Location/Prospect	334	40	374	1	0 - 50	0 - 50
Sisson	Gold	Underground	664	36	700	3	0 - 50	0 - 50
Slick Shaft	Gold	Underground	874	249	1,123	2	0 - 50	500 - 1,000
Spanish Flat	Gold	Hydraulic	504	180	684	0	0 - 50	250 - 500
St. Lewis Debris Dam	Gold	Hydraulic, Dredge	659	9,919	10,578	0	>100,000	>100,000
Star	Gold	Pit/Quarry	274	29	303	0	0 - 50	0 - 50
Telegraph Mine	Gold	Underground	374	45	419	1	0 - 50	0 - 50
Tennessee	Gold	Placer, Underground	1,719	20,349	22,068	4	1,000 - 10,000	500 - 1,000
Union Keystone	Gold	Underground	694	42	736	1	0 - 50	0 - 50
Unknown	Gold	Placer	124	25	149	1	0 - 50	0 - 50
Unknown	Gold	Dredge	54	96	150	0	10,000 - 100,000	10,000 - 100,000
Unknown	Unknown	Underground	146	46	192	1	0 - 50	0 - 50
Unknown	Gold	Underground	224	24	248	1	0 - 50	0 - 50
Unknown	Gold	Placer	114	175	289	1	0 - 50	250 - 500

Mine Name	Comm-odity	Operation type	Physical PAR Score	Chemical PAR Score	Total PAR Score	Number of Openings	Tailings (Cubic Yards)	Waste (Cubic Yards)
Unknown	Gold	Underground	324	27	351	1	0 - 50	0 - 50
Unknown	Gold	Underground	419	21	440	2	0 - 50	0 - 50
Unknown	Unknown	Underground	434	36	470	1	0 - 50	0 - 50
Unknown	Gold	Underground	474	35	509	1	0 - 50	0 - 50
Unknown	Unknown	Underground	474	39	513	1	0 - 50	0 - 50
Unknown	Unknown	Underground	154	390	544	0	50 - 250	0 - 50
Unknown	Gold	Dredge, Underground	464	102	566	1	0 - 50	50 - 250
Unknown	Unknown	Underground	384	188	572	1	0 - 50	500 - 1,000
Unknown	Unknown	Underground, Mineral Location/Prospect	574	30	604	1	0 - 50	0 - 50
Unknown	Gold	Underground	624	31	655	2	0 - 50	0 - 50
Unknown	Gold	Underground	724	32	756	2	0 - 50	0 - 50
Unknown	Unknown	Hydraulic	454	444	898	0	50 - 250	50 - 250
Unknown	Gold	Placer, Underground	424	531	955	2	0 - 50	10,000 - 100,000
Unknown	Gold	Underground	949	28	977	2	0 - 50	0 - 50
Unknown	Aggregate, Stone	Pit/Quarry	874	106	980	0	0 - 50	500 - 1,000
Unknown	Gold	Underground	664	463	1,127	1	0 - 50	1,000 – 10,000
Unknown	Gold	Underground	1,084	182	1,266	2	0 - 50	250 - 500
Unknown	Gold	Underground	864	458	1,322	2	0 - 50	1,000 – 10,000
Unknown	Gold	Underground	1,234	190	1,424	3	0 - 50	500 - 1,000
Unknown	Gold	Placer	1,694	237	1,931	3	0 - 50	250 - 500
Unknown	Unknown	Underground	2,024	34	2,058	5	0 - 50	0 - 50
Unknown	Gold	Underground	2,074	45	2,119	4	0 - 50	0 - 50
Unknown	Gold	Underground	129	2,823	2,952	1	0 - 50	0 - 50
Unknown	Unknown	Unknown	94	3,076	3,170	0	10,000 - 100,000	0 - 50
Unknown	Gold	Hydraulic, Underground	134	3,282	3,416	1	1,000 - 10,000	1,000 – 10,000
Unknown	Gold	Underground	594	4,683	5,277	3	1,000 - 10,000	1,000 – 10,000
Unknown	Gold	Hydraulic	1,444	4,650	6,094	0	1,000 - 10,000	1,000 – 10,000
Unknown	Gold	Underground	374	10,652	11,026	1	1,000 - 10,000	1,000 – 10,000
Unknown	Gold	Underground	1,224	12,427	13,651	3	250 - 500	250 - 500
Upper	Gold	Underground	234	1,741	1,975	2	250 -	250 -

Mine Name	Comm-odity	Operation type	Physical PAR Score	Chemical PAR Score	Total PAR Score	Number of Openings	Tailings (Cubic Yards)	Waste (Cubic Yards)
Carson							500	500
Upper Dutch Diggins	Gold	Hydraulic	814	336	1,150	0	0 - 50	500 - 1,000
Wallis	Gold	Underground, Mineral Location/Prospect	874	462	1,336	2	0 - 50	1,000 – 10,000
West Coast	Gold	Underground	464	31	495	1	0 - 50	0 - 50
Whiskey Diggings	Gold	Pit/Quarry	454	604	1,058	0	50 - 250	500 - 1,000
William Tell	Gold	Underground	959	25	984	2	0 - 50	0 - 50
Winrod	Gold	Underground	164	28	192	0	0 - 50	0 - 50
Yankee Hill Diggings	Gold	Pit/Quarry	1,034	651	1,685	2	0 - 50	1,000 – 10,000

IV. Findings and Recommendations

A. __Priority Lists of Sites__

Two priority lists were developed, one based on the chemical PAR scores and the other based on combining the sample data and chemical PAR scores for the sampled sites. The chemical PAR scores were categorized from very low potential with a score of 1 to high potential with a score of 5 (Table 5). The chemical PAR ranking of sites is listed in Table 6 and displayed in Figure 4.

Table 5: Matrix for Ranking Sites Based on Chemical PAR Scores

	Very Low	Low	Moderate	Moderately High	High
Range of Chemical PAR Scores	0-999	1,000-1,999	2,000-2,999	3,000-3,999	>4,000
Overall Site Ranking (Inventoried Sites)	**1**	**2**	**3**	**4**	**5**

Table 6: Chemical PAR Score Ranking of Sites in the North Yuba Watershed

OMR Id	Mine Name	Commodity	Operation Type	Chemical PAR Score	Ranking
462161	Tennessee	Gold	Placer, Underground	20,349	5
462256	Unknown	Gold	Underground	12,427	5
462227	Unknown	Gold	Underground	10,652	5
462213	Lower Brandy City Diggings	Gold	Hydraulic	10,066	5
462190	Brandy City Diggings	Gold	Hydraulic, Underground	10,052	5
462122	Comet	Gold	Underground	10,051	5

OMR Id	Mine Name	Commodity	Operation Type	Chemical PAR Score	Ranking
462062	Keystone	Gold	Processing Plant/Mill, Underground	10,044	5
582008	St. Lewis Debris Dam	Gold	Hydraulic, Dredge	9,919	5
462252	Queen City	Gold	Processing Plant/Mill, Underground	8,041	5
462206	Indian Hill	Gold	Hydraulic, Placer, Processing Plant/Mill	7,054	5
462059	Columbo	Gold	Processing Plant/Mill	6,339	5
462044	Big Boulder	Gold	Placer, Underground, Processing Plant/Mill	6,033	5
462263	Luella	Gold	Underground	5,729	5
462072	Golden Scepter	Gold	Underground, Mineral Location/Prospect	5,633	5
462267	Unknown	Gold	Underground	4,683	5
462261	Craigs Flat	Gold	Hydraulic	4,652	5
462262	Unknown	Gold	Hydraulic	4,650	5
462033	Argus Placer	Gold	Pit/Quarry, Placer, Processing Plant/Mill, Underground	4,648	5
462265	Excelsior	Gold	Hydraulic	4,640	5
462260	Depot Hill	Gold	Hydraulic	4,640	5
462170	Unknown	Gold	Hydraulic, Underground	3,282	4
582010	Unknown	Unknown	Unknown	3,076	4
462248	California	Gold	Hydraulic, Underground	3,062	4
462194	Unknown	Gold	Underground	2,823	3
462057	Clippership	Gold	Hydraulic	2,650	3
462269	Lower Brush Creek	Gold	Underground, Processing Plant/Mill	2,356	3
462266	Holly Peak	Gold	Hydraulic	2,350	3
462067	Monarch	Gold	Placer, Processing Plant/Mill, Underground	2,349	3
462270	Lucky Boy	Gold	Processing Plant/Mill, Underground	2,341	3
462135	Eureka Diggings	Gold	Placer	2,336	3
462050	Oakland Pond	Gold	Underground	2,031	3
462158	Poverty Hill	Gold	Hydraulic	1,850	2
462066	Gold Point	Gold	Processing Plant/Mill, Underground	1,748	2
462257	Upper Carson	Gold	Underground	1,741	2
462181	Empire	Gold	Processing Plant/Mill, Underground	1,631	2
462240	Golden Hub	Unknown	Underground	1,591	2
462250	Lucky Hill	Gold	Pit/Quarry, Processing Plant/Mill, Underground	1,149	2
462239	Mountain Boy	Gold	Hydraulic, Underground	663	1
462249	Caledonia	Gold	Hydraulic	653	1
322018	Yankee Hill Diggings	Gold	Pit/Quarry	651	1
462210	Pride Hydraulic	Gold	Hydraulic	643	1

OMR Id	Mine Name	Commodity	Operation Type	Chemical PAR Score	Ranking
462258	Lower Carson	Gold	Underground	642	1
462253	Whiskey Diggings	Gold	Pit/Quarry	604	1
322012	Barnard Diggins	Gold	Hydraulic	587	1
462230	Unknown	Gold	Placer, Underground	531	1
462209	New Century	Gold	Hydraulic	483	1
462235	Bellevue	Gold	Pit/Quarry	478	1
462123	Arizona	Gold	Placer, Underground	475	1
462231	Unknown	Gold	Underground	463	1
462047	Wallis	Gold	Underground, Mineral Location/Prospect	462	1
462056	Unknown	Gold	Underground	458	1
462165	City of Six	Gold	Pit/Quarry, Placer, Underground	456	1
322013	Unknown	Unknown	Hydraulic	444	1
462196	Unknown	Unknown	Underground	390	1
322017	Upper Dutch Diggins	Gold	Hydraulic	336	1
462136	New Kirk	Gold	Placer, Underground	333	1
462204	1001	Gold	Dredge, Underground,Hydraulic	328	1
462080	Slick Shaft	Gold	Underground	249	1
462164	Pliocene	Gold	Mineral Location/Prospect	244	1
462183	Unknown	Gold	Placer	237	1
462036	Hilda	Gold	Placer, Underground	235	1
322011	Secret Diggings	Gold	Hydraulic	226	1
462228	Unknown	Gold	Underground	190	1
462208	Unknown	Unknown	Underground	188	1
462232	Unknown	Gold	Underground	182	1
322014	Spanish Flat	Gold	Hydraulic	180	1
322015	Claybank	Gold	Hydraulic	178	1
462046	Peck	Gold	Underground	177	1
462173	Unknown	Gold	Placer	175	1
462175	Mountain Mine	Gold	Processing Plant/Mill, Underground	141	1
462237	Pacific	Gold	Processing Plant/Mill, Underground	138	1
462246	Potosi Site	Gold	Underground	115	1
322016	Independence	Gold	Hydraulic	108	1
462234	Davis Motor Mine	Gold	Hydraulic, Underground	108	1
582006	Unknown	Aggregate, Stone	Pit/Quarry	106	1
462117	Cometose	Gold	Underground	104	1
462195	Unknown	Gold	Dredge, Underground	102	1
462192	Unknown	Gold	Dredge	96	1

OMR Id	Mine Name	Commodity	Operation Type	Chemical PAR Score	Ranking
462224	Unknown	Unknown	Underground	46	1
462217	Australia	Gold	Underground	46	1
462219	Unknown	Gold	Underground	45	1
462191	Telegraph Mine	Gold	Underground	45	1
462233	Isabel Placer	Gold	Pit/Quarry, Underground	44	1
462241	Union Keystone	Gold	Underground	42	1
462042	Pride	Copper, Gold	Pit/Quarry, Underground	42	1
462216	Old Colony	Gold	Unknown	41	1
462180	Monte Cristo	Gold	Placer	41	1
462116	Ironsides	Gold	Processing Plant/Mill, Underground	41	1
462172	Buffalo	Gold	Underground	41	1
462082	Shasta	Gold	Underground, Mineral Location/Prospect	40	1
462220	Borrow Pit	Sand and Gravel	Pit/Quarry	40	1
462229	Unknown	Unknown	Underground	39	1
462238	Orient	Gold	Underground	39	1
462212	Unknown	Unknown	Underground	36	1
462045	Sisson	Gold	Underground	36	1
462251	Unknown	Gold	Underground	35	1
462188	Unknown	Unknown	Underground	34	1
462089	Alpha	Gold	Placer, Processing Plant/Mill, Underground	33	1
	Unknown	Gold	Underground	32	1
462163	Monumental	Gold	Underground	32	1
462247	West Coast	Gold	Underground	31	1
462179	Unknown	Gold	Underground	31	1
462244	Unknown	Unknown	Underground, Mineral Location/Prospect	30	1
462245	Star	Gold	Pit/Quarry	29	1
462211	Winrod	Gold	Underground	28	1
462182	Unknown	Gold	Underground	28	1
462254	Unknown	Gold	Underground	27	1
462040	William Tell	Gold	Underground	25	1
582009	Unknown	Gold	Placer	25	1
462105	Garabaldi	Gold	Underground	25	1
462225	Unknown	Gold	Underground	24	1
462214	Unknown	Gold	Underground	21	1

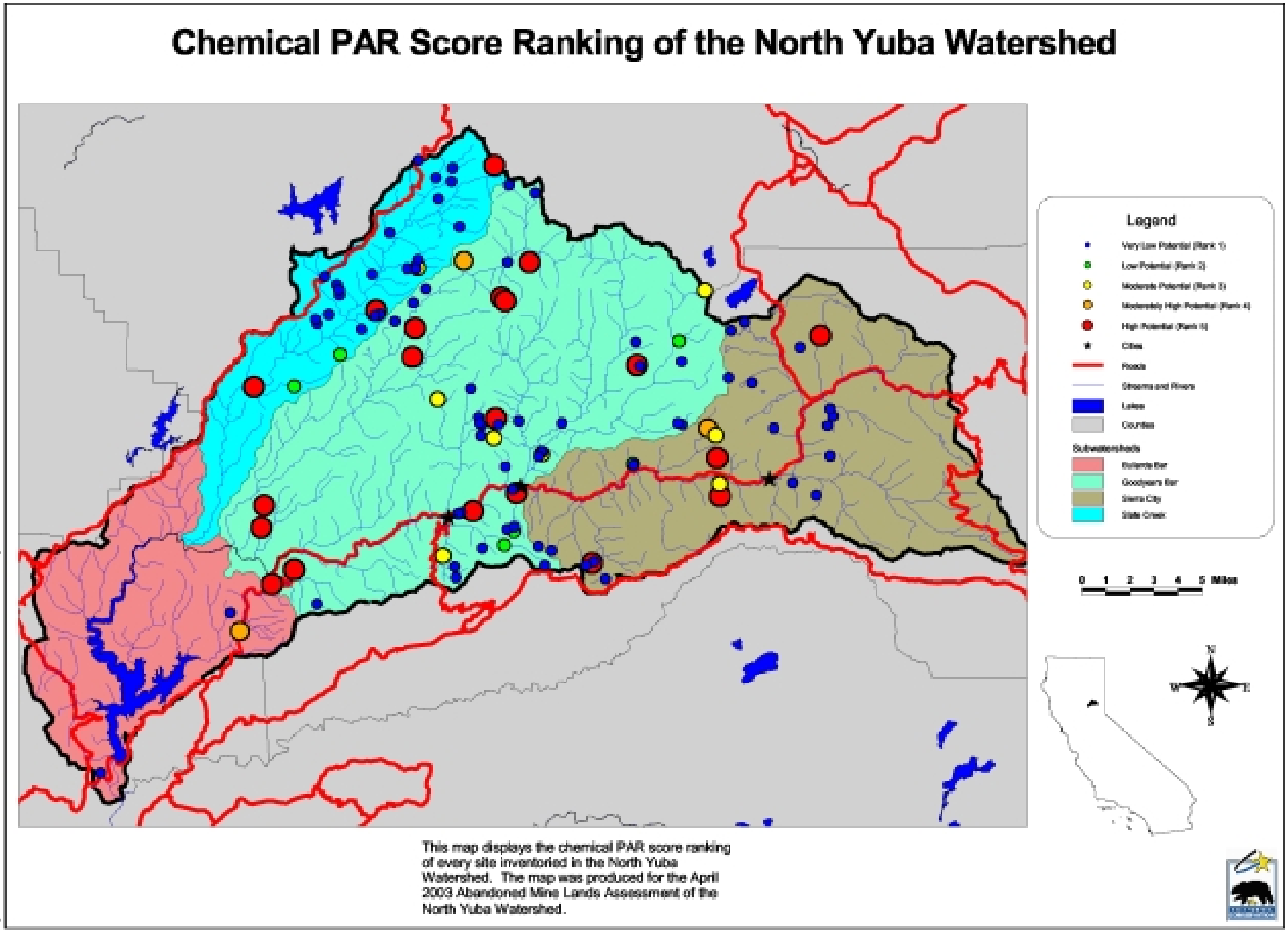


Figure 4: Chemical PAR Score Ranking of the North Yuba Watershed

The second ranking incorporated both the chemical PAR scores and the soil sample analysis results. The soil sample analysis results were categorized and scored based on the potential for environmental impacts. The categories varied from no potential impacts with a score of 0 to high potential impacts with a score of 5 (Table 7). These category scores were then combined with the scores from the chemical PAR ranking for the sampled sites. This final sum category score was categorized again to give an overall ranking for the sampled sites in the watershed (Table 8). The overall site ranking for the sampled sites is listed in Table 9 and displayed in Figure 5.

Table 7: Matrix for Scoring Sites by Chemical PAR Scores and Soil Sample Results

	No	Very Low	Low	Moderate	Moderately High	High
Arsenic (ppm)	nd	1-2.9	3-4.9	5-6.9	7-8.9	>8.9
Lead (ppm)	nd	1-9	10-19	20-29	30-39	>39
Mercury (ppm)	nd	0.01-0.19	0.20-0.39	0.4-0.59	0.6-0.79	>0.79
Chemical Par Score	n/a	1-999	1,000-1,999	2,000-2,999	3,000-3,999	>4,000
Category Score	**0**	**1**	**2**	**3**	**4**	**5**

Table 8: Matrix for Ranking Soil Sampled Sites

	Very Low	Low	Moderate	Moderately High	High
Range of Summed Scores	1-4	5-8	9-12	13-16	>16
Overall Site Ranking (Sampled Sites Only)	**1**	**2**	**3**	**4**	**5**

Table 9: Ranking of Soil Sampled Sites

OMR ID	Mine Name	Mercury (ppm)	Mercury Category Score	Lead (ppm)	Lead Category Score	Arsenic (ppm)	Arsenic Category Score	Chemical PAR Score	Chemical PAR Category Score	Sum of Mercury, Lead, Arsenic, and Chemical PAR Category Scores	Overall Sampled Site Ranking
462227	Unknown	0.6	**4**	25	**3**	12	**5**	10652	**5**	17	**5**
462062	Keystone	0.34	**2**	42	**5**	80	**5**	10044	**5**	17	**5**
462116	Ironsides	47	**5**	590	**5**	130	**5**	41	**1**	16	**4**
462206	Indian Hill	5	**5**	20	**3**	4.2	**2**	7054	**5**	15	**4**
462222	Sebastopol	0.35	**2**	21	**3**	29	**5**	5040	**5**	15	**4**
462050	Oakland Pond	0.46	**3**	32	**4**	9.5	**5**	2031	**3**	15	**4**
462241	Union-Keystone	0.63	**4**	130	**5**	600	**5**	42	**1**	15	**4**
462059	Columbo	-1	**0**	22	**3**	53	**5**	6339	**5**	13	**4**
462248	California	0.9	**5**	15	**2**	4	**2**	3062	**4**	13	**4**

OMR ID	Mine Name	Mercury (ppm)	Mercury Category Score	Lead (ppm)	Lead Category Score	Arsenic (ppm)	Arsenic Category Score	Chemical PAR Score	Chemical PAR Category Score	Sum of Mercury, Lead, Arsenic, and Chemical PAR Category Scores	Overall Sampled Site Ranking
462234	Davis Motor	0.31	**2**	1000	**5**	36	**5**	108	**1**	13	**4**
462067	Monarch	0.13	**1**	23	**3**	310	**5**	2349	**3**	12	**3**
462270	Lucky Boy	-1	**0**	30	**4**	670	**5**	2341	**3**	12	**3**
462250	Lucky Hill	0.68	**4**	26	**3**	6.5	**3**	1149	**2**	12	**3**
462183	Unknown	0.33	**2**	24	**3**	10	**5**	237	**1**	11	**3**
322014	Spanish Flat	0.66	**4**	15	**2**	7.5	**4**	180	**1**	11	**3**
462237	Pacific	0.31	**2**	140	**5**	6.8	**3**	138	**1**	11	**3**
462243	Excelsior	0.1	**1**	13	**2**	4.9	**2**	4640	**5**	10	**3**
322011	Secret Diggings	0.53	**3**	80	**5**	2.9	**1**	226	**1**	10	**3**
462190	Brandy City Diggings	-1	**0**	6.5	**1**	3.3	**2**	10052	**5**	8	**2**
462044	Big Bolder	-1	**0**	12	**2**	1.8	**1**	6033	**5**	8	**2**
462223	Argus Placer	-1	**0**	25	**3**	-1	**0**	4648	**5**	8	**2**
462036	Hilda	-1	**0**	15	**2**	15	**5**	235	**1**	8	**2**
322015	Claybank	0.29	**2**	29	**3**	4.7	**2**	178	**1**	8	**2**
462239	Mountain Boy	0.19	**1**	14	**2**	4.9	**2**	663	**1**	6	**2**

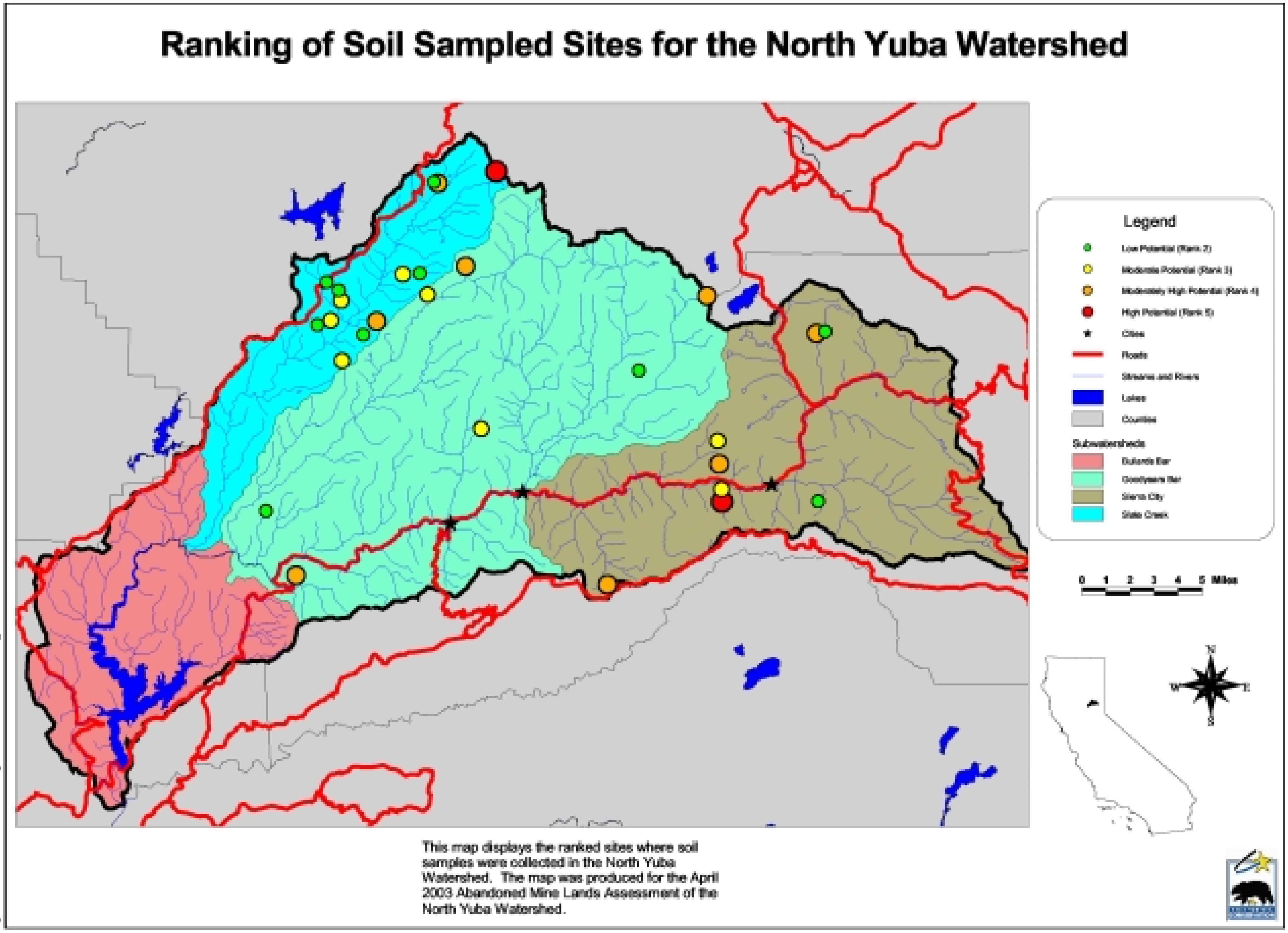


Figure 5: Ranking of Soil Sampled Sites for the North Yuba Watershed

B. Further Actions

This report presents data obtained from the inventory of 128 abandoned mine sites in the North Yuba Watershed. Using a Preliminary Appraisal and Ranking (PAR) model, as well as results of soil sample analyses, it evaluates the potential impacts of each mine site to human health and the environment. The report also presents several prioritizations of these sites for possible remediation activity.

Not all of the abandoned mine sites within the North Yuba Watershed were visited for this report. A more complete assessment of the watershed would include inventory data from approximately 40 additional abandoned mine sites on public lands as well as an estimated 77 abandoned mine features on private lands. This additional information would allow for a more comprehensive prioritization of sites within the watershed.

Working from these priority lists, interested parties may wish to conduct full site characterizations of the abandoned mine sites that demonstrate the highest potential risk of contamination to the environment. Full site characterizations would help determine the most suitable approaches to their reclamation.

Other future actions might include a sampling program to examine the downstream effects of high mercury, lead and arsenic concentrations found at some of the mine sites in the North Yuba Watershed. A sampling program such as this would help determine if mined material is moving off site and how that material may be affecting water quality.

V. **Appendix: Watershed Selection Criteria**

The selection criteria for priority watersheds were created by a multi faceted approach that involved many geospatial datasets. The geospatial datasets used were: mining history, watersheds, watershed boundaries, arsenic occurrences, acid rock drainage (ARD) occurrences and ownership.

The State of California's population of watersheds (Figure 6) was partitioned based on water flowing into the Bay Delta area (Figure 7), defining the California Bay-Delta Authority Watershed. This watershed was further partitioned into two distinct regions, the Sierra Nevada Province and the Coast Range Province (Figure 8). The decision to differentiate these regions was made because of the unique issues that apply to each region. For example, nearly all of the mercury sources in the Sierra Nevada Province are anthropogenic. Also, arsenic plays a larger role in the Sierra Nevada Province as a constituent of concern. At the same time, geothermal activity plays a larger role in the Coast Range Province as a contributor of heavy metals to surface waters. By separating the California Bay-Delta Authority Watershed into two regions, analysis could be conducted independently using different geospatial datasets. The result of this independent analysis gives a more refined watershed ranking.

The Sierra Nevada Province analysis used the following datasets: Principal Areas of Mine Pollution (PAMP)(Figure 9), arsenic occurrences (Figure 10), public ownership (Figure 11), acid rock drainage occurrences (Figure 12), historic hard rock mining (Figure 13), historic hydraulic mining (Figure 14) and watershed boundaries. The PAMP dataset was created from an earlier dataset of mines with production values over $100,000 that can potentially impact water quality. Watersheds impacted by arsenic were derived from the USGS's Mineral Resource Data System (MRDS) by selecting out arsenic bearing minerals. The public ownership dataset was created to show public (i.e. USFS, BLM, NPS) and private land ownership. The acid rock drainage (ARD) was derived from the MRDS dataset by selecting out acid generating ore minerals and ore bodies (i.e. sulfur, pyrite, etc.). Areas of historic hard rock and hydraulic mining were created by digitizing the mine symbols from the USGS 7.5-minute 1:24,000 topographic maps.

Using these datasets and GIS, a model for ranking the potential impact of mining in a watershed was developed. The data in the seven datasets were categorized and scored. The categories varied from very low with a score of 0 to extreme with a score of 5 (Table 10). The category scores were then summed to give an overall ranking for each of the watersheds (Table 11). The results are displayed in Table 12 and Figure 15.

Table 10: Matrix for Scoring Watershed Categories

Spatial Data Set Description	Very Low	Low	Moderate	High	Very High	Extreme
Number of Principal Areas of Mine Pollution (PAMP) Sites	0	1-19	20 - 29	40- 59	60 - 69	> 79
Public Ownership in Acres by Watershed	0	1-9,999	10,000 – 49,000	50,000 – 99,000	100,000 – 199,000	> 200,000
Number of Abandoned Mines that may have Acid Rock Drainage by Watershed	0	1-9	10-19	20 - 29	30 - 40	> 40
Number of Hard Rock Mines by Watershed	0	1-9	10-49	50 - 99	100 - 200	> 200

Number of Abandoned Mines that may have Arsenic by Watershed	0	1-3	4-6	7-9	10-12	> 12
Area in Acres of Hydraulic Mines Sites by Watersheds	0	1-99	100 - 249	250 – 499	500 – 999	> 1,000
Category Score	**0**	**1**	**2**	**3**	**4**	**5**

Table 11: Matrix for Ranking Watersheds

	Very Low	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Range of Summed Scores	0	1-4	5-9	10-14	15 - 20	> 20
Overall Watershed Ranking Value	**0**	**1**	**2**	**3**	**4**	**5**

Table 12: Rank of Watersheds in the Sierra Nevada Province

Watershed Name	**Sum of Category Scores**	**Overall Watershed Ranking Value**
North Yuba	27	5
Copperopolis	22	5
Middle Yuba	21	5
South Yuba	21	5
Middle Fork American	20	4
North Fork American	20	4
Upper Bear	20	4
Cosumnes	19	4
South Fork American	19	4
North Fork Merced	18	4
Big Oak Flat	17	4
Mariposa	17	4
Buckhorn Peak	16	4
Foothill Drain	15	4
Middle Fork Feather	15	4
Upper Mokelumne	14	3
Bloomer Hill	12	3
South Fork Calaveras	12	3
Sutter Creek	12	3
Ure Mountain	12	3
Clavey River	11	3
Mammoth Pool	11	3
Nevada City	11	3
North Fork Feather	11	3
South Fork Merced	10	3
Yosemite	10	3
East Branch North Fork	10	3
Hetch Hetchy	9	2
South Fork Stanislaus	9	2

Watershed Name	Sum of Category Scores	Overall Watershed Ranking Value
Below Oroville Reservoir	8	2
Chowchilla River	8	2
Daulton	8	2
Fresno River	8	2
Middle Fork Stanislaus	8	2
North Fork Calaveras	8	2
South Honcut Creek	8	2
Auberry	7	2
Dry Creek	7	2
Estanislo	7	2
Kassenbaum Flats	7	2
North Fork San Joaquin	7	2
North Fork Stanislaus	7	2
South Fork Feather	7	2
Upper Little Chico	7	2
West Branch North Fork	7	2
Campo Seco	6	2
Cherry Creek	6	2
Penny Creek	6	2
Upper Dry Creek	6	2
Vizard Creek	6	2
Lakeshore	5	2
Mount Starr King	5	2
North Fork	5	2
Redinger	5	2
South Fork Tuolumne	5	2
Jenny Lind	4	1
New Hogan Reservoir	4	1
Clark Fork	3	1
Little Dry Creek	3	1
Lower Calaveras	3	1
Middle Tuolumne	3	1
Reeds Creek	3	1
Table Mountain	3	1
Upper Butte Creek	2	1
Olive Hill	1	1
Cohasset	0	1
Deer Creek	0	1

Figure 6: Watersheds of California

Figure 7: CALFED Bay Delta Watershed

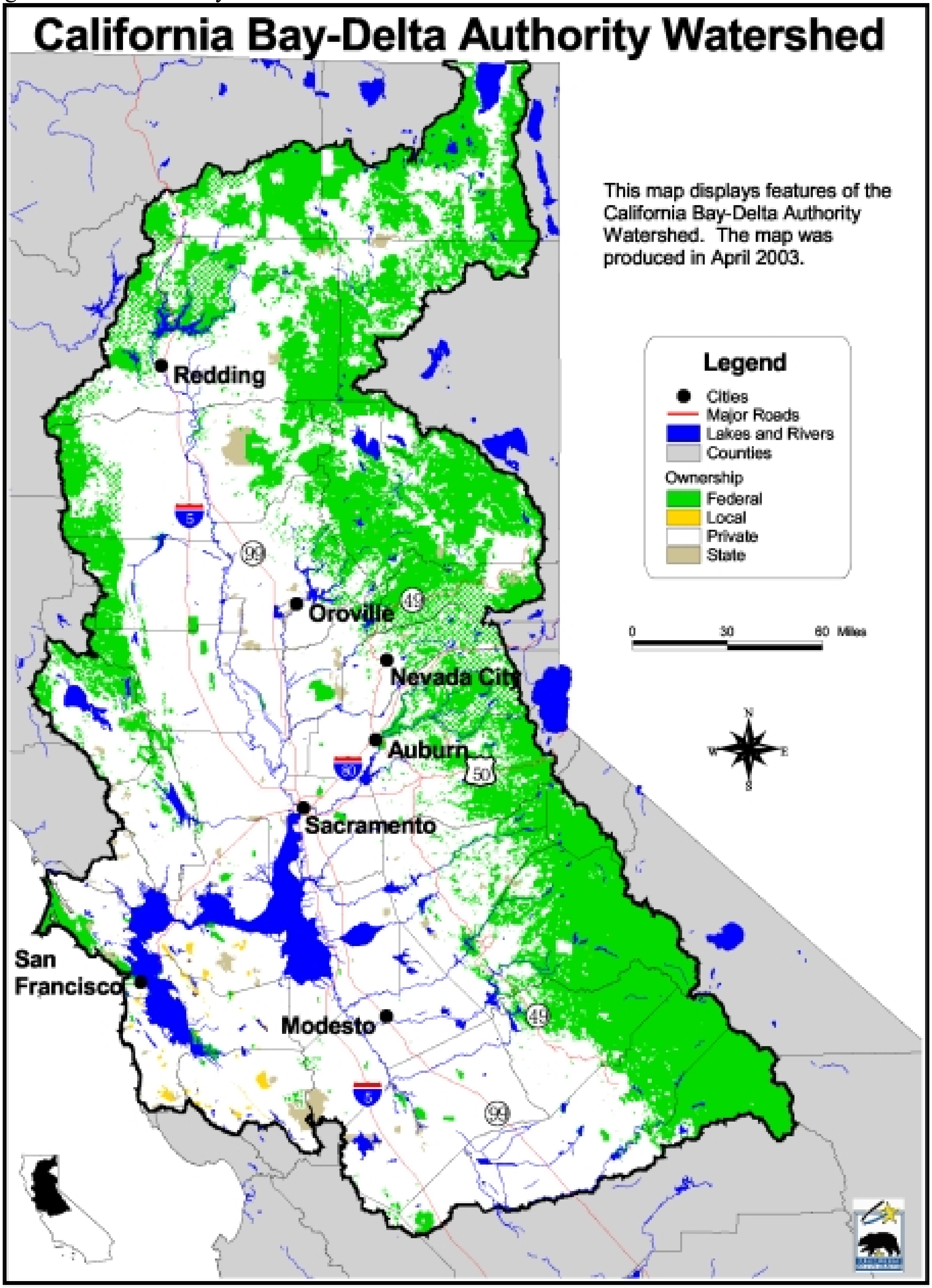


Figure 8: Provinces of the California Bay-Delta Authority Watershed

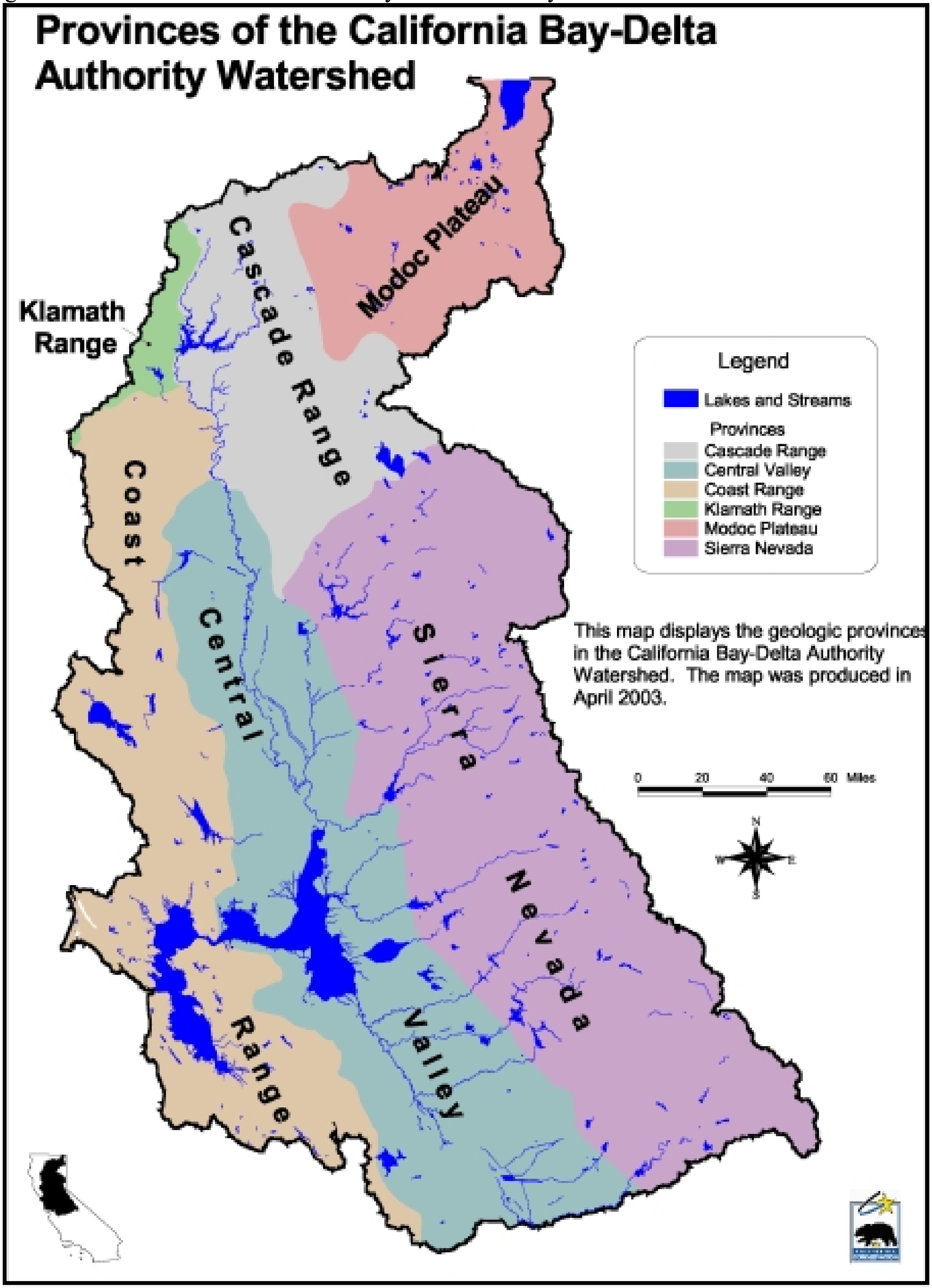


Figure 9: Principle Areas of Mine Pollution in the Sierra Nevada Province

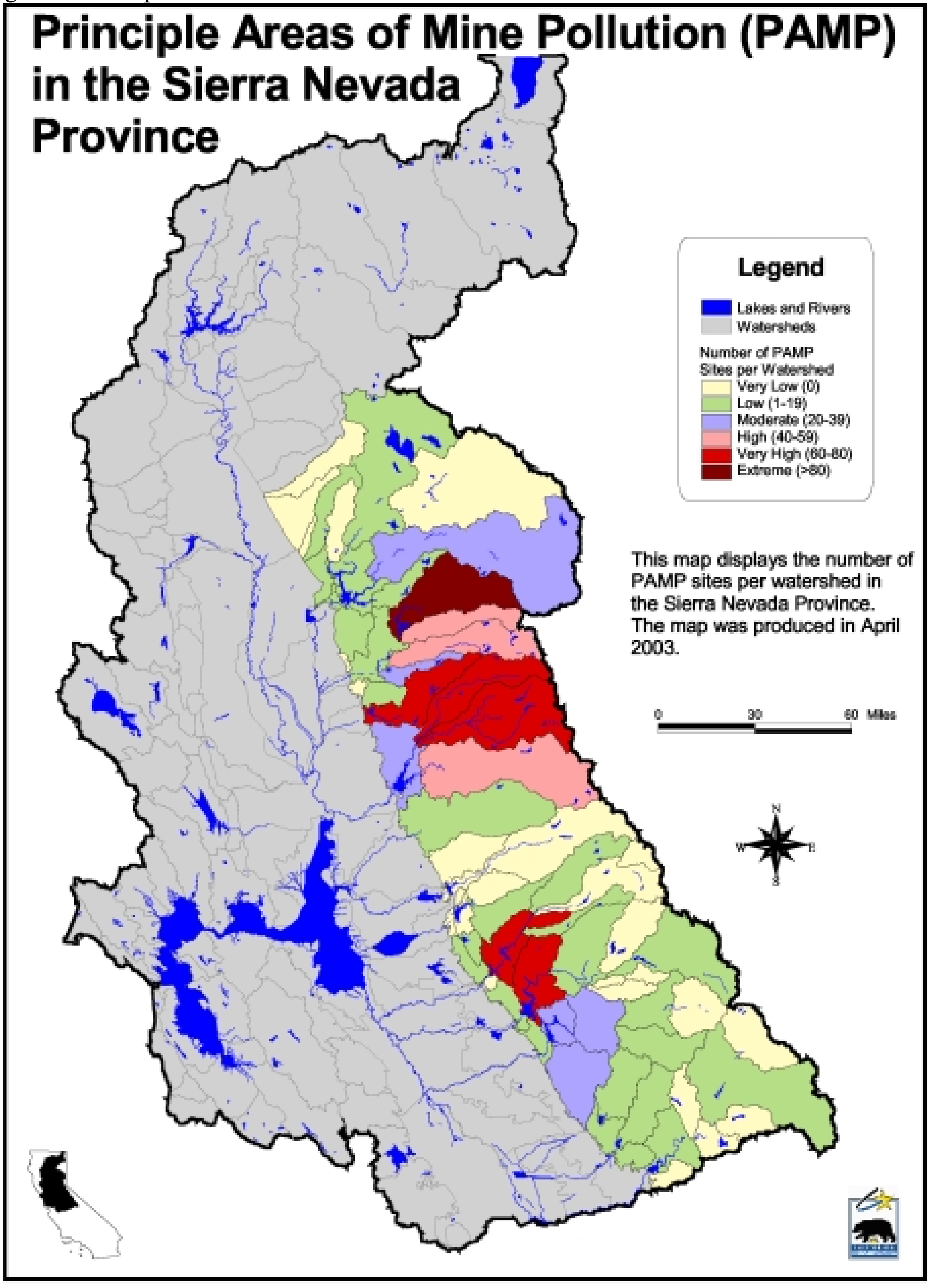


Figure 10: Arsenic Impacted Watersheds in the Sierra Nevada Province

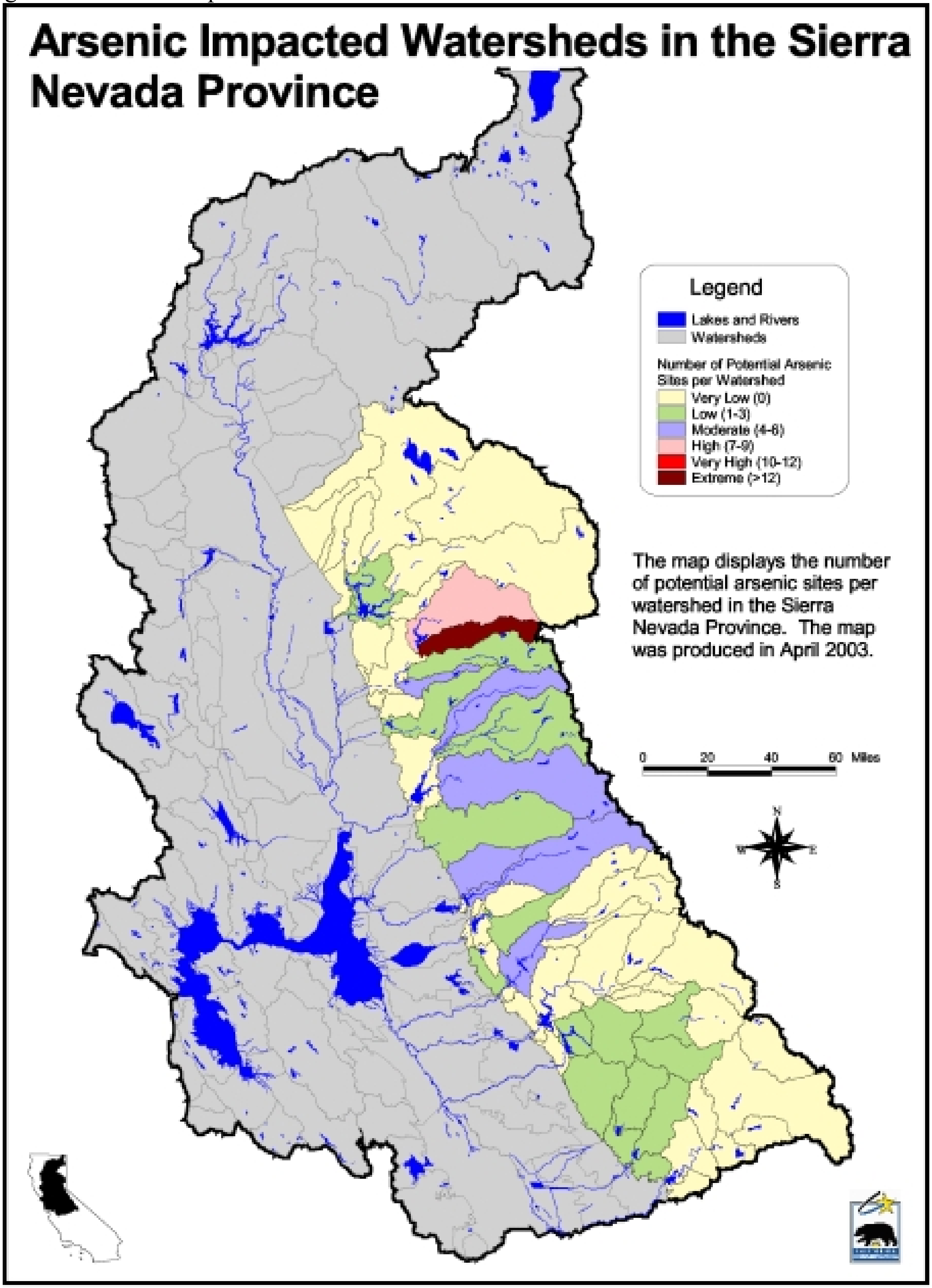


Figure 11: Public Land Ownership by Watershed in the Sierra Nevada Province

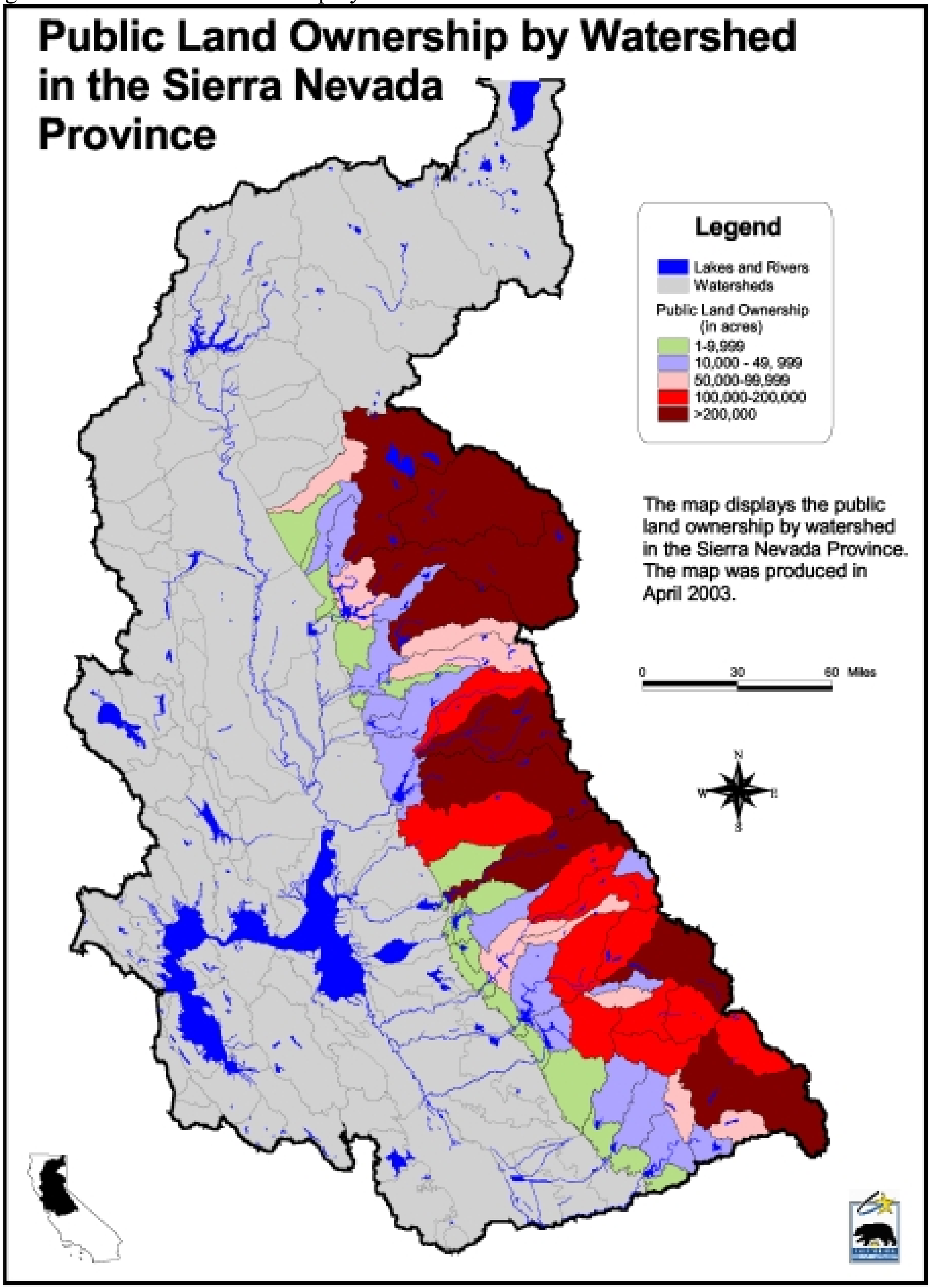


Figure 12: Acid Rock Drainage Impacted Watersheds in the Sierra Nevada Province

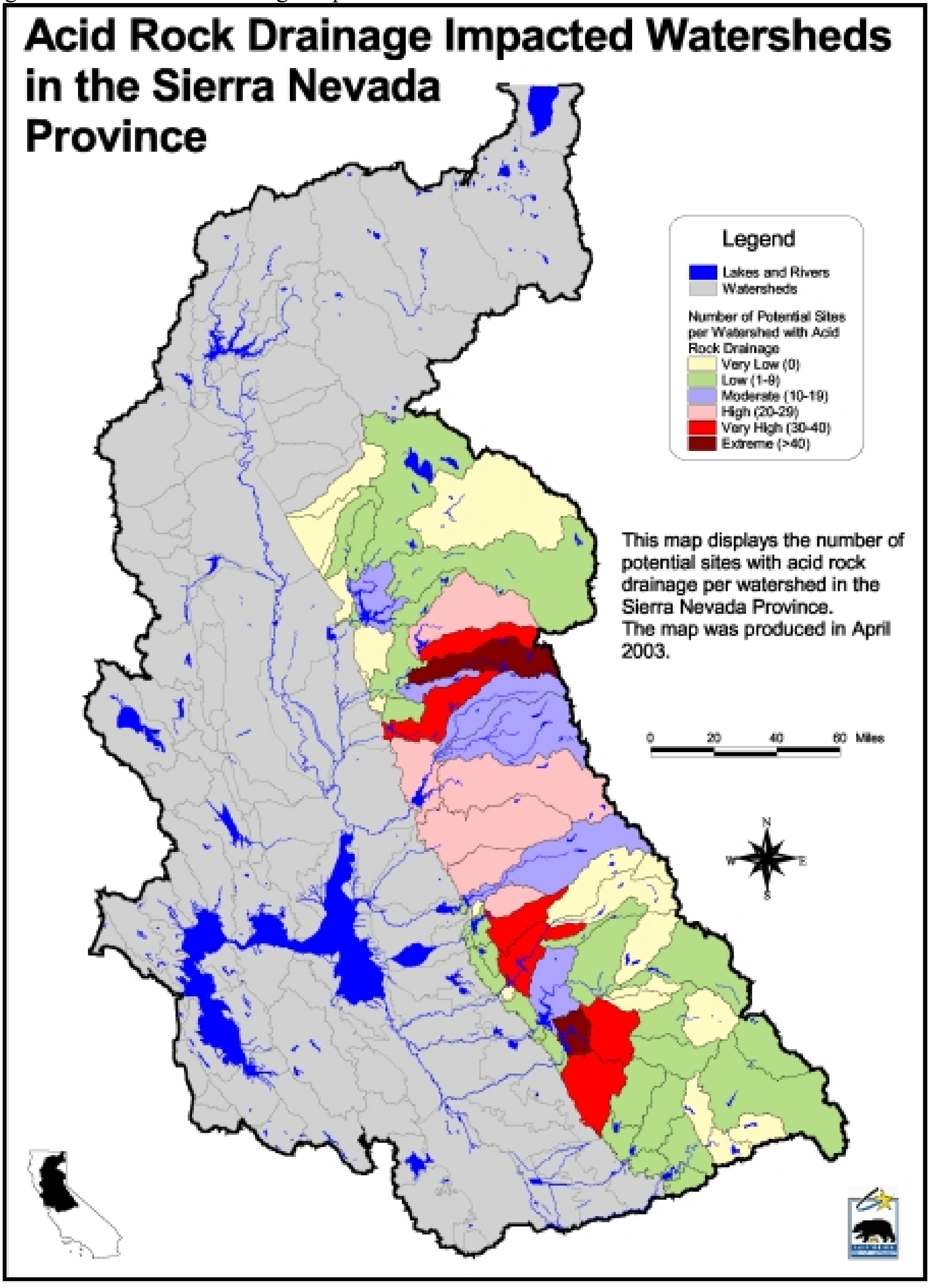


Figure 13: Hard Rock Mines per Watershed in the Sierra Nevada Province

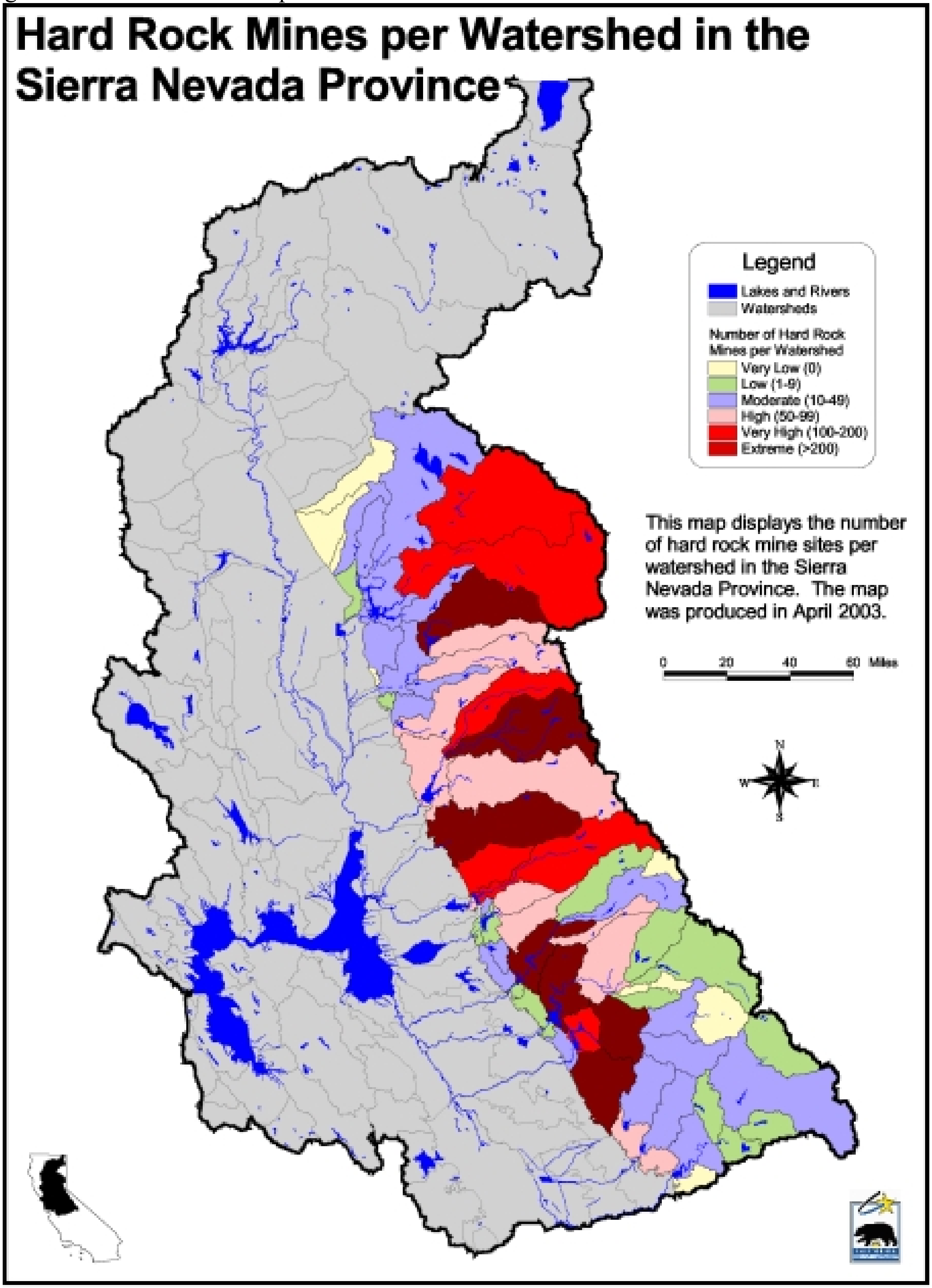


Figure 14: Hydraulically Mined Watersheds in the Sierra Nevada Province

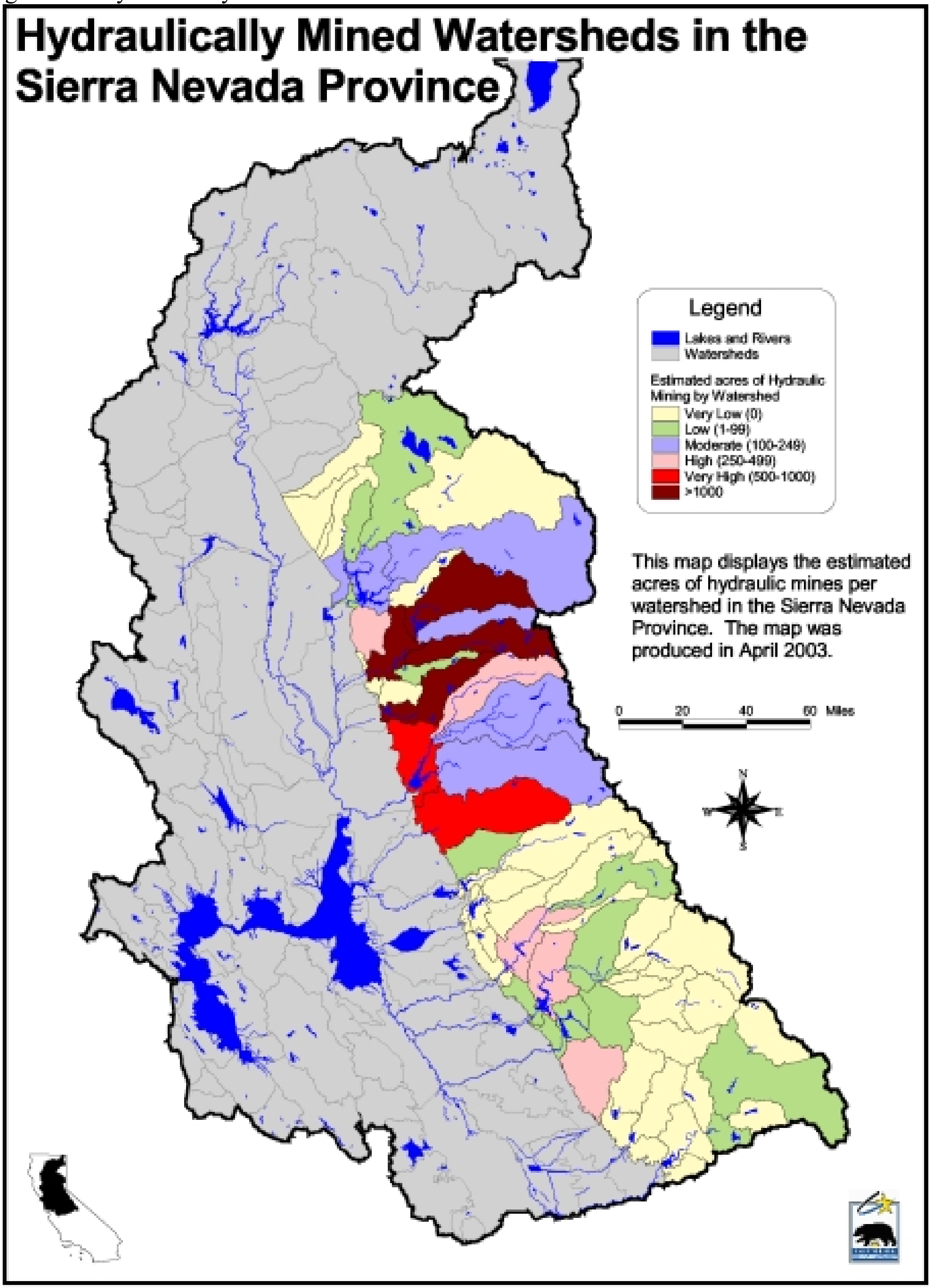
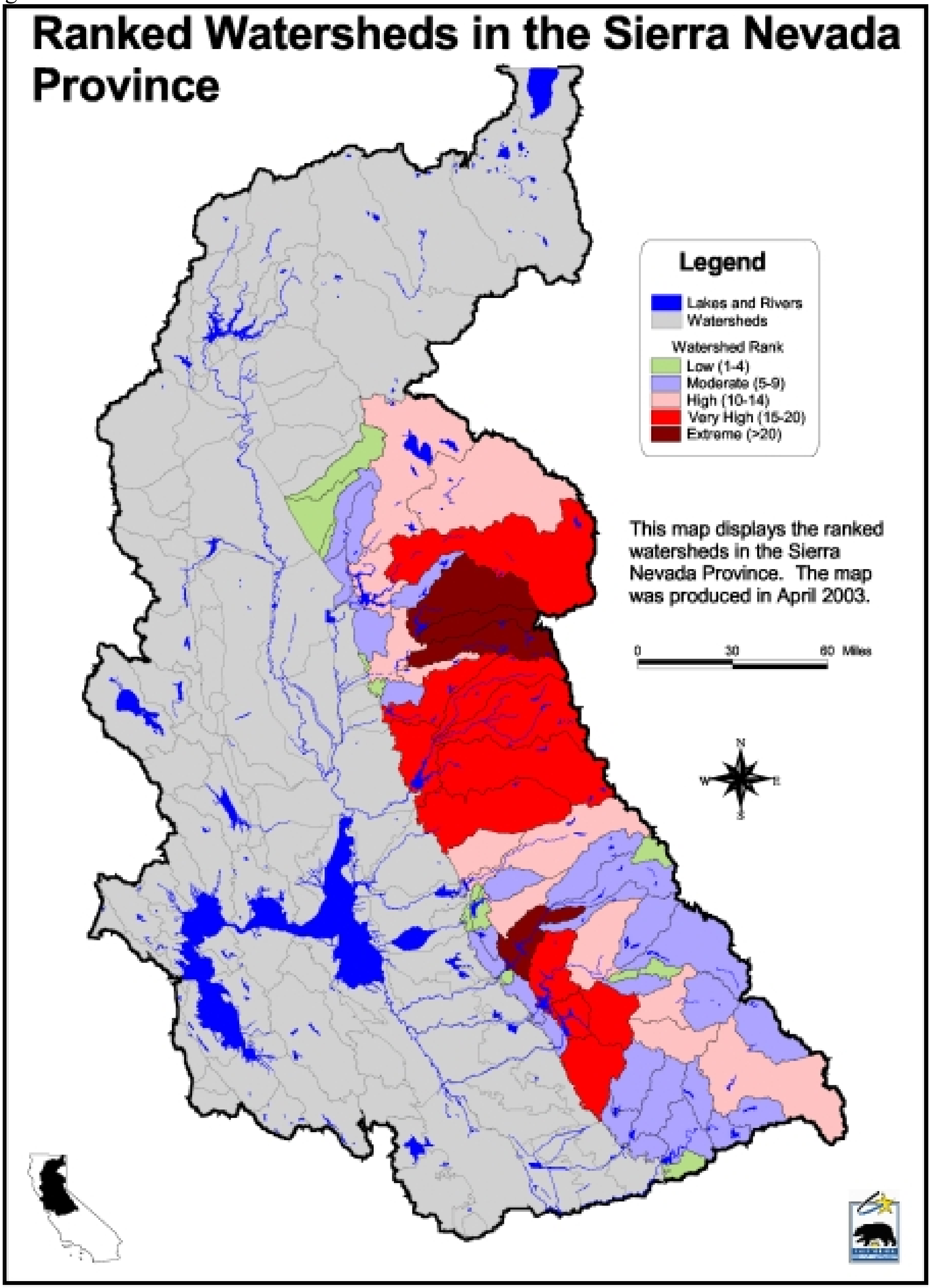


Figure 15: Ranked Watersheds of the Sierra Nevada Province



References

Carlson, D.W. and Clark W.B., 1956, *Mining in the Downieville and Alleghany Districts, Sierra County*. California Journal of Mines and Geology, Vol. 52.

Causey, J. D., 1998, *MAS/MILS Mineral Location Database Information.* U.S. Geological Survey.

Clark, W.B., 1998, *Gold Districts of California, Bulletin 193.* California Division of Mines and Geology.

California Department of Conservation, 2000a, *California's Abandoned Mines: A Report on the Magnitude and Scope of the Issue in the State*. Office of Mine Reclamation, Abandoned Mine Lands Unit.

California Department of Conservation, 2000b, *California Geology Map.* California Division of Mines and Geology.

California Department of Conservation, 2000c, *Principle Areas of Mine Pollution (PAMP).* Office of Mine Reclamation, Abandoned Mine Lands Unit.

California Department of Conservation, 2001, *Topographically Occurring Mine Symbols (TOMS)*. Office of Mine Reclamation, Abandoned Mine Lands Unit.

Frank, D.G., 1999, *Mineral Resource Data System (MRDS).* U.S. Geological Survey.

Hickman, J.C., ed., 1993, *The Jepson Manual: Higher Plants of California*. University of California Press, Berkeley and Los Angeles.

Interagency California Watershed Mapping Committee, 1999, *The California Watershed Map*. Teale Data Center.

U.S. Department of Commerce, 1998, *1990 Federal Census for Cities and Census Designated Areas (updated)*. Teale Data Center.

U.S. Forest Service and Bureau of Land Management, 1999, *Govownership*. Teale Data Center.

U.S. Geological Survey, 1996, *Roads*. Teale Data Center.

U.S. Geological Survey, 1999, *Counties*. Teale Data Center.